11-1045(L) & 11-1057(CON)
11-1051(CON), 11-1056(CON)

United States Court of Appeals for the District of Columbia Circuit

STATE OF NEW YORK; STATE OF VERMONT; STATE OF CONNECTICUT,

Petitioners,

v.

NUCLEAR REGULATORY COMMISSION; UNITED STATES OF AMERICA,

Respondents,

STATE OF NEW JERSEY,

Intervenor for Petitioner,

NUCLEAR ENERGY INSTITUTE, INC.; ENTERGY NUCLEAR OPERATIONS INC.,

Intervenors for Respondent.

On Petition for Review of Final Action of
the United States Nuclear Regulatory Commission

JOINT APPENDIX — VOLUME 4 of 4 (JA939-End)

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TABLE OF CONTENTS

PAGE

VOLUME 1 - Federal Regulations

TABLE OF CONTENTS

PAGE

VOLUME 1 (Cont'd)

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

PAGE

VOLUME 4 (Cont'd)

TABLE OF CONTENTS

PAGE

VOLUME 4 (Cont'd)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:	NRC Docket ID
Waste Confidence Decision Update	2008-0482

COMMENTS SUBMITTED BY THE OFFICE OF THE ATTORNEY GENERAL OF THE STATE OF CONNECTICUT CONCERNING THE NUCLEAR REGULATORY COMMISSION'S PROPOSED WASTE CONFIDENCE DECISION UPDATE

Richard Blumenthal, Attorney General of Connecticut, submits these comments regarding the Nuclear Regulatory Commission's ("NRC") proposed Waste Confidence Decision Update.

The Waste Confidence Decision Update is illegal and unacceptable. It is based on patently false assumptions, violates the clear terms of the National Environmental Policy Act ("NEPA") and inexcusably permits incalculable amounts of highly radioactive spent nuclear fuel ("SNF") to accumulate at the nation's 104 nuclear power stations with no meaningful time limitation. The record is without evidence to support NRC's position that long-term storage of highly radioactive waste at civilian nuclear power stations is safe. In fact, the uncontroverted evidence shows that there have been numerous leaks and spills at aging spent nuclear fuel pools and that civilian reactors are highly vulnerable to accidents or attacks. Instead of leaving this deadly waste at vulnerable sites -- in many cases near residential communities -- the NRC must act now to establish a safe and effective solution to the problems of spent nuclear waste.

Interests of the State of Connecticut

As chief legal officer of the State of Connecticut, the Attorney General has long supported efforts to protect human health and safety and the environment from improper use of radioactive materials. Connecticut is a densely populated state containing several current or decommissioned nuclear power sites. Any effort to permit the continued storage of SNF at these facilities directly affects the citizens of the State. The Attorney General is also currently involved as an interested governmental body in the relicensing proceedings for the Indian Point nuclear plants. *See* In the Matter of Entergy Nuclear Operations, Inc., ASLBP No. 07-858-03-LR-BD01, Memorandum and Order (July 31, 2008). The State of Connecticut has a strong interest in ensuring the safety of nuclear power plants near or within its borders.

Overview of the Proposed Amendment to the Waste Confidence Rule

The NRC seeks in this proposed rule, published for comment on October 9, 2008, to amend two of its five Waste Confidence findings, specifically finding (2) relating to the length of time that can be expected until the national high-level waste repository will be available, and finding (4) relating to how long spent nuclear fuel can be safely stored on-site in its current form. See 73 Fed. Reg. 59551 (Oct. 9, 2008). NRC's goal is to amend finding (2) to assume that a SNF storage facility will be available within 50-60 years beyond the licensed life of current reactors, and to amend finding (4) to permit spent fuel to be stored on-site for 60 years at existing nuclear facilities. In addition, the NRC is proposing an alternative finding (2) to remove **any** reference to a time period.

The proposed changes are arbitrary and capricious, contrary to the National Environmental Policy Act, and directly contradicted by the simple facts of the real and potential harms associated with the storage of SNF.

Historical Background on the Rule

In 1979, the United States Court of Appeals for the District of Columbia Circuit, in *State of Minnesota v. NRC*, 602 F.2d 412, 413-14 (D.C. Cir. 1979), questioned whether there would be offsite storage available for SNF from certain power stations after license termination. Intervenors in that case argued that any expansion of on-site storage could occur only after analysis of environmental implications.

NRC staff, however, believed that NEPA did not require the preparation of an environmental impact statement, because any modifications as to where and how SNF would be stored would not "significantly affect the quality of the human environment." See Atomic Safety and Licensing Appeal Board. *Id.* at 414-15. The D.C. Circuit found that the Commission's "implicit" policy conclusion that a "reasonable assurance that methods of safe permanent disposal of high-level wastes can be available when they are needed" was unsupported by the record and remanded the issue to the Commission to undertake a record-based rulemaking proceeding to establish a supportable policy. *Id.* at 417. The result was the 1984 Waste Confidence Decision.

Waste Confidence Findings

The 1984 Waste Confidence Decision established five findings necessary to permit the continued licensing of nuclear power plants in the absence of an existing national storage repository. Those findings were:

(1) The Commission finds reasonable assurance that safe disposal of HLW [high level nuclear waste] and SNF [spent nuclear fuel] in a mined geologic repository is technically feasible;

(2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial HLW and SNF will be available by the years 2007-2009, and that sufficient repository capacity will be available within 30 years beyond the expiration of any reactor operating license to dispose of existing commercial HLW and SNF originating in such reactor and generated up to that time;

(3) The Commission finds reasonable assurance that HLW and SNF will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all HLW and SNF;

(4) The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations (ISFSIs);

(5) The Commission finds reasonable assurance that safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

49 Fed. Reg. 34658 (Aug. 31, 1984). After making these findings, NRC amended its regulations to say that the environmental impacts of onsite SNF storage are not properly part of a relicensing proceeding. (10 C.F.R. § 51.23(a)).

Subsequent events demonstrated that the Waste Confidence Rule had no connection to reality. Yucca Mountain, of course, did not open by 2007. As long ago as 1990, NRC amended the Waste Confidence Rule findings (2) and (4) to reflect later dates of availability of the national repository and to clarify that, in finding (4), the expiration of a reactor's operating license referred to the full 40 year initial license as well as any revised or renewed licensing term. The NRC added that it found "reasonable assurance that at least one geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) . . . ." 55 Fed. Reg. 38474 (Sept. 18, 1990). NRC also amended finding (4) to read: "The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite of offsite ISFSIs." Id. *See* 55 Fed. Reg. 38472 (Sept. 18, 1990).

Waste Confidence Decision Update

Since the last revisions to the Waste Confidence Rule, there has still been no appreciable progress at Yucca Mountain. While $14 billion has been spent on this designated federal repository, there is still no realistic operational date in sight. Therefore, NRC is now seeking, once again, to amend finding (2) to give itself more time. NRC will claim that it finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time. 73 Fed. Reg. at 59551. The Commission also seeks to amend finding (4), again, to read that "The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations." 73 Fed. Reg. at 59551.

The NRC has also published a separate alternative proposed rule which would amend 10 C.F.R. § 51.23(a) to say that if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. 73 Fed. Reg. 59547 (Oct. 9, 2008).

The Revised Waste Confidence Findings Are Without Support

The Waste Confidence Rule proceedings were intended to "assess [the] degree of assurance that radioactive wastes produced by nuclear power plants can be safely disposed of, to determine when such disposal or offsite storage will be available, and to determine whether radioactive wastes can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available." 73 Fed. Reg. 59552. There is insufficient evidence that radioactive wastes produced by nuclear power plants can be safely disposed of for an indefinite period of time on-site at private, civilian nuclear reactors.

The facts are clear. Yucca Mountain is not open and has no reasonable chance of opening in the next 10 years. If it ever does open, it will already be too small for all of the waste it was to accommodate. Department of Energy ("DOE") facilities have accumulated approximately 13,000 tons of waste, and civilian power reactors have generated an additional 58,000 tons. The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, December 2008, p.5. As civilian reactors add about 2,000 tons annually, current estimates are that total waste generated by the current fleet of reactors will total between 109,300 and 130,000 tons, depending on how many reactors are granted license extensions. *Id.* Yucca Mountain, even if it opened tomorrow, is statutorily limited to hold only 77,000 tons of waste. *See* National Waste Policy Act of 1982, Public Law 97–425, 42 U.S.C. 10101 et seq., § 114(d). In fact, the head of DOE's civilian nuclear waste program told Congress that by 2010 -- next year -- the amount of waste produced by the country's 104 nuclear power plants plus defense waste will already exceed the total allowable storage capacity for

Yucca Mountain. *See* The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, December 2008; *see also* CNN, Report: Expand Nevada nuclear dump or OK second site (Nov. 7, 2008), http://www.cnn.com/2008/US/11/07/nuclear.dump.nevada.ap/.

In sum, there is no national repository, available or nearly available, and even the one under consideration will not be able to house even the waste awaiting disposal by the end of next year. There is no basis, therefore, for the Waste Confidence Rule's finding (2) that there is reasonable assurance that the nation will have a safe repository for all of the SNF from existing reactors at any discernible point in the future.

There No Evidence to Support the Assurance that Spent Fuel from Civilian Reactors Can Be Stored Safely for At Least 60 Years, Or More, Either Onsite or Offsite

NRC finding (4), that spent fuel from reactors can be stored safely for at least 60 years beyond the licensed life of the reactors (or, under the NRC's alternate proposal, indefinitely), either onsite or offsite, is without support.

NRC's existing rules governing the storage of spent nuclear fuel were based on several considerations including: (1) the long-term integrity of spent fuel under water pool storage conditions, (2) structure and component safety for extended facility operation, (3) the safety of dry storage, and (4) potential risks of accidents and acts of sabotage at spent fuel storage facilities. 49 Fed. Reg. 34658. *See, e.g.*, NUREG-1738, Final Technical Study of 1 Spent Fuel Pool Accident Risk and Decommissioning Nuclear Power Plants (NRC: January 2001); National

Academy of Sciences Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, Safety and Security of Commercial Spent Nuclear Fuel Storage (The National Academies Press: 2006); Gordon Thompson, Risks and Risk-Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants (May 25, 2006).

The facts, as developed over the last several decades, clearly demonstrate that NRC's rule is based on false assumptions. In fact, an accident or attack on a SNF pool could result in a loss of coolant and subsequent fire releasing deadly amounts of radiological material and toxic fumes. An NRC report issued in October 2000, described in detail what can occur if there is a loss of coolant in a fuel pool:

> This reaction of zirconium and air, or zirconium and steam is exothermic (i.e., produces heat). The energy released from the reaction, combined with the fuel's decay energy, can cause the reaction to become self-sustaining and ignite the zirconium. The increase in heat from the oxidation reaction can also raise the temperature in adjacent fuel assemblies and propagate the oxidation reaction. The zirconium fire would result in a significant release of the spent fuel fission products which would be dispersed from the reactor site in the thermal plume from the zirconium fire. Consequence assessments have shown that a zirconium fire could have significant latent health effects and resulted (sic) in numbers of early fatalities.[1]

A Department of Energy report indicates that such a fire would release considerable amounts of cesium-137, an isotope that accounted for most of the offsite radiation exposure from

[1] NRC Report October, 2000 at 3-1 (internal citation omitted).

the 1986 Chernobyl accident.[2] Another report, authored by NRC, concludes that, in the event of a pool fire, approximately 100 percent of the pool's inventory of cesium would be released to the atmosphere.[3]

The emission of radioactive particles from a spent fuel pool accident would lead to horrific consequences. The NRC study stated that human fatalities within the first year of such an event "can be as large as for a severe reactor accident even if fuel has decayed several years."[4] The radioactive fallout from this type of release could also make tens of thousands of acres of land uninhabitable.

A recent report by the National Academy of Sciences, the NRC's own technical staff and independent experts contradicts the NRC's assertion that high-density fuel storage pools pose no significant environmental risk. *See* Jan Beyea, Report to the Massachusetts Attorney General on the Potential Consequences of a Spent-fuel Pool Fire at the Pilgrim or Vermont Yankee Nuclear Plant (May 25, 2006). This report showed that fuel storage pools are susceptible to fire and radiological release from a wide range of conditions, including natural phenomena, operator error, equipment failure, or intentional attack. The environmental impacts of a fire in a spent fuel pool may be severe, extending over a geographic area larger than one state's boundaries and continuing for decades.

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[2] *See* US Department of Energy, Health and Environmental Consequences of the Chernobyl Nuclear Power Plant Accident, DOE/ER-0332 (Washington, DC: DOE. June 1987).

[3] *See* V L Sailor et al, Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82, NUREG/CR-4982 (Washington, DC: NRC, July 1987).

[4] *See* NRC Report October, 2000 at 3-34.

While these reports are deeply troubling, NRC's assumptions include a greater flaw. NRC assumes that a leak or loss of radioactivity from spent fuel storage is not possible. That assumption is so demonstrably wrong that its use is absurd.

Examples of leaking SNF pools, unfortunately abound. To name but a few in the Northeast-

- The decommissioned Connecticut Yankee Nuclear Power Station has a tritium contaminated groundwater plume associated with historic leaks from that facility.
- In August 2005, Entergy Corporation discovered a leak or tritium in the spent fuel pool at Indian Point Nuclear Power Station Unit 2. Hydrological information indicates that some contaminated ground water likely will, or has migrated to the Hudson River. In addition to the leak from Unit 2 at Indian Point, there is evidence of the radionuclides nickel-63, cesium-137, strontium-90, and cobalt-60 around the facility which appear to have come from leakage in the Unit 1 spent fuel pool. Unit 1 was shut in 1974, but its spent fuel pool still contains expended fuel and radioactive water. Liquid Radioactive Release Lessons Learned Task Force Final Report (Sept. 1, 2006) ("Lessons Learned Report") at 5-6.
- Ground water samples taken by Brookhaven National Laboratories (BNL) showed concentrations of tritium that were twice the allowable federal drinking water standards. General Accounting Office, Information on the Tritium Leak and Contractor Dismissal at the Brookhaven National Laboratory (GAO/RCED-

98-26) November 1997, at 1. The tritium was found to be leaking from the laboratory's spent-fuel pool into the local water supply aquifer. Id. The leak appears to have occurred for as long as 12 years.

- Finally, Seabrook power plant suffered a leak of tritium from a defect in the liner of the cask loading pool.

Even in the face of years of accidental releases of radionuclides, the NRC states in its proposed rule that "[n]othing has occurred ... which calls into question the Commission's confidence in the safety of both wet and dry storage of [spent nuclear fuel] in the normal operation of spent fuel pools. ..." 73 Fed. Reg. at 59548. The record offers no hint as to the basis for this nonsensical statement.

While dry cask storage is safer than storage in pools, there is no evidence that the dry cask modules are safe for the essentially indefinite period of time that NRC is currently proposing in the Waste Confidence Rule. The testing and evaluations conducted with respect to the various dry cask designs was premised entirely on use of dry cask as a means of temporary storage of SNF and not as an alternative to proper long-term disposal. The effect of weathering or other age-induced phenomena on dry cask modules has never been determined. Further, essentially all civilian reactors are located near major bodies of water (usually rivers) for cooling water purposes. The impact of 100- or 500-year flood events on large scale dry cask storage facilities needs to be carefully considered. Furthermore, the impact on the safety of dry cask units from global climate change as it relates to rising sea levels and the periodicity of major flood events has never been evaluated.

Acts of Terrorism

Any plan or regulation that permits long-term storage of SNF at existing nuclear power stations poses an unacceptable danger to the public. According to a report prepared for Congress by the Government Accountability Office, the nation's nuclear power plants remain vulnerable to a terrorist attack.[5] Further, Mohamed ElBaradei, Director General of the International Atomic Energy Agency, warned of "the potential of terrorists targeting nuclear facilities."[6] Mr. ElBaradei also stated that the "safety and security of nuclear material is a legitimate concern of all States" and that "[t]he willingness of terrorists to commit suicide to achieve their evil makes the nuclear terrorism threat far more likely than it was before September 11."[7] This threat is not conjectural. The threat exists and the federal government's failure to complete Yucca Mountain on schedule does not mean that it would now be safe or reasonable to decide that scattered, vulnerable, temporary industry sites have become an acceptable safe intermediate "solution."

In the years since 9/11, the federal government has repeatedly acknowledged that there is a credible threat of intentional attacks on nuclear power plants, including the specific threat of an aircraft attack. For example, on November 15, 2002, the FBI sent a bulletin to law enforcement agencies, warning them that Al-Qaeda's "highest priority targets remain within the aviation,

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[5] Nuclear Power Plants Efforts Made to Upgrade Security, but the Nuclear Regulatory Commission's Design Basis Threat Process Should Be Improved, March 2006, GAO-06-388..

[6] International Atomic Energy Agency, *Calculating the New Global Nuclear Terrorism Threat* (November 1, 2001) *available at* www.iaea.org/worldatom/Press/P_release/2001/nt_Pressrelease.shtml.

[7] *Id.*

petroleum, and nuclear sectors." Text of FBI Terror Warning, CBSNews.com (Nov. 15, 2002), available at http://www/cbsnews.com/stories/2002/11/15/attack/main529501.

On September 4, 2003, the United States General Accounting Office ("GAO") issued a report noting that the nation's commercial nuclear power plants are possible terrorist targets and criticizing the NRC's oversight and regulation of nuclear power plant security. GAO, Nuclear Regulatory Commission: Oversight of Security at Commercial Nuclear Power Plants Needs to Be Strengthened, GAO-03-752 (2003) (E 241-57); see also GAO, Testimony Before the Subcomm. on Nat'l Security, Emerging Threats, & Int'l Relations, House Comm. on Gov't Reform, Nuclear Power Plants Have Upgraded Security, But the NRC Needs to Improve Its Process for Revising the DBT, GAO- 06-555T, at 1 (2006) [hereinafter "2006 GAO Testimony"] (E 964) (stating that, "[a]ccording to the [NRC] . . . , there continues to be a general credible threat of a terrorist attack on the nation's commercial nuclear power plants, in particular by al Qaeda and like-minded Islamic terrorist groups").

In 2005, the National Academy of Sciences released a report from a study it conducted at the request of Congress, with the sponsorship of the NRC and the Department of Homeland Security, of the security risks posed by the storage of spent fuel at nuclear plant sites. See Nat'l Acad. of Scis., Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report (2006) [hereinafter NAS Study] (E 725-846). Based upon information provided by the NRC, the National Academy of Sciences judged that "attacks with civilian aircraft remain a credible threat." Id. at 30 (E 760). It noted that terrorists might choose to attack spent fuel pools because they are "less well protected structurally than reactor cores" and "typically contain inventories of

medium- and long-lived radionuclides that are several times greater than those contained in individual reactor cores." Id. at 36 (E 766). The National Academy of Sciences concluded that the storage pools are susceptible to fire and radiological release from a wide range of conditions, including intentional attacks with large civilian aircraft. Id. at 49, 57 (E 779, 787).

The NRC's Waste Confidence Update Fails to Comply with NEPA

The National Environmental Policy Act of 1969 ("NEPA"), 42 U.S.C. §§ 4321-4347, and the implementing regulations formally promulgated by the Council on Environmental Quality ("CEQ"), 40 C.F.R. Parts 1500-1508, place upon the NRC the obligation to consider every significant aspect of the environmental impact of a proposed action and ensures that the Commission will inform the public that it has indeed considered environmental concerns in its decision making process. *Calvert Cliffs' Coordinating Committee, Inc. v. United States Atomic Energy Comm'n*, 449 F.2d 1109, 1114 (D.C. Cir. 1971). NEPA provides, in pertinent part, as follows:

> The Congress authorizes and directs that, to the fullest extent possible . . .
>
> (2) all agencies of the Federal Government shall -- . . .
>
> (C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on --
>
> (i) the environmental impact of the proposed action,
>
> (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
>
> (iii) alternatives to the proposed action,

> (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
>
> (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

42 U.S.C. § 4332. As a general matter, NEPA imposes a two step process: first, an agency must prepare an Environmental Assessment (EA) which identifies impacts of, and alternatives to, the proposed action; second, if the EA reveals that the proposed action may involve an impact to the environment, the agency must prepare an Environmental Impact Statement (EIS); alternatively, if the agency concludes that the proposed action will have no significant impact, it must prepare a Finding of No Significant Impact ("FONSI"). As a federal agency, NRC must comply with NEPA and the CEQ regulations.

NEPA directs that certain issues must be studied and that the reviewing agency must take a "hard look" at these issues, but does not direct what result an agency must reach. Federal appellate courts have been very clear, however, that NEPA is an important federal law and compliance is mandatory. "NEPA was created to ensure that agencies will base decisions on detailed information regarding significant environmental impacts and that information will be available to a wide variety of concerned public and private actors. *Morongo Band of Mission Indians v. Federal Aviation Administration,* 161 F.3d 569, 575 (9th Cir. 1998)." *Mississippi River Basin Alliance v. Westphal,* 230 F.3d 170, 175 (5th Cir. 2000).

Thus, the fundamental goal of an evaluation under NEPA is to require responsible government agencies involved with a given project to undertake a careful and thorough

analysis of the need for that project and its impacts before committing to proceed with the project. As the Tenth Circuit has held:

> The purpose of NEPA is to require agencies to consider environmentally significant aspects of a proposed action, and, in so doing, let the public know that the agency's decisionmaking process includes environmental concerns. *Baltimore Gas & Elec. Co. v. Natural Resources Defense Council,* 462 U.S. 87, 97, 76 L. Ed. 2d 437, 103 S. Ct. 2246 (1983); *Sierra Club v. United States Dep't of Energy,* 287 F.3d 1256, 1262 (10th Cir. 2002).

Utahns For Better Transportation v. United States Dept. of Transp., 305 F.3d 1152, 1162 (10th Cir. 2002). In a similar vein, the D.C. Circuit has held:

> NEPA was intended to ensure that decisions about federal actions would be made only after responsible decision-makers had fully adverted to the environmental consequences of the actions, and had decided that the public benefits flowing from the actions outweighed their environmental costs. *Jones v. District of Columbia Redevelopment Land Agency,* 162 U.S. App. D.C. 366, 499 F.2d 502, 512 (D.C. Cir. 1974). . . .

Illinois Commerce Com. v. Interstate Commerce Com., 848 F.2d 1246, 1259 (D.C. Cir. 1988).

It is not only the government decision-makers who are to be served by an EIS. As one court noted: "The purpose of an EIS is to 'compel the decision-maker to give serious weight to environmental factors' in making choices, *and to enable the public to* 'understand and consider meaningfully the factors involved.' *County of Suffolk [v. Secretary of Interior],* 562 F.2d at 1375 (*citing Sierra Club v. Morton*, 510 F.2d 813, 819 (5th Cir. 1975))." *Town of Huntington v. Marsh*, 859 F.2d 1134, 1141 (2d Cir. 1988)(emphasis added.)

Reflecting these statutory objectives, NEPA case law has established "a relatively low threshold for the preparation of an EIS." *Natural Resources Def. Council v. Duvall,* 777 F. Supp. 1533, 1537 (E.D. Cal. 1991). If the Environmental Assessment establishes that an

agency's "action may have a significant effect upon the . . . environment, an EIS must be prepared." *Nat'l Parks & Conservation Ass'n v. Babbitt*, 241 F.3d 722, 730 (9th Cir. 2001); *National Audubon Society v. Hoffman*, 132 F.3d 7, 12 (2d Cir. 1997). Where the impacts of an agency action are unclear, an agency must first prepare an Environmental Assessment to determine whether the proposed action may have a significant environmental effect. *See Nat'l Parks & Conservation Ass'n,* 241 F.3d at 730 (citing 40 C.F.R. § 1501.4). Regardless of the ultimate outcome, CEQ regulations require NRC to prepare an Environmental Assessment that identifies and discusses the impacts of the proposed action and the alternatives thereto. 40 C.F.R. § 1508.9(a),(b); *Hanly v. Kleindienst*, 471 F.2d 823, 834-35 (2d Cir. 1972).

In the present case, NRC has not take the requisite "hard look" at the environmental consequences of its actions because it has never published an Environmental Assessment of any kind. Similarly, NRC has failed to meet CEQ's requirements for making a finding of no significant impact. 40 C.F.R. § 1508.13. Because NRC has not conducted even the most minimal of assessments, neither governmental decision makers nor the public have ever had the opportunity to consider and comment on the administrative record. The mandates of NEPA have not been met and these proposed amendments to the Waste Confidence Rule cannot legally be enacted.

Conclusion

Neither casks nor pools can be accepted as a long-term situation. Most of the 104 existing U.S. nuclear power stations are located near major population centers. Even with the modestly enhanced security plans in place since September 11, 2001, these power plants are highly vulnerable. The spent fuel pools, in fact, are even more vulnerable than the reactors because the fuel is not housed in large concrete containment domes and because, due to the huge amounts of old fuel left within them, the pools contain much more total radioactivity than the reactors. Even with safer dry cask storage systems, it is illegal and unsafe to warehouse vast amounts of highly dangerous nuclear waste at scattered sites all around the country when it is well established that terrorists networks are focusing on the nation's nuclear and utility industries, and when there is no evidence of the long term reliability and safety of this new technology.

The current proposed amendments are short-sighted, illegal, and dangerous. The NRC should fundamentally revise its approach to long-term storage of spent nuclear fuel. After conducting a full and fair environmental impact study, it must adopt plans to create a safe and efficient method of creating a permanent national repository for high level nuclear waste.

Dated: February 5, 2009

Respectfully submitted

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:

Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation

RIN 3150-AI47
NRC-2008-0404

COMMENTS SUBMITTED BY THE OFFICES OF THE ATTORNEYS GENERAL OF THE STATES OF NEW YORK AND VERMONT AND THE COMMONWEALTH OF MASSACHUSETTS CONCERNING CONSIDERATION OF ENVIRONMENTAL IMPACTS OF TEMPORARY STORAGE OF SPENT FUEL AFTER CESSATION OF REACTOR OPERATION

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Table of Contents

Page

Table of Contents (cont'd)

UNITED STATES OF AMERICA
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The People of the States of New York and Vermont and the Commonwealth of Massachusetts, by their respective Attorneys General (together "the Commenting States") submit these comments regarding the Nuclear Regulatory Commission's ("NRC") proposed rule concerning the "temporary" storage of high level nuclear waste until a repository is available.

A. The State of New York's Interest in this Proceeding

Attorney General Andrew M. Cuomo has taken the lead in opposing the relicensing of the Indian Point nuclear plants. The State of New York has identified serious concerns about the safety and environmental impacts of Indian Point Units 1, 2, and 3, and has set these concerns out in the State's Petition to Intervene in the United State Nuclear Regulatory Commission's proceeding to consider whether to renew the operating licenses for these plants. On July 31,

2008, the Atomic Safety and Licensing Board issued a decision admitting 11 contentions presented by the State for an evidentiary hearing. *See In the Matter of Entergy Nuclear Operations, Inc.*, ASLBP No. 07-858-03-LR-BD01, Memorandum and Order (July 31, 2008). The admitted contentions involve, among other things: weaknesses in the units' aging electrical and piping systems, reactor pressure vessel components, and containment dome; unauthorized radionuclide leaks from various components, and deficiencies in significant accident mitigation analyses. The State of New York has a strong interest in ensuring the safety of this and other nuclear power plants within its borders.

B. The State of Vermont's Interest in this Proceeding

The State of Vermont has a strong interest in the management of waste from nuclear plants. Vermont Yankee Nuclear Power Station is in Vermont and received its original operating license in 1973. The State of Vermont had one contention admitted in the recent license renewal case. *In the Matter of Entergy Nuclear Vermont Yankee, LLC*, ALSBP No. 06-849-03-LR. A second Vermont contention was rejected that contended that the applicant had failed to include new and significant information regarding the likelihood of spent fuel having to be stored onsite for longer than was evaluated in the Generic Environmental Impact Statement ("GEIS") and perhaps indefinitely. It was rejected on the basis of the current Waste Confidence Rule. Additionally, Vermont adopted certain admitted contentions submitted by the New England Coalition.

C. The Commonwealth of Massachusetts' Interest in this Proceeding

The Commonwealth of Massachusetts has a substantial interest in assuring the safe operation of nuclear power plants within or in proximity to its borders. The Commonwealth also recognizes that nuclear power should be a part of the region's energy portfolio so long as proper and adequate safety and environmental precautions are followed pursuant to the National Environmental Policy Act ("NEPA"), the Atomic Energy Act ("AEA"), and the Administrative Procedure Act ("APA"). Therefore, the Commonwealth has opposed efforts by the NRC to extend the licenses for the Pilgrim nuclear power plant, located in Plymouth, MA, and the Vermont Yankee nuclear power plant, located about ten miles from the Massachusetts border in Vernon, Vermont, unless and until the NRC properly addresses new and significant information on the risks of spent fuel pool storage at these facilities.[1] In each proceeding, the Commonwealth contended that the NRC's failure to address appropriately this new and significant information, including a 2001 report prepared by NRC staff, a report by the National Academy of Sciences, and a report prepared by the Commonwealth's own expert, violated NEPA, the AEA, the APA, and NRC implementing regulations. This information established

[1] *See* Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene with Respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Pilgrim Nuclear Power Plant Operating License (May 26, 2006) (No. 50-293-LR). ADAMS No. ML061630088 (Pilgrim Contention); *see also* Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene with Respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Vermont Yankee Nuclear Power Plant Operating License (May 26, 2006) (No. 50-271-LR). ADAMS No. ML061640065 (Vermont Yankee Contention).

that if a fuel pool were to suffer even a partial loss of cooling water, whether caused by terrorist attack, natural phenomena, equipment failure, or operator error, this could cause, over a wide range of scenarios, a catastrophic fire leading to a large atmospheric release of radioactive isotopes, extending beyond Massachusetts borders (Pilgrim) or across the border into Massachusetts communities (Vermont Yankee). In a separate expert report, the Commonwealth demonstrated that such a large atmospheric release could cause thousands of cases of cancer and billions of dollars in economic damage. *See Commonwealth v. NRC*, 522 F.3d 115, 122 – 123 (1st Cir. 2008).

In a parallel petition for rulemaking, the Commonwealth presented these same contentions regarding the risks of spent fuel pool storage and requested that the NRC revisit the conclusion of its 1996 License Renewal Generic Environmental Impact Statement that spent fuel storage poses no significant environmental impacts. *Commonwealth v. NRC*, 522 F. 3d at 123-124. Consistent with the U.S. Court of Appeals for the Ninth Circuit's decision in *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016 (9th Cir. 2006), *cert. denied*, 127 S.Ct. 1124 (2007), the Commonwealth and other rulemaking supporters also requested the NRC to reverse its policy of refusing to consider the environmental impacts of intentional attacks on nuclear power plants. *See* 449 F. 3d at 1035.

Subsequently, the NRC denied the Commonwealth's rulemaking petition. *See* 73 Fed. Reg. 46204 (Aug. 8, 2008). That decision is now on appeal to federal court. *See State of New York, Richard Blumenthal, Attorney General of Connecticut,*

Commonwealth of Massachusetts v. United States Nuclear Regulatory Commission and United States of America, Docket Nos.: 08-3903-ag(L); 08-4833-ag (CON); 08-5571-ag (CON) (2d Cir. 2008).

I. Overview

The NRC's proposed rule would amend 10 C.F.R. § 51.23(a) to say that if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for an unknown period of time beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. 73 Fed. Reg. 59547 (Oct. 9, 2008). Phrased differently, the NRC here proposes a generic determination of no significant environmental impact from the temporary storage of spent fuel after cessation of reactor operation. The proposed rule is arbitrary, grounded neither in science nor law, contrary to the National Environmental Policy Act ("NEPA"), the Atomic Energy Act ("AEA"), and the Administrative Procedure Act ("APA"), and ignores numerous instances of environmental harm from leaking spent fuel pools around the country.

To fully understand the context of the proposed rule, a brief review of the Waste Confidence proceedings is in order.

A. Background on the Waste Confidence Rule

In 1984, the NRC issued a "Waste Confidence Decision" in response to a remand from the United States Court of Appeals for the District of Columbia

Circuit in *State of Minnesota v. NRC*, 602 F.2d 412 (D.C. Cir. 1979), which raised the question of whether an offsite storage or disposal facility would be available for the spent nuclear fuel produced at two reactors at the expiration of their licenses or whether the spent nuclear fuel could be stored onsite until an offsite solution was available. The D.C. Circuit explained that

> It was anticipated, when most of the nuclear power plants now in operation in the United States were licensed, that spent fuel would be stored at the reactor site only long enough to allow the fuel assemblies to cool sufficiently to permit safe shipment off-site for reprocessing (the extraction from the rods of usable uranium and plutonium) or permanent disposal [and that] [s]pent fuel storage capacity at these plants is therefore limited.

Minnesota v. NRC, 602 F.2d at 413-14. Two facilities, Vermont Yankee in Vermont and Prairie Island in Minnesota, had applied for license amendments to allow for expanded on-site spent fuel pool storage in anticipation of filling their spent fuel pools to capacity, which would have happened by 1978 and 1982 respectively. *Id.* Intervenors argued that approval of expanded on-site storage could only be granted after analysis of environmental and safety implications. Staff in each licensing proceeding found, in part because the modifications would entail no increase in the amount of wastes annually generated by the reactor, "reasonable assurances" that the modifications would not endanger public health and safety, and that they satisfied the standards of the Atomic Energy Act and NRC regulations, and concluded that NEPA did not require the preparation of environmental impact statements because the modifications would not "significantly affect the quality of the human environment", findings which were affirmed by the Atomic Safety and

Licensing Appeal Board. *Id.* at 414-15.[2] The D.C. Circuit found insufficient the Commission's "implicit" policy of a "reasonable assurance that methods of safe permanent disposal of high-level wastes can be available when they are needed" and remanded the issue to the Commission to undertake at least a generic rulemaking to establish such a policy. *Id.* at 417. The result was the 1984 Waste Confidence Decision.

1. The 1984 Waste Confidence Findings

The 1984 Waste Confidence Decision established five findings designed to allow the continued licensing of nuclear power plants in the absence of an existing repository for high level nuclear waste. Those findings were:

> (1) The Commission finds reasonable assurance that safe disposal of HLW [high level nuclear waste] and SNF [spent nuclear fuel] in a mined geologic repository is technically feasible;
>
> (2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial HLW and SNF will be available by the years 2007-2009, and that sufficient repository capacity will be available within 30 years beyond the expiration of any reactor operating license to dispose of existing commercial HLW and SNF originating in such reactor and generated up to that time;
>
> (3) The Commission finds reasonable assurance that HLW and SNF will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all HLW and SNF;
>
> (4) The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating

[2] Ironically, radionuclide contamination was subsequently found in Prairie Island's groundwater. *See* NUREG 1437, Vol. 1, Sec. 4.8.2.

> license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations ("ISFSIs");
>
> (5) The Commission finds reasonable assurance that safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

49 Fed. Reg. 34658 (Aug. 31, 1984). Based on these findings, the Commission amended 10 C.F.R. Part 51 (specifically, it added 10 C.F.R. § 51.23(a)) to say that the environmental impacts of at-reactor storage after the termination of reactor operating licenses need not be considered in Commission proceedings related to issuance or amendment of a reactor operating license.

2. 1990 Revisions to the Waste Confidence Findings

In 1990, the NRC issued a decision revising affirming in general the findings but revising Findings Two and Four to reflect new dates of availability of the first repository and to clarify that, in Finding Four, the expiration of a reactor's operating license referred to the full 40 year initial license as well as any revised or renewed licensing term. Following these revisions, Finding Two then read:

> The Commission finds reasonable assurance that at least one mined geologic repository will be available *within the first quarter of the twenty-first century*, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of an reactor to dispose of the commercial HLW and SNF originating in such reactor and generated up to that time."

(Emphasis added to show revisions from the 1984 rule). 55 Fed. Reg. 38474 (Sept. 18, 1990). Finding Four was amended to read:

> The Commission finds reasonable assurance that, if necessary, spent

> fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (*which may include the term of a revised or renewed license*) of that reactor at its spent fuel storage basin, or at either onsite of offsite ISFSIs.

(Emphasis added to show revisions from the 1984 rule). *Id.* The Commission revised 10 C.F.R. § 51.23(a) to conform to these revisions. *See* 55 Fed. Reg. 38472 (Sept. 18, 1990).

The Commission, in 1999, again confirmed these findings and stated that it would consider undertaking a reevaluation of the Waste Confidence Decision if, *inter alia,* significant and pertinent unexpected events occur, raising substantial doubt about the Decision's continued viability. 64 Fed. Reg. 68005 (Dec. 6, 1999).

B. The Current Waste Confidence Decision Update

The NRC is now taking a "fresh look" at the Waste Confidence findings, although it is not reopening the findings pursuant to its 1999 criteria, in anticipation of significant number of applications for new reactors. 73 Fed. Reg. at 59553. Specifically, the NRC seeks to amend Finding Two again, this time to read that

> The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonable be expected to be available *within 50-60 years beyond the licensed life for operation* (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time.

73 Fed. Reg. at 59551 (emphasis added to show proposed changes). The Commission also seeks to amend Finding Four again, to read that:

> The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely without significant environmental impacts *for at least 60 years* beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations.

73 Fed. Reg. at 59551 (emphasis added to show proposed changes).[3] Along with these changes, the NRC also seeks to amend 10 C.F.R. § 51.23 to essentially reflect changes to Finding Four. The following comments address this proposed regulatory change.

II. The Premise Upon Which the Original Waste Confidence Finding Four Was Based Has Not Been Substantiated

In concluding that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license, the Commission considered four major issues: (1) the long-term integrity of spent fuel under water pool storage conditions, (2) structure and component safety for extended facility operation, (3) the safety of dry storage, and (4) potential risks of accidents and acts of sabotage at spent fuel storage facilities. 49 Fed. Reg. 34658. The Commenting States believe that occurrences over the last twenty-two years undermine at least two prongs of this analysis.

[3]The Commenting States simultaneously are submitting comments on the Proposed Waste Confidence Decision Update under separate cover.

A. Leaking Spent Fuel Pools at Facilities Around the Country, Which Have Contaminated Groundwater and Public Waterways, Call Into Question the Integrity of Spent Fuel Under Water Storage Conditions

Recent reports by the National Academy of Sciences, the NRC's own technical staff and independent experts contradict the NRC's assertion that high-density fuel storage pools pose no significant environmental risk.[4] Instead, these studies show that absent proper safety precautions, fuel storage pools are potentially susceptible to fire and radiological release from a wide range of conditions, including natural phenomena, operator error, equipment failure, or intentional attack. The environmental impacts of a fire in a spent fuel pool may be severe, extending over a geographic area larger than a state's legal boundaries and continuing for decades.

In its 1990 rulemaking, the Commission determined that:

> experience with water storage of [spent nuclear fuel] continued to confirm that pool storage is a benign environment for [spent nuclear fuel] that does not lead to significant degradation of spent fuel integrity; that the water pools in which the assemblies are stored will remain safe for extended periods; and that degradation mechanisms are well understood and allow time for appropriate remedial action.

73 Fed. Reg. at 59548. However, spent fuel pools at multiple reactors around the

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[4] *See, e.g.*, NUREG-1738, Final Technical Study of 1 Spent Fuel Pool Accident Risk and Decommissioning Nuclear Power Plants (NRC: January 2001); National Academy of Sciences Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, Safety and Security of Commercial Spent Nuclear Fuel Storage (The National Academies Press: 2006); Gordon Thompson, Risks and Risk-Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants (May 25, 2006); Jan Beyea, Report to the Massachusetts Attorney General on the Potential Consequences of a Spent-fuel Pool Fire at the Pilgrim or Vermont Yankee Nuclear Plant (May 25, 2006).

country have, since the original Waste Confidence Decision and even since the 1990 rulemaking, leaked radioactive water into the subsurface.

Indian Point Unit Two

In August 2005, the licensee (Entergy) discovered a leak in the spent fuel pool at Unit 2, and further investigation revealed tritium in onsite ground water. Based on hydrological information and sample analyses of monitoring wells, Entergy has admitted that some contaminated ground water likely will, or has migrated to the Hudson River. *See* Indian Point Energy Center License Renewal Application, Appendix E, Applicant's Environmental Report (May 2007) ("Indian Point LRA Environmental Report"), at 5-4.

Indian Point Unit One

In addition to the detection of tritium, the radionuclides nickel-63, cesium-137, strontium-90, and cobalt-60 have been detected onsite at Indian Point, which appear to have come from leakage in the Unit 1 spent fuel pool, which has been permanently shut down since 1974, but whose spent fuel pool still contained expended fuel and radioactive water until late 2008. Liquid Radioactive Release Lessons Learned Task Force Final Report (Sept. 1, 2006) ("Lessons Learned Report") at 5-6. Radioactive fluid which escaped that pool still exists in groundwater and in the subsurface geologic formations. Hydrogeologic Site Investigation Report for the Indian Point Energy Center, GZA GeoEnvironmental, Inc. (Jan. 7, 2008).

These two sets of leaks may have existed for five to ten years before Entergy

identified them in 2005. *See* Indian Point LRA Environmental Report at 5-5.

Brookhaven National Laboratories

In January 1997, ground water samples taken by Brookhaven National Laboratories (BNL) staff revealed concentrations of tritium that were twice the allowable federal drinking water standards, and some samples taken later were 32 times the standard. *See* General Accounting Office, Information on the Tritium Leak and Contractor Dismissal at the Brookhaven National Laboratory (GAO/RCED-98-26)(Nov. 1997), at 1. The tritium was found to be leaking from the laboratory's High Flux Beam Reactor's spent-fuel pool into the aquifer that provides drinking water for nearby Suffolk County residents. *Id.* The Department of Energy (DOE) and BNL's investigation of this incident concluded that the tritium had been leaking for as long as 12 years without DOE's or BNL's knowledge. *Id.* A subsequent federal government investigation concluded that Brookhaven employees did not aggressively monitor its reactor's spent-fuel pool for leaks – even going so far as to postpone an agreed-upon monitoring well system – so years passed before tritium contamination was discovered in the aquifer near the spent-fuel pool. *Id.* at 2.

Seabrook

In June 1999, the operator of the Seabrook power plant measured elevated tritium concentrations in the sump during routine monitoring. The licensee identified that the tritium activity was associated with an input to the sump from the Containment Annulus. Seabrook's investigation identified the source of the

tritium leakage to be from a defect in the liner of the cask loading pool, which is connected to the fuel transfer canal in the Fuel Handling Building. Seabrook detected a maximum tritium concentration of about 750,000 pCi/L in a sample of non-potable water collected from the annulus sump in close proximity to the location of the leak.

Point Beach

Also in 1999, tritium and other radionuclides were identified near a retention pond at the Point Beach Nuclear Power Plant, near Manitowoc, Wisconsin. Tritium concentration in sand lenses in the top twelve feet of soil around the former retention pond ranged from 177 to 14,250 pCi/L. Tritium, which originated from leaks from the former retention pond, has been detected in these streams in concentrations ranging from the minimum detectable activity levels of about 200 pCi/L up to 400 pCi/L.

Salem

On September 18, 2002, the operator of the Salem Nuclear Station in Delaware found that Unit 1 Spent Fuel Pool water had leaked into a narrow seismic gap between the Unit 1 Auxiliary Building and Unit 1 Fuel Handling Building, and entered the Mechanical Penetration Room. Further licensee investigation identified tritium contamination in non-potable ground water near the Unit 1 fuel handling building. Maximum tritium levels of 15,000,000 pCi/L were identified in the ground water near the seismic gap. Lessons Learned Report at 7-8.

These pools leaked during the reactors' initial licensing term, calling into

question the possibility for compromised structural integrity of spent fuel pools as many reactors around the country seek, and are granted, license renewals.

The NRC was sufficiently concerned about these occurrences that it conducted a study in 2006. *See* Lessons Learned Report. The NRC noted in its report on tritium releases that "[m]any of the releases reviewed varied significantly in methods for estimating and/or monitoring the source term in surface or ground water, predicting or monitoring the distribution of the radionuclide concentrations in the environment through time, and subsequently evaluating current and future dose impacts to the general public or offsite areas. Lessons Learned Report at 13. The NRC has acknowledged that "it lacks regulatory guidance for monitoring and evaluating both the immediate and long-term offsite dose or environmental impact of these inadvertent releases." Lessons Learned Report at 13. There is currently no mandatory groundwater testing requirement in place, only an industry-created voluntary initiative. Lessons Learned Report at iii, 33. The NRC concluded that "systems or structures that are buried or that are in contact with soil, such as [spent fuel pools] ... are particularly susceptible to undetected leakage." Lessons Learned Report at 26. Indeed, NRC concluded that "[spent fuel pool] performance deficiencies are not specifically addressed in the NRC inspection program significance determination process." *Id.*

Yet despite these well-documented unplanned releases, the NRC states in its proposed rule that "[n]othing has occurred ... which calls into question the Commission's confidence in the safety of both wet and dry storage of [spent nuclear

fuel] in the normal operation of spent fuel pools. ..." 73 Fed. Reg. at 59548. The Commenting States urge the Commission to consider the increasing frequency of spent fuel pool leaks as evidence "calling into question the Commission's confidence in the safety of both wet and dry storage of [spent nuclear fuel] in the normal operation of spent fuel pools."

Moreover, apart from unintended releases from degradation or other unforeseen problems, increased on-site storage also increases the opportunity for human error resulting in unauthorized releases. The NRC discussed numerous unplanned leaks that occurred because of human error in its Lessons Learned Report. *See* Lessons Learned Report at 34. The Brookhaven example detailed above, in which a federal government investigation concluded that Brookhaven employees did not aggressively monitor its reactor's spent-fuel pool for leaks, resulting in groundwater contamination that had been going on for twelve years, undetected, is one example of human error resulting in radioactive contamination in relation to spent fuel. Other examples include the Hatch facility in 1986, where "licensee personnel did not follow valving procedures for operating spent fuel pool canal seals which resulted in an unmonitored, unplanned release of spent fuel pool water to the onsite environment including a swamp area. The licensee experienced a spill of water (141,000 gallons) containing an estimated 0.20 curies of tritium and 0.373 curies of mixed fission product activity." *Id.* In March, 1991, in an event the NRC considered "serious" at the James A. FitzPatrick facility in Western New York, "licensee personnel did not follow valving procedures for a radioactive waste

concentrator which cross-contaminated the auxiliary boiler and caused an airborne radioactivity release (steam plume) from the boiler. This resulted in deposition of onsite contamination and release of contaminated water from a storm drain. An estimated 0.4 to 1.5 curies of mixed fission and activation product activity was released from the boiler, of which an estimated 0.03 to 0.05 curies was released from the site via a storm drain." *Id.* At the Hope Creek Station in April 1995, in an event the NRC characterized as "of significant regulatory concern," licensee personnel "did not correctly operate a radioactive waste concentrator which caused an airborne radioactivity release resulting in onsite contamination. An estimated 25 gallons of contaminated water, containing approximately 0.085 curies of mixed activation products, was released." *Id.* These examples show the potential for human error in operations relating to nuclear waste that can result in unplanned releases.

Given the increasing number of leaking spent fuel pools around the country, and the lack of monitoring requirements or guidelines for spent fuel pool leaks, a blank check authorization to store spent fuel onsite with no site-specific environmental review is inappropriate, and is in violation of NEPA, the APA, and the AEA.

B. Recent Events Should Undermine the NRC's Confidence in the Potential Risks of Accidents and Acts of Sabotage at Spent Fuel Storage Facilities.

1. Accidents

The recent July 16, 2007 earthquake in Niigata Province, Japan, which

damaged the world's largest nuclear power plant, tipped over storage drums, and released radioactive material into the environment, further demonstrates the vulnerability of nuclear plants to natural forces. *See* Martin Fackler, *Japan Nuclear-Site Damage Worse Than Reported,* N.Y. TIMES (July 19, 2007), available at http://www.nytimes.com/2007/07/19/world/asia/19japan.html; THE ASAHI SHIMBUN, *Radioactive Water Likely Flowed via Electric Cables after Earthquake* (July 23, 2007).

Seismic issues are potentially problematic at a number of power reactor locations across the United States. Seismologists at Columbia University's Lamont-Doherty Earth Observatory, in August of 2008, published the results of their study on earthquakes in the greater New York City Area, indicating the existence of a new fault line that could "significantly increase" the probability of an earthquake in the greater New York City Area. Lynn R. Sykes, John G. Armbruster, Won-Young Kim, and Leonardo Seeber, *Observations and Tectonic Setting of Historic and Instrumentally Located Earthquakes in the Greater New York City–Philadelphia Area*, Bulletin of the Seismological Society of America, Vol. 98, No. 4, pp. 1696–1719 (August 2008). More significantly, the study found that the Indian Point nuclear power plants sit at the previously unidentified intersection of two active seismic zones. *Id.* The study also found that historic activity of earthquakes of a magnitude more than 5 has been higher in southeastern New York than in many other areas of the central and eastern United States, and that the fault lengths and stresses suggest magnitude-6 quakes, or even 7 — which would be 10 and 100 times

bigger than magnitude 5 — are "quite possible." Id; see also Robert Roy Britt, *Large Earthquake Could Strike New York City* (Aug. 21, 2008), *available at* http://www.livescience.com/environment/080821-new-york-earthquakes.html.[5]

An earthquake registering 5.2, with aftershocks registering 4.6, shook the D.C. Cook and Palisades reactors in Michigan in April of 2008. *See* PNO-III-08-004A, Preliminary Notification of Event or Unusual Occurrence (Apr. 18, 2008), ML081090639. The PNO about this unusual occurrence noted that several other Region III and Region IV nuclear power reactors experienced seismic activity from the initial earthquake and the aftershock as well. *Id.* Given the differing seismology of various plants around the country, a generic determination of environmental safety for potentially long-term on-site storage of spent fuel is inappropriate, and is in violation of NEPA, the APA, and the AEA.

2. Acts of Sabotage

Aside from accidents, spent fuel storage pools may be potentially susceptible to fire and radiological release from intentional attacks if the NRC and licensees fail to take measures to protect against such attacks. National Research Council of the National Academies, *Safety and Security of Commercial Spent Nuclear Fuel Storage*: Public Report 17, 40 (2006). On September 11, 2001, terrorists hijacked four jet airliners and crashed three of them into their intended targets. The impact

[5] The report correctly states that "[m]uch new seismological information is available since their initial approvals in 1973 and 1975. Nevertheless, the U.S. Nuclear Regulatory Commission so far has not permitted any new information to be used or old information on which the original licenses were based to be contested in considering extensions of licenses." *Id.* at 1717.

of the fuel-laden planes caused explosions and large, long-lasting fires. Those explosions and fires destroyed a portion of the Pentagon in northern Virginia and caused the collapse of the World Trade Center towers and nearby buildings in New York City. *See* Nat'l Comm'n on Terrorist Attacks Upon the U.S. ("9/11 Commission"), *The 9/11 Commission Report* (2004).

Two of the hijacked planes flew near or over Indian Point, a nuclear power plant located on the Hudson River twenty-four miles north of New York City. *See id.* at 32. The wind direction at the time of the attacks was towards the southeast — that is, from Indian Point towards New York City. *See id.* at 285. Extrapolating from 2000 census information, more than seventeen million people live within fifty miles of the Indian Point reactors and spent fuel pools. *See* Edwin Lyman, *Chernobyl on the Hudson? The Health & Economic Impacts of a Terrorist Attack at the Indian Point Nuclear Plant* 23 (2004).

The 9/11 Commission's report revealed that Khalid Sheikh Mohammad, the mastermind of the 9/11 attacks, originally planned to hijack additional aircraft to crash into targets on both coasts, including nuclear power plants. *The 9/11 Commission Report*, at 154. As late as July 2001, the terrorists were considering attacking a specific nuclear facility in New York, which one of the pilots "had seen during familiarization flights near New York." *Id.* at 245. This was most likely Indian Point.

In the years since 9/11, the federal government has repeatedly acknowledged that there is a credible threat of intentional attacks on nuclear power plants,

including the specific threat of an aircraft attack. For instance:

- On January 23, 2002, the NRC issued an alert to the nation's nuclear power plants warning of the potential for an attack by terrorists who planned to crash a hijacked airliner into a nuclear facility. Kenneth R. Bazinet & Richard Sisk, *Plant Attacks Feared*, N.Y. DAILY NEWS (Feb. 1, 2002), at 5, *available at* 2002 WL 3165383.

- In his 2002 State of the Union address, President Bush stated that "diagrams of American nuclear power plants" had been found in Afghanistan, suggesting that Al-Qaeda may have been planning attacks on those facilities. *The President's State of the Union Address* (Jan. 29, 2002), *available at* http://www.pbs.org/newshour/bb/white_house/sotu2002/sotu_text.html.

- On May 14, 2002, Gordon Johndroe, a spokesman for the Office of Homeland Security, noted that "we know that Al-Qaeda has been gathering information and looking at nuclear facilities and other critical infrastructure as potential targets." Bill Gertz, *Security Boosted at Nuke Facilities*, WASH. TIMES (May 14, 2002), *available at* http://www.ohiocitizen.org/campaigns/electric/pre2003/boosted.htm.

- On May 24, 2002, the NRC reported that the nation's nuclear power plants had been placed on heightened alert as a result of information gained by the intelligence community. *Wide-Ranging New Terror Alerts*, CBS News.com (May 26, 2002), *available at* http://www.cbsnews.com/stories/2002/05/24/attack/main510054.shtml.

- On November 15, 2002, the FBI sent a bulletin to law enforcement agencies, warning them that Al-Qaeda's "highest priority targets remain within the aviation, petroleum, and nuclear sectors." *Text of FBI Terror Warning*, CBSNews.com (Nov. 15, 2002), *available at* http://www.cbsnews.com/stories/2002/11/15/attack/main529501.shtml.

- On May 1, 2003, the FBI issued a Threat Communication warning the nuclear plant operators to remain vigilant about suspicious activity that could signal a potential terrorist attack. *FBI Warns of Nuke Plant Danger*, CBS News.com (May 1, 2003), *available at* http://www.cbsnews.com/stories/2003/09/04/attack/

main571556.shtml.

- On September 4, 2003, the United States General Accounting Office ("GAO") issued a report noting that the nation's commercial nuclear power plants are possible terrorist targets and criticizing the NRC's oversight and regulation of nuclear power plant security. GAO, *Nuclear Regulatory Commission: Oversight of Security at Commercial Nuclear Power Plants Needs to Be Strengthened*, GAO-03-752 (2003); *see also* GAO, Testimony Before the Subcomm. on Nat'l Security, Emerging Threats, & Int'l Relations, House Comm. on Gov't Reform, *Nuclear Power Plants Have Upgraded Security, But the NRC Needs to Improve Its Process for Revising the DBT*, GAO-06-555T, at 1 (2006)(stating that, "[a]ccording to the [NRC] . . . , there continues to be a general credible threat of a terrorist attack on the nation's commercial nuclear power plants, in particular by al Qaeda and like-minded Islamic terrorist groups").

- On July 1, 2004, the FBI issued a bulletin to 18,000 law enforcement agencies nationwide warning that recent intelligence continued to show al-Qaeda's interest in attacking a range of facilities, including nuclear plants. *FBI's 4th Warning*, CBSNews.com (July 2, 2004), *available at* http://www.cbsnews.com/stories/2004/07/08/national/printable628204.shtml.

- On July 11, 2007, the NRC amended the operating license for Indian Point Unit 3 to require the licensee to address large fires and explosions including those caused by planes. Indian Point Unit 3 Operating License, DPR-64, Condition AC, Mitigation Strategy License Condition (July 11, 2007), ML052720273, at 8.

In 2005, the National Academy of Sciences released a report from a study it conducted at the request of Congress, with the sponsorship of the NRC and the Department of Homeland Security, of the security risks posed by the storage of spent fuel at nuclear plant sites. *See* Nat'l Acad. of Scis., *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report* (2006). Based upon information provided by the NRC, the National Academy of Sciences judged that

"attacks with civilian aircraft remain a credible threat." *Id.* at 30. It noted that terrorists might choose to attack spent fuel pools because they are "less well protected structurally than reactor cores" and "typically contain inventories of medium- and long-lived radionuclides that are several times greater than those contained in individual reactor cores." *Id.* at 36. The National Academy of Sciences concluded that the storage pools are susceptible to fire and radiological release from a wide range of conditions, including intentional attacks with large civilian aircraft. *Id.* at 49, 57. Similarly, the German Reactor Safety Organization, a scientific-technical research group that works primarily for nuclear regulators in Germany, found that large jetliners crashing into nuclear facilities under a variety of scenarios could cause uncontrollable situations and the release of radiation. German Reactor Safety Org., *Protection of German Nuclear Power Plants Against the Backgroud of the Terrorist Attacks in the U.S. on Sept. 11, 2001* (Nov. 27, 2002), *translation available at* http://www.greenpeace.org/raw/content/international/press/reports/protection-of-german-nuclear-p.2.pdf.

Nuclear power plants in the United States, all of which were designed and built between the 1950s and 1980s, were not intended to withstand the impact of aircraft crashes or explosive forces. *See* 2/22/06 Comments of Nuclear Energy Institute to NRC in RIN 3150-AH60, at Enclosure 2, p. 10; *NRC: Nuclear Power Plants Not Protected Against Air Crashes*, ASSOCIATED PRESS (Mar. 28, 2002); Director's Decision Under 10 CFR 2.206, at 12, *In the Matter of All Nuclear Power Reactor Licensees*, DD-02-04 (Nov. 1, 2002), *available at* http://www.nrc.gov/reading-

rm/doc-collections/petitions-2-206/ directors-decision/2002/ml022890031.pdf.

The NRC does not currently require existing nuclear power plants to develop protections against airborne attacks prior to the events of September 11, 2001. The NRC previously found the risks acceptable because of the low probability that an aircraft would *accidentally* hit a nuclear power plant. *See, e.g.*, Power Authority of the State of New York and Consolidated Edison Company, *Indian Point Probabilistic Safety Study* (1982) at 7.6-6 (concluding that the probability of an accidental crash was sufficiently low as to "present no significant hazard"). The NRC did not consider – or considered it extremely unlikely – that anyone would deliberately crash an airplane into a nuclear power plant.

Under current storage practices, the indefinite storage of spent nuclear fuel at power reactor sites long after the reactors have ceased power generation poses significant potential hazards. For example, in terms of volume there will be more spent fuel present after the end of power generation operations than during such power generation when such waste is still being generated and accumulating. Thus, the volume of any release of spent fuel could conceivably be greater during a post-operation phase. Also, by postponing the removal of waste from power reactor sites, NRC's proposed action essentially will extend the duration of the existence of such potential hazard at reactor sites.

In the aftermath of the September 11 attacks and other new and significant information, the NRC's outdated conclusion – that fuel pool storage risks are insignificant – is no longer defensible.

III. Given That the Premise Upon Which the Original Waste Confidence Finding Four Was Based Has Not Been Substantiated, Site-Specific Environmental Review for Each Reactor is Required

In light of the above information, the Commenting States objects to the NRC's generic finding of safety in relation to temporary storage of nuclear waste. Instead, the Commenting States submit that site-by-site analysis of the potential for environmental impacts is appropriate, and required by the National Environmental Policy Act, given different security risks, seismic conditions, population densities, licensing periods, and differing histories of leaks at each of the nation's facilities. Moreover, the Commenting States submit that consideration of the quantity of waste generated in the renewed licensing term should be considered at license renewal, and urges the NRC to undertake a revision of 10 C.F.R. § 51.23(b) to implement this change. License renewals should consider – if not hinge upon – the facility's ability to store, for the indefinite period of time NRC foresees, all of the facility's spent nuclear fuel.

IV. The NRC's Proposed Rule Fails to Comply With NEPA and the AEA

NEPA, 42 U.S.C. §§ 4321-4347, and the implementing regulations adopted by the Council on Environmental Quality ("CEQ"), 40 C.F.R. Parts 1500-1508, place upon the NRC the obligation to consider every significant aspect of the environmental impact of a proposed action and ensures that the Commission will inform the public that it has indeed considered environmental concerns in its decisionmaking process. *Baltimore Gas & Elec. Co. v. Natural Res. Def. Counsel, Inc.*, 462 U.S. 87, 97 (1983). The NRC's Waste Confidence Decision Update, like its

1984 and 1990 predecessors, fails to comply with NEPA and the AEA.

Following NEPA's passage, CEQ promulgated regulations for Environmental Assessments, which are developed during a preliminary step in the environmental review process. *See* 40 C.F.R. § 1508.9. Environmental Assessments should "[b]riefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact," (40 C.F.R. § 1508.9(a)(1)) and identify alternatives to the proposed action (40 C.F.R. § 1508.9(b)). The NRC never published, and does not publish here, an Environmental Assessment of any kind.

Similarly, NRC has failed to meet CEQ's requirements for making a finding of no significant impact. 40 C.F.R. § 1508.13 defines a finding of no significant impact as

> a document by a Federal agency briefly presenting the reasons why an action ... will not have a significant effect on the human environment and for which an environmental impact statement therefore will not be prepared. It shall include the environmental assessment or a summary of it and shall note any other environmental documents related to it. If the assessment is included, the finding need not repeat any of the discussion in the assessment but may incorporate it by reference.

40 C.F.R. § 1508.13. NRC never published a proper finding of no significant impact despite attempting, in Finding Four, to propose a finding of no significant impact that spent fuel can be stored for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations, but it does so without giving any evidence or analysis whatsoever for that finding. To the contrary, the

Commenting States presents here evidence that there may indeed be significant environmental impacts from long term spent fuel storage either onsite or offsite. NRC's Waste Confidence Decision update fails to comply with NEPA.

The NRC has consistently declined to review the environmental impacts, or potential environmental impacts, of spent fuel storage consistent with NEPA, the APA, and the AEA. Indeed, despite being titled "Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation," this proposed rule essentially evades meaningful environmental review of this important issue. The State of New York and the Commonwealth of Massachusetts have also challenged the NRC's refusal to undertake meaningful environmental review of spent fuel storage administratively and in federal court as well. *See State of New York, v. Nuclear Reg. Comm'n*, 08-3903-ag (2d Cir., Aug. 8, 2008); *Commonwealth of Massachusetts v. United States Nuclear Reg. Comm'n and United States of America*, 08-5571-ag (1st Cir. 2008); *see also Massachusetts v. NRC*, 522 F.2d 115 (1st Cir. 2008); August 13, 2007 State of New York Comments, PRM 51-13, Re: Proposed Amendment to 10 C.F.R. Part 51 rescinding finding that environmental impacts of pool storage of spent nuclear fuel are insignificant.

The proposed rule fails to satisfy the requirements of the AEA as well as NEPA because any generic decision to allow for the storage of additional spent reactor fuel and other radioactive waste must be accompanied by (1) thorough, supported, and well-documented safety findings, and (2) an EIS that fully assesses the environmental impacts of the uranium cycle, including health and

environmental impacts and costs; and that examines a reasonable array of alternatives, including the alternative of not producing any additional radioactive waste. *See State of Minnesota v. NRC*, 602 F.2d 412. The NRC 's proposed waste confidence decision update and this rulemaking, which rely on speculation instead of science, do not comply with these requirements.

A. Neither Table S-3, Nor Any Other NRC Analysis, Properly Evaluates the Environmental Impact of Turning Reactor Locations Around the Country Into High Level Waste Repositories

In the 1970s the NRC decided that licensing boards should assume, for purposes of NEPA, that the permanent storage of certain nuclear wastes would have no significant environmental impact (the so-called "zero-release" assumption) and thus should not affect the decision whether to license a particular nuclear power plant. In 1979, the NRC published its final Table S-3 rule. 44 Fed. Reg. 45362 *et seq.* (1979). Table S-3 is a numerical compilation of the NRC's estimates of resources used and effluents released by fuel cycle activities supporting a year's operation of a typical light-water reactor. The State of New York and the Natural Resources Defense Council challenged Table S-3 as violating NEPA and the APA in combined proceedings which were ultimately appealed to the United States Supreme Court. *See Baltimore Gas & Elec.* 462 U.S. 87. As the Supreme Court explained, the NRC in its Final S-3 Rule "summarized the major uncertainties of long-term storage of nuclear wastes, noted that the probability of intrusion was small, and found the evidence 'tentative but favorable' that an appropriate storage

site could be found." *Id.* at 94. The NRC adhered to the zero-release assumption in its final rule, confident that the solidified waste would not escape and harm the environment once the repository was sealed. The NRC acknowledged that this assumption was uncertain because of the "remote" possibility that water might enter the repository, which was then projected to be in a bedded-salt environment, dissolve the radioactive materials, and transport them to the biosphere. *Id.*

The Commenting States submit that some of the crucial bases upon which Table S-3 was created, and upheld by the Supreme Court – namely, that a repository location was certain and ascertainable, and that transuranic and high level nuclear waste would end up in the federal repository – have been eroded or abolished by subsequent developments. Specifically, (1) no site has been established, even twenty-five years after the Supreme Court considered and upheld Table S-3; (2) the NRC is currently evaluating only one repository location, which is not bedded-salt; and (3) the NRC is now seeking approval to store nuclear waste on-site – in perpetuity – as opposed to in a repository. In light of the lack of confidence in a repository nearly fifty years after the process began, and twenty-five years after *Baltimore Gas and Electric*, the NRC must now analyze what is actually happening: 104 reactor sites around the country are poised to become long-term high level waste repositories.

B. The 30-Year-Old Table S-3 Can No Longer Support the Commission's Current Policy Preference

Additionally, the Commenting States submit that in light of the foregoing,

Table S-3, and the bases upon which it was upheld by the Court, are obsolete and that the Table should be re-designed to take into account current conditions.

Now that it is apparent that there is little or no basis for NRC or the public to have confidence about the future of high level waste disposal, and that the NRC may force high level nuclear waste to remain at reactor sites indefinitely, there is no technical or scientific basis for using the generic approach in Table S-3 to address those impacts that are site specific and arise as a result of these changed circumstances. In particular, each nuclear power reactor site could now face the potential for a radiation release due to leakage or failure of on-site storage systems whose useful lives will have to go well-beyond the initially-envisioned 30-year window beyond the reactor's shutdown. Thus, the NRC must perform a Design Basis Threat ("DBT") Analysis and Severe Accident Mitigation Analysis ("SAMA"), and must analyze all potential impacts and alternatives for each nuclear plant. Similarly, off-site land impacts will now have to be considered for each plant with the focus on lost economic development potential and lost tax base increases caused by the indefinite storage of high level nuclear waste sites that will adversely impact land values. Finally, now that it is known that the bases upon which the initial waste confidence findings were made have not proven true, the NRC must prepare a supplemental environmental impact statement for every operating nuclear power plant, as well as for all plants seeking to increase their initial projected nuclear waste production, to include the site specific evaluations of impacts not previously considered. In short, NRC should no longer rely on the 30-year-old Table S-3 to

support its current waste disposal policy.

V. Comments on the Proposed Alternative Approach: The NRC's Confidence in Indefinite Storage is Unwarranted

In its Waste Confidence Decision Update, the NRC seeks specific comments on an alternative approach, revising Finding Two without a reference to a timeframe for the availability of a repository (73 Fed. Reg. at 59561), although the proposed Finding Two revision states reasonable assurance that repository capacity can reasonably be expected to be available within 50-60 years of the licensed life of a reactor. 73 Fed. Reg. at 59551. Yet in this rulemaking, the NRC deletes reference to a 50-60 year time period, and instead seeks to promulgate changes to 10 C.F.R. § 51.23 as though the alternative finding in the Waste Confidence Decision update already has public and industry support. This approach is premature and inappropriate until public comment has been received on the main proposed change to Finding Two and on its alternative.

Moreover, and most significantly, *neither* time period has any grounding in science or technology. The NRC has admitted that its original thirty-year time estimation was based on no scientific or technical facts, but instead on the period of time in which it expected a repository to be available. *See* 55 Fed. Reg. 38472. The NRC's reasoning – that because no problems significant in the NRC's eyes have occurred in the first licensing term of the first fleet of American nuclear reactors, no problems will occur no matter how long spent fuel remains on reactor sites – is antithetical to science, the laws of time, and common sense. For example, over an

indefinite period of storage the probability of a severe earthquake increases. Stated differently, the longer the waste is stored on-site, the greater the likelihood a site may experience an earthquake. This is but one example of the increasing risks and hazards posed by indefinite on-site storage. The NRC's alternative approach, which the NRC admits is unsubstantiated by science or technology, is arbitrary. Not only is there no basis for such unconditional confidence in the indefinite on-site or off-site storage of waste, but NRC must not "permanently postpone" an objective review of the environmental consequences of waste disposal.

VI. Conclusion

The Commenting States do not support proposed regulatory changes to 10 C.F.R. § 51.23 which are grounded neither in science nor law, contrary to the National Environmental Policy Act, the Atomic Energy Act, and the Administrative Procedure Act, and which ignore numerous instances of environmental harm from leaking spent fuel pools around the country. The Commenting States urge the NRC to require and perform a site-specific evaluation of the environmental impacts of spent fuel pool storage at each reactor location across the country, taking into account environmental factors including population density, water resources, seismicity, and subsurface geology.

Dated: February 6, 2009

Respectfully submitted,

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:

Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation

RIN 3150-AI47
NRC-2008-0482

COMMENTS SUBMITTED BY THE OFFICES OF THE ATTORNEYS GENERAL OF THE STATES OF NEW YORK AND VERMONT AND THE COMMONWEALTH OF MASSACHUSETTS CONCERNING THE NUCLEAR REGULATORY COMMISSION'S PROPOSED WASTE CONFIDENCE DECISION UPDATE

Submitted: February 6, 2009

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Table of Contents

Page

Table of Contents (cont'd)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:	
Waste Confidence Decision Update	NRC Docket ID 2008-0482

COMMENTS SUBMITTED BY THE OFFICE OF THE ATTORNEYS GENERAL OF THE STATES OF NEW YORK AND VERMONT AND THE COMMONWEALTH OF MASSACHUSETTS CONCERNING THE NUCLEAR REGULATORY COMMISSION'S PROPOSED WASTE CONFIDENCE DECISION UPDATE

The People of the States of New York and Vermont and the Commonwealth of Massachusetts, by their respective Attorneys General (together "the Commenting States") submit these comments regarding the Nuclear Regulatory Commission's ("NRC") proposed Waste Confidence Decision Update.

The State of New York's Interest in this Proceeding

The Waste Confidence Decision Update affects New York State's residents and natural resources. Attorney General Andrew M. Cuomo has taken the lead in opposing the relicensing of the Indian Point nuclear plants. The State of New York has identified serious concerns about the safety and environmental impacts of Indian Point Units 1, 2, and 3, and has set these concerns out in the State's Petition to Intervene in the United State Nuclear Regulatory Commission's proceeding to consider whether to renew the operating licenses for these plants. On July 31, 2008, the Atomic Safety and Licensing Board issued a decision admitting 11

contentions presented by the State for an evidentiary hearing. *See In the Matter of Entergy Nuclear Operations, Inc.*, ASLBP No. 07-858-03-LR-BD01, Memorandum and Order (July 31, 2008). The admitted contentions involve, among other things: weaknesses in the units' aging electrical and piping systems, reactor pressure vessel components, and containment dome; unauthorized radionuclide leaks from various components, and significant accident mitigation analyses. The State of New York has a strong interest in ensuring the safety of this and other nuclear power plants within its borders.

The State of Vermont's Interest in this Proceeding

The State of Vermont has a strong interest in the management of waste from nuclear plants. Vermont Yankee Nuclear Power Station is in Vermont and received its original operating license in 1973. The State of Vermont had one contention admitted in the recent license renewal case. *In the Matter of Entergy Nuclear Vermont Yankee, LLC*, ALSBP No. 06-849-03-LR. A second Vermont contention was rejected that contended that the applicant had failed to include new and significant information regarding the likelihood of spent fuel having to be stored onsite for longer than was evaluated in the Generic Environmental Impact Statement ("GEIS") and perhaps indefinitely. It was rejected on the basis of the current Waste Confidence Rule. Additionally, Vermont adopted certain admitted contentions submitted by the New England Coalition.

The Commonwealth of Massachusetts' Interest in this Proceeding

The Commonwealth of Massachusetts has a substantial interest in assuring the safe operation of nuclear power plants within or in proximity to its borders. The Commonwealth also recognizes that nuclear power should be a part of the region's energy portfolio so long as proper and adequate safety and environmental precautions are followed pursuant to the National Environmental Policy Act ("NEPA"), the Atomic Energy Act ("AEA"), and the Administrative Procedure Act ("APA"). Therefore, the Commonwealth has opposed efforts by the NRC to extend the licenses for the Pilgrim nuclear power plant, located in Plymouth, MA, and the Vermont Yankee nuclear power plant, located about ten miles from the Massachusetts border in Vernon, Vermont, unless and until the NRC properly addresses new and significant information on the risks of spent fuel pool storage at these facilities.[1] In each proceeding, the Commonwealth contended that the NRC's failure to address appropriately this new and significant information, including a 2001 report prepared by NRC staff, a report by the National Academy of Sciences, and a report prepared by the Commonwealth's own expert, violated NEPA, the

[1] *See* Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene with Respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Pilgrim Nuclear Power Plant Operating License (May 26, 2006) (No. 50-293-LR). ADAMS No. ML061630088 (Pilgrim Contention); *see also* Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene with Respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Vermont Yankee Nuclear Power Plant Operating License (May 26, 2006) (No. 50-271-LR). ADAMS No. ML061640065 (Vermont Yankee Contention).

APA, the AEA, and NRC implementing regulations. This information established that if a fuel pool were to suffer even a partial loss of cooling water, whether caused by terrorist attack, natural phenomena, equipment failure, or operator error, this could cause, over a wide range of scenarios, a catastrophic fire leading to a large atmospheric release of radioactive isotopes, extending beyond Massachusetts borders (Pilgrim) or across the border into Massachusetts communities (Vermont Yankee). In a separate expert report, the Commonwealth demonstrated that such a large atmospheric release could cause thousands of cases of cancer and billions of dollars in economic damage. *See Commonwealth v. NRC*, 522 F.3d 115, 122 – 123 (1st Cir. 2008).

In a parallel petition for rulemaking, the Commonwealth presented these same contentions regarding the risks of spent fuel pool storage and requested that the NRC revisit the conclusion of its 1996 License Renewal Generic Environmental Impact Statement that spent fuel storage poses no significant environmental impacts. *Commonwealth v. NRC*, 522 F. 3d at 123-124. Consistent with the U.S. Court of Appeals for the Ninth Circuit's decision in *San Luis Obispo Mothers for Peace v. NRC,* 449 F.3d 1016 (9th Cir. 2006), *cert. denied,* 127 S.Ct. 1124 (2007), the Commonwealth and other rulemaking supporters also requested the NRC to reverse its policy of refusing to consider the environmental impacts of intentional attacks on nuclear power plants. *See* 449 F. 3d at 1035.

Subsequently, the NRC denied the Commonwealth's rulemaking petition. *See* 73 Fed. Reg. 46204 (Aug. 8, 2008). That decision is now on appeal to federal

court. *See State of New York, Richard Blumenthal, Attorney General of Connecticut, Commonwealth of Massachusetts v. United States Nuclear Regulatory Commission and United States of America*, Docket Nos.: 08-3903-ag(L); 08-4833-ag (CON); 08-5571-ag (CON) (2d Cir. 2008).

I. Overview

Published for comment on October 9, 2008, the NRC in this proposed rule proposes to amend two of its five Waste Confidence findings, Finding Two relating to the timeframe in which a high-level waste repository will be available, and Finding Four relating to the timeframe for which high-level waste can safely and without significant environmental impacts be stored on-site. *See* 73 Fed. Reg. 59551 (Oct. 9, 2008). Specifically, the Commission seeks to amend Finding Two to establish reasonable assurances that a repository for high-level nuclear waste will be available within 50-60 years beyond the licensed life of a reactor, and to amend Finding Four to establish that if necessary, spent fuel can be stored safely on-site for at least 60 years beyond the licensed life of a reactor. The Commission also proposes and seeks comment on an alternative finding in this rulemaking, which would revise Finding Two to remove any reference to a time period; Finding Two would presumably be revised to say only that the Commission reasonably assures itself that a repository will become available someday.

The proposed rule is arbitrary, grounded neither in science nor law, contrary to NEPA, the AEA, and the APA, and ignores numerous instances of environmental harm from leaking spent fuel pools around the country.

A. Background on the Waste Confidence Findings

In 1984, the NRC issued a "Waste Confidence Decision" in response to a remand from the United States Court of Appeals for the District of Columbia Circuit in *State of Minnesota v. NRC*, 602 F.2d 412 (D.C. Cir. 1979), which raised the question of whether an off-site storage or disposal facility (*i.e.*, a repository) would be available for the spent nuclear fuel produced at two reactors at the expiration of their licenses or whether the spent nuclear fuel could be stored onsite until an off-site solution was available. The D.C. Circuit explained that

> It was anticipated, when most of the nuclear power plants now in operation in the United States were licensed, that spent fuel would be stored at the reactor site only long enough to allow the fuel assemblies to cool sufficiently to permit safe shipment off-site for reprocessing (the extraction from the rods of usable uranium and plutonium) or permanent disposal [and that] [s]pent fuel storage capacity at these plants is therefore limited.

Minnesota v. NRC, 602 F.2d at 413-14. Two facilities, Vermont Yankee in Vermont and Prairie Island in Minnesota, had applied for license amendments to allow for expanded on-site spent fuel pool storage in anticipation of filling their spent fuel pools to capacity, which would have happened by 1978 and 1982 respectively. *Id.* Intervenors argued that approval of expanded on-site storage could only be granted after analysis of environmental and safety implications. Staff in each licensing proceeding found, in part because the modifications would entail no increase in the amount of wastes annually generated by the reactor, "reasonable assurances" that the modifications would not endanger public health and safety, and that they satisfied the standards of the Atomic Energy Act and NRC regulations, and

concluded that NEPA did not require the preparation of environmental impact statements because the modifications would not "significantly affect the quality of the human environment," findings which were affirmed by the Atomic Safety and Licensing Appeal Board. *Id.* at 414-15. The D.C. Circuit found insufficient the Commission's "implicit" policy of a "reasonable assurance that methods of safe permanent disposal of high-level wastes can be available when they are needed" and remanded the issue to the Commission to undertake at least a generic rulemaking to establish such a policy. *Id.* at 417. The result was the 1984 Waste Confidence Decision.[2]

1. The 1984 Waste Confidence Findings

The 1984 Waste Confidence Decision established five findings designed to allow the continued licensing of nuclear power plants in the absence of an existing repository for high level nuclear waste. Those findings were:

> (1) The Commission finds reasonable assurance that safe disposal of HLW [high level nuclear waste] and SNF [spent nuclear fuel] in a mined geologic repository is technically feasible;
>
> (2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial HLW and SNF will be available by the years 2007-2009, and that sufficient repository capacity will be available within 30 years beyond the expiration of any reactor operating license to dispose of existing commercial HLW and SNF originating in such reactor and generated up to that time;
>
> (3) The Commission finds reasonable assurance that HLW and SNF will be managed in a safe manner until sufficient repository

[2] Ironically, radionuclide contamination was subsequently found in Prairie Island's groundwater. *See* NUREG 1437, Vol. 1, Sec. 4.8.2.

capacity is available to assure the safe disposal of all HLW and SNF;

(4) The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations (ISFSIs);

(5) The Commission finds reasonable assurance that safe independent onsite or offsite spent fuel storage will be made available if such storage capacity is needed.

49 Fed. Reg. 34658 (Aug. 31, 1984). Based on these findings, the Commission amended 10 CFR Part 51 (specifically, it added 10 C.F.R. § 51.23(a)) to say that the environmental impacts of at-reactor storage after the termination of reactor operating licenses need not be considered in Commission proceedings related to issuance or amendment of a reactor operating license.

2. 1990 Revisions to the Waste Confidence Findings

In 1990, the NRC issued a decision revising affirming in general the findings but revising Findings Two and Four to reflect new dates of availability of the first repository and to clarify that, in Finding Four, the expiration of a reactor's operating license referred to the full 40 year initial license as well as any revised or renewed licensing term. Following these revisions, Finding Two then read:

> The Commission finds reasonable assurance that at least one mined geologic repository will be available *within the first quarter of the twenty-first century*, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of an reactor to dispose of the commercial HLW and SNF originating in such reactor and generated up to that time."

(Emphasis added to show revisions from the 1984 rule). 55 Fed. Reg. 38474 (Sept. 18, 1990). Finding Four was amended to read:

> The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (*which may include the term of a revised or renewed license*) of that reactor at its spent fuel storage basin, or at either onsite of offsite ISFSIs.

(Emphasis added to show revisions from the 1984 rule). *Id.* The Commission revised 10 C.F.R. § 51.23(a) to conform to these revisions. *See* 55 Fed. Reg. 38472 (Sept. 18, 1990).

The Commission, in 1999, again confirmed these findings and stated that it would consider undertaking a reevaluation of the Waste Confidence Decision if, *inter alia,* significant and pertinent unexpected events occur, raising substantial doubt about the Decision's continued viability. 64 Fed. Reg. 68005 (Dec. 6, 1999).

B. The Current Waste Confidence Decision Update

The NRC is now taking a "fresh look" at the Waste Confidence findings, although it is not reopening the findings pursuant to its 1999 criteria, in anticipation of significant number of applications for new reactors. 73 Fed. Reg. at 59553. Specifically, the NRC seeks to amend Finding Two again, this time to read that

> The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonable be expected to be available *within 50-60 years beyond the licensed life for operation* (which may include the term of a revised or renewed license) of any reactor to

> dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time.

73 Fed. Reg. at 59551 (emphasis added to show proposed changes). The Commission also seeks to amend Finding Four again, to read that

> The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely without significant environmental impacts *for at least 60 years* beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations.

73 Fed. Reg. at 59551 (emphasis added to show proposed changes).

C. The NRC's Affiliated Rulemaking Regarding Temporary Storage of Spent Fuel

On the same day that it published the proposed Waste Confidence Decision Update, the NRC published a proposed rule which would amend 10 C.F.R. § 51.23(a) to say that if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin either onsite or at offsite independent spent fuel storage installations. 73 Fed. Reg. 59547 (Oct. 9, 2008). The Commenting States are submitting comments on that proposed rule under separate cover.

II. The NRC Lacks a Reasonable Basis To Support Its Findings That Radioactive Waste Generated By Nuclear Power Plants Can Be Safely Disposed Of

The Waste Confidence proceedings were initiated to "assess [the] degree of assurance that radioactive wastes produced by nuclear power plants can be safely

disposed of, to determine when such disposal or offsite storage will be available, and to determine whether radioactive wastes can be safely stored onsite past the expiration of existing facility licenses until offsite disposal or storage is available." 73 Fed. Reg. 59552.

The NRC's restatement of three Waste Confidence findings and revision of two others is not grounded in fact. Events that have occurred since these findings were issued demonstrate that the initial findings were in error, and undercut any basis to make similar findings at this time. The NRC, despite decades of inaction on waste storage, seeks the public's support yet again of unsupported statements with potentially devastating consequences should the NRC's optimistic findings prove incorrect. Federal agencies have had a long history of attempts to develop safe, permanent radioactive waste disposal, dating back to the 1950s.[3] There is no scientific or technical basis to the NRC's proposed findings, and the NRC lacks a reasonable basis to reasonably ensure that radioactive wastes produced by nuclear power plants can be safely disposed of, especially for an indefinite period of time on-site.

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[3] *See* In the Matter of Proposed Rulemaking on Storage and Disposal of Nuclear Waste, 10 CFR Parts 50 and 51 (Waste Confidence Rulemakings), PR-50, 51 (44 F.R. 61372), Statement of Position of Robert Abrams, Attorney General of the State of New York (July 7, 1980) ("1980 NY Statement of Position") at 9-14. As this filing explained, there is no factual basis for confidence either that nuclear waste will be safely disposed of by any given date or that it will be safely stored indefinitely until it is disposed of safely. *See* 1980 NY Statement of Position. The State of New York maintains the same position today. As Attorney General Abrams stated nearly thirty years ago, "[c]onfidence cannot be predicated on hope." *Id.* at 2.

A. The NRC Lacks a Reasonable Basis For Its Finding That Sufficient Mined Geologic Repository Capacity Can Reasonably Expected to Be Available (Waste Confidence Finding Two)

Current facts prevent the Commenting States from being reasonably assured that "sufficient mined geologic repository capacity can reasonably be expected to be available within 50–60 years beyond the licensed life for operation" of the nation's 104 operating reactors, as Finding Two requires. Here are the facts:

- Today, DOE facilities have already generated 12,800 tons of waste, and power reactors have generated 58,000 tons, which increases by approximately 2,000 tons per year. The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, December 2008, at 5.

- DOE estimates that total waste generated by the current fleet of operating reactors will total between 109,300 and 130,000 tons, depending on how many reactors are granted extended licenses. *Id.*

- Yucca Mountain is the country's only repository currently undergoing licensing proceedings, and it is statutorily limited to hold only 77,000 tons of waste.

See National Waste Policy Act of 1982, Public Law 97–425, 42 U.S.C. 10101 *et seq.*, § 114(d). But in November, 2008, the head of DOE's civilian nuclear waste program told Congress that within two years – that is, by 2010 – the amount of waste produced by the country's 104 nuclear power plants plus defense waste will exceed 77,000 tons. *See* The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, December 2008. DOE called on Congress to remove the 77,000 ton limit of Yucca Mountain, noting that the 77,000 ton limit is not based on any technical considerations related to Yucca Mountain.

See The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, December 2008. Moreover, Yucca Mountain's future as a repository site is not certain, and, as the NRC notes in its Federal Register notice, the NWPA bars DOE from investigating any other potential site until the resolution of the Yucca Mountain siting proceeding. 73 Fed. Reg. 59551, 59555. If Yucca Mountain is found not to be a suitable site for a repository, this would leave the country – in 2009, almost sixty years after the federal government's search for a repository began – with no agreed-upon site at all. Should that be the case, the federal government would have to begin the process of locating a suitable repository site again, which has been unsuccessful despite a half-century of trying.

These facts do not inspire confidence in the public that "sufficient mined geologic repository capacity can reasonably be expected to be available within 50–60 years beyond the licensed life for operation" of the nation's 104 operating reactors.

B. The NRC Lacks a Reasonable Basis for Its Finding That Spent Fuel from Reactors Within the States' Borders Can Be Stored Safely for At Least 60 Years, Or More, Beyond the Licensed Life for Operation (Waste Confidence Finding Four)

As New York argued in 1980, there is no basis for confidence that spent fuel can be stored safely without significant environmental impacts either onsite or offsite for the length of time proposed by the NRC. *See* 1980 NY Statement of Position at 102. Just as there was no basis for confidence then, there is no basis for confidence now that spent fuel from reactors within the States' borders can be

stored safely for at least 60 years beyond the licensed life of the reactors (or, under the NRC's alternate proposal, indefinitely), in either onsite or offsite spent fuel installations.

1. The Premise Upon Which the Original Waste Confidence Finding Four Was Based Has Not Been Substantiated

In concluding that spent fuel can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of a reactor's operating license, the Commission considered four major issues: (1) the long-term integrity of spent fuel under water pool storage conditions, (2) structure and component safety for extended facility operation, (3) the safety of dry storage, and (4) potential risks of accidents and acts of sabotage at spent fuel storage facilities. 49 Fed. Reg. 34658. The Commenting States believe that occurrences over the last twenty-two years undermine at least two prongs of this analysis.

a. Leaking Spent Fuel Pools at Facilities Around the Country, Which Have Contaminated Groundwater and Public Waterways, Call Into Question the Integrity of Spent Fuel Under Water Storage Conditions

Recent reports by the National Academy of Sciences, the NRC's own technical staff and independent experts contradict the NRC's assertion that high-density fuel storage pools pose no significant environmental risk.[4] Instead, these studies show

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[4]*See, e.g.*, NUREG-1738, Final Technical Study of 1 Spent Fuel Pool Accident Risk and Decommissioning Nuclear Power Plants (NRC: January 2001); National Academy of Sciences Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, Safety and Security of Commercial Spent Nuclear Fuel Storage (The National Academies Press: 2006); Gordon Thompson, Risks and Risk-

(continued...)

that absent proper safety precautions, fuel storage pools are potentially susceptible to fire and radiological release from a wide range of conditions, including natural phenomena, operator error, equipment failure, or intentional attack.

In its 1990 rulemaking, the Commission determined that:

> experience with water storage of [spent nuclear fuel] continued to confirm that pool storage is a benign environment for [spent nuclear fuel] that does not lead to significant degradation of spent fuel integrity; that the water pools in which the assemblies are stored will remain safe for extended periods; and that degradation mechanisms are well understood and allow time for appropriate remedial action.

73 Fed. Reg. at 59548. However, spent fuel pools at multiple reactors around the country have, since the original Waste Confidence Decision and even since the 1990 rulemaking, leaked radioactive water into the subsurface.

Indian Point Unit Two

In August 2005, the licensee (Entergy) discovered a leak in the spent fuel pool at Unit 2, and further investigation revealed tritium in onsite ground water. Based on hydrological information and sample analyses of monitoring wells, Entergy has admitted that some contaminated ground water likely will, or has migrated to the Hudson River. *See* Indian Point Energy Center License Renewal

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[4](...continued)
Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants (May 25, 2006); Jan Beyea, Report to the Massachusetts Attorney General on the Potential Consequences of a Spent-fuel Pool Fire at the Pilgrim or Vermont Yankee Nuclear Plant (May 25, 2006); Jan Beyea, Report to the Massachusetts Attorney General on the Potential Consequences of a Spent-fuel Pool Fire at the Pilgrim or Vermont Yankee Nuclear Plant (May 25, 2006).

Application, Appendix E, Applicant's Environmental Report (May 2007) ("Indian Point LRA Environmental Report"), at 5-4.

Indian Point Unit One

In addition to the detection of tritium, the radionuclides nickel-63, cesium-137, strontium-90, and cobalt-60 have been detected onsite at Indian Point, which appear to have come from leakage in the Unit 1 spent fuel pool, which has been permanently shut down since 1974, but whose spent fuel pool still contained expended fuel and radioactive water until late 2008. Liquid Radioactive Release Lessons Learned Task Force Final Report (Sept. 1, 2006) ("Lessons Learned Report") at 5-6. Radioactive fluid which escaped that pool still exists in groundwater and in the subsurface geologic formations. Hydrogeologic Site Investigation Report for the Indian Point Energy Center, GZA GeoEnvironmental, Inc. (Jan. 7, 2008).

These two sets of leaks may have existed for five to ten years before Entergy identified them in 2005 (Indian Point LRA Environmental Report at 5-5), undermining the NRC's statement that "degradation mechanisms are well understood and allow time for appropriate remedial action." 73 Fed. Reg. at 59548.

Brookhaven National Laboratories

In January 1997, ground water samples taken by Brookhaven National Laboratories ("BNL") staff revealed concentrations of tritium that were twice the allowable federal drinking water standards, and some samples taken later were 32 times the standard. *See* General Accounting Office, Information on the

Tritium Leak and Contractor Dismissal at the Brookhaven National Laboratory (GAO/RCED-98-26) (Nov. 1997), at 1. The tritium was found to be leaking from the laboratory's High Flux Beam Reactor's spent-fuel pool into the aquifer that provides drinking water for nearby Suffolk County residents. *Id.* The Department of Energy (DOE) and BNL's investigation of this incident concluded that the tritium had been leaking for as long as 12 years without DOE's or BNL's knowledge. *Id.* A subsequent federal government investigation concluded that Brookhaven employees did not aggressively monitor its reactor's spent-fuel pool for leaks – even going so far as to postpone an agreed-upon monitoring well system – so years passed before tritium contamination was discovered in the aquifer near the spent-fuel pool. *Id.* at 2.

Seabrook

In June 1999, the operator of the Seabrook power plant measured elevated tritium concentrations in the sump during routine monitoring. The licensee identified that the tritium activity was associated with an input to the sump from the Containment Annulus. Seabrook's investigation identified the source of the tritium leakage to be from a defect in the liner of the cask loading pool, which is connected to the fuel transfer canal in the Fuel Handling Building. Seabrook detected a maximum tritium concentration of about 750,000 pCi/L in a sample of non-potable water collected from the annulus sump in close proximity to the location of the leak.

Point Beach

Also in 1999, tritium and other radionuclides were identified near a retention pond at the Point Beach Nuclear Power Plant, near Manitowoc, Wisconsin. Tritium concentration in sand lenses in the top twelve feet of soil around the former retention pond ranged from 177 to 14,250 pCi/L. Tritium, which originated from leaks from the former retention pond, has been detected in these streams in concentrations ranging from the minimum detectable activity levels of about 200 pCi/L up to 400 pCi/L.

Salem

On September 18, 2002, the operator of the Salem Nuclear Station in Delaware found that Unit 1 Spent Fuel Pool water had leaked into a narrow seismic gap between the Unit 1 Auxiliary Building and Unit 1 Fuel Handling Building, and entered the Mechanical Penetration Room. Further licensee investigation identified tritium contamination in non-potable ground water near the Unit 1 fuel handling building. Maximum tritium levels of 15,000,000 pCi/L were identified in the ground water near the seismic gap. Lessons Learned Report at 7-8.

These pools leaked during the reactors' initial licensing term, calling into question the possibility for compromised structural integrity of spent fuel pools as many reactors around the country seek, and are granted, license renewals.

The NRC was sufficiently concerned about these occurrences that it conducted a study in 2006. *See* Lessons Learned Report. The NRC noted in its report on tritium releases that "[m]any of the releases reviewed varied significantly

in methods for estimating and/or monitoring the source term in surface or ground water, predicting or monitoring the distribution of the radionuclide concentrations in the environment through time, and subsequently evaluating current and future dose impacts to the general public or offsite areas. Lessons Learned Report at 13. The NRC has acknowledged that "it lacks regulatory guidance for monitoring and evaluating both the immediate and long-term offsite dose or environmental impact of these inadvertent releases." Lessons Learned Report at 13. There is currently no mandatory groundwater testing requirement in place, only an industry-created voluntary initiative. Lessons Learned Report at iii, 33. The NRC concluded that "systems or structures that are buried or that are in contact with soil, such as [spent fuel pools] ... are particularly susceptible to undetected leakage." Lessons Learned Report at 26. Indeed, NRC concluded that "[spent fuel pool] performance deficiencies are not specifically addressed in the NRC inspection program significance determination process." *Id.*

Yet despite these well-documented unplanned releases, the NRC states in its proposed rule that "[n]othing has occurred ... which calls into question the Commission's confidence in the safety of both wet and dry storage of [spent nuclear fuel] in the normal operation of spent fuel pools. ..." 73 Fed. Reg. at 59548. The Commenting States urge the Commission to consider the increasing frequency of spent fuel pool leaks as evidence "calling into question the Commission's confidence in the safety of both wet and dry storage of [spent nuclear fuel] in the normal operation of spent fuel pools."

Moreover, apart from unintended releases from degradation or other unforeseen problems, increased on-site storage also increases the opportunity for human error resulting in unauthorized releases. The NRC discussed numerous unplanned leaks that occurred because of human error in its Lessons Learned Report. *See* Lessons Learned Report at 34. The Brookhaven example detailed above, in which a federal government investigation concluded that Brookhaven employees did not aggressively monitor its reactor's spent-fuel pool for leaks, resulting in groundwater contamination that had been going on for twelve years, undetected, is one example of human error resulting in radioactive contamination in relation to spent fuel. Other examples include the Hatch facility in 1986, where "licensee personnel did not follow valving procedures for operating spent fuel pool canal seals which resulted in an unmonitored, unplanned release of spent fuel pool water to the onsite environment including a swamp area. The licensee experienced a spill of water (141,000 gallons) containing an estimated 0.20 curies of tritium and 0.373 curies of mixed fission product activity." *Id.* In March, 1991, in an event the NRC considered "serious" at the James A. FitzPatrick facility in Western New York, "licensee personnel did not follow valving procedures for a radioactive waste concentrator which cross-contaminated the auxiliary boiler and caused an airborne radioactivity release (steam plume) from the boiler. This resulted in deposition of onsite contamination and release of contaminated water from a storm drain. An estimated 0.4 to 1.5 curies of mixed fission and activation product activity was released from the boiler, of which an estimated 0.03 to 0.05 curies was released

from the site via a storm drain." *Id.* At the Hope Creek Station in April 1995, in an event the NRC characterized as "of significant regulatory concern," licensee personnel "did not correctly operate a radioactive waste concentrator which caused an airborne radioactivity release resulting in onsite contamination. An estimated 25 gallons of contaminated water, containing approximately 0.085 curies of mixed activation products, was released." *Id.* These examples show the potential for human error in operations relating to nuclear waste that can result in unplanned releases.

Given the increasing number of leaking spent fuel pools around the country, and the lack of monitoring requirements or guidelines for spent fuel pool leaks, a blank check authorization to store spent fuel onsite with no site-specific environmental review is inappropriate, and is in violation of NEPA, the APA, and the AEA.

b. Recent Events Should Undermine the NRC's Confidence in the Potential Risks of Accidents and Acts of Sabotage at Spent Fuel Storage Facilities.

i. Accidents

The recent July 16, 2007 earthquake in Niigata Province, Japan, which damaged the world's largest nuclear power plant, tipped over storage drums, and released radioactive material into the environment, further demonstrates the vulnerability of nuclear plants to natural forces. *See* Martin Fackler, *Japan Nuclear-Site Damage Worse Than Reported,* N.Y. TIMES (July 19, 2007), *available at* http://www.nytimes.com/2007/07/19/world/asia/19japan.html; THE ASAHI SHIMBUN,

Radioactive Water Likely Flowed via Electric Cables after Earthquake (July 23, 2007).

Seismic issues are potentially problematic at a number of power reactor locations across the United States. Seismologists at Columbia University's Lamont-Doherty Earth Observatory, in August of 2008, published the results of their study on earthquakes in the greater New York City Area, indicating the existence of a new fault line that could "significantly increase" the probability of an earthquake in the greater New York City Area. Lynn R. Sykes, John G. Armbruster, Won-Young Kim, and Leonardo Seeber, *Observations and Tectonic Setting of Historic and Instrumentally Located Earthquakes in the Greater New York City–Philadelphia Area*, Bulletin of the Seismological Society of America, Vol. 98, No. 4, pp. 1696–1719 (Aug. 2008). More significantly, the study found that the Indian Point nuclear power plants sit at the previously unidentified intersection of two active seismic zones. *Id.* The study also found that historic activity of earthquakes of a magnitude more than 5 has been higher in southeastern New York than in many other areas of the central and eastern United States, and that the fault lengths and stresses suggest magnitude-6 quakes, or even 7 – which would be 10 and 100 times bigger than magnitude 5 – are "quite possible." *Id; see also* Robert Roy Britt, *Large Earthquake Could Strike New York City* (Aug. 21, 2008), *available at* http://www.livescience.com/environment/080821-new-york-earthquakes.html.[5]

[5] The report correctly states that "[m]uch new seismological information (continued...)

An magnitude 5.2 earthquake, with aftershocks registering 4.6, shook the D.C. Cook and Palisades reactors in Michigan in April of 2008. *See* PNO-III-08-004A, Preliminary Notification of Event or Unusual Occurrence (Apr. 18, 2008), ML081090639. The PNO about this unusual occurrence noted that several other Region III and Region IV nuclear power reactors experienced seismic activity from the initial earthquake and the aftershock as well. *Id.* Given the differing seismology of various plants around the country, a generic determination of environmental safety for potentially long-term on-site storage of spent fuel is inappropriate, and is in violation of NEPA, the APA, and the AEA.

ii. Acts of Sabotage

Aside from accidents, spent fuel storage pools may be potentially susceptible to fire and radiological release from intentional attacks if the NRC and licensees fail to take measures to protect against such attacks. National Research Council of the National Academies, *Safety and Security of Commercial Spent Nuclear Fuel Storage*: Public Report 17, 40 (2006). On September 11, 2001, terrorists hijacked four jet airliners and crashed three of them into their intended targets. The impact of the fuel-laden planes caused explosions and large, long-lasting fires. Those explosions and fires destroyed a portion of the Pentagon in northern Virginia and caused the

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[5](...continued)
is available since their initial approvals in 1973 and 1975. Nevertheless, the U.S. Nuclear Regulatory Commission so far has not permitted any new information to be used or old information on which the original licenses were based to be contested in considering extensions of licenses." *Id.* at 1717.

collapse of the World Trade Center towers and nearby buildings in New York City. *See* Nat'l Comm'n on Terrorist Attacks Upon the U.S. ("9/11 Commission"), *The 9/11 Commission Report* (2004).

Two of the hijacked planes flew near or over Indian Point, a nuclear power plant located on the Hudson River twenty-four miles north of New York City. *See id.* at 32. The wind direction at the time of the attacks was towards the southeast — that is, from Indian Point towards New York City. *See id.* at 285. Extrapolating from 2000 census information, more than seventeen million people live within fifty miles of the Indian Point reactors and spent fuel pools. *See* Edwin Lyman, *Chernobyl on the Hudson? The Health & Economic Impacts of a Terrorist Attack at the Indian Point Nuclear Plant* 23 (2004).

The 9/11 Commission's report revealed that Khalid Sheikh Mohammad, the mastermind of the 9/11 attacks, originally planned to hijack additional aircraft to crash into targets on both coasts, including nuclear power plants. *The 9/11 Commission Report*, at 154. As late as July 2001, the terrorists were considering attacking a specific nuclear facility in New York, which one of the pilots "had seen during familiarization flights near New York." *Id.* at 245. This was most likely Indian Point.

In the years since 9/11, the federal government has repeatedly acknowledged that there is a credible threat of intentional attacks on nuclear power plants, including the specific threat of an aircraft attack. For instance:

- On January 23, 2002, the NRC issued an alert to the nation's nuclear power plants warning of the potential for an attack by terrorists who planned to crash a hijacked airliner into a nuclear facility. Kenneth R. Bazinet & Richard Sisk, *Plant Attacks Feared*, N.Y. DAILY NEWS (Feb. 1, 2002), at 5, *available at* 2002 WL 3165383.

- In his 2002 State of the Union address, President Bush stated that "diagrams of American nuclear power plants" had been found in Afghanistan, suggesting that Al-Qaeda may have been planning attacks on those facilities. *The President's State of the Union Address* (Jan. 29, 2002), *available at* http://www.pbs.org/newshour/bb/white_house/sotu2002/sotu_text.html.

- On May 14, 2002, Gordon Johndroe, a spokesman for the Office of Homeland Security, noted that "we know that Al-Qaeda has been gathering information and looking at nuclear facilities and other critical infrastructure as potential targets." Bill Gertz, *Security Boosted at Nuke Facilities*, WASH. TIMES (May 14, 2002), *available at* http://www.ohiocitizen.org/campaigns/electric/pre2003/boosted.htm.

- On May 24, 2002, the NRC reported that the nation's nuclear power plants had been placed on heightened alert as a result of information gained by the intelligence community. *Wide-Ranging New Terror Alerts*, CBS News.com (May 26, 2002), *available at* http://www.cbsnews.com/stories/2002/05/24/attack/main510054.shtml.

- On November 15, 2002, the FBI sent a bulletin to law enforcement agencies, warning them that Al-Qaeda's "highest priority targets remain within the aviation, petroleum, and nuclear sectors." *Text of FBI Terror Warning*, CBSNews.com (Nov. 15, 2002), *available at* http://www.cbsnews.com/stories/2002/11/15/attack/main529501.shtml.

- On May 1, 2003, the FBI issued a Threat Communication warning the nuclear plant operators to remain vigilant about suspicious activity that could signal a potential terrorist attack. *FBI Warns of Nuke Plant Danger*, CBS News.com (May 1, 2003), *available at* http://www.cbsnews.com/stories/2003/09/04/attack/main571556.shtml.

- On September 4, 2003, the United States General Accounting Office ("GAO") issued a report noting that the nation's commercial nuclear power plants are possible terrorist targets and criticizing the NRC's oversight and regulation of nuclear power plant security. GAO, *Nuclear Regulatory Commission: Oversight of Security at Commercial Nuclear Power Plants Needs to Be Strengthened*, GAO-03-752 (2003); *see also* GAO, Testimony Before the Subcomm. on Nat'l Security, Emerging Threats, & Int'l Relations, House Comm. on Gov't Reform, *Nuclear Power Plants Have Upgraded Security, But the NRC Needs to Improve Its Process for Revising the DBT*, GAO-06-555T, at 1 (2006) (stating that, "[a]ccording to the [NRC] . . . , there continues to be a general credible threat of a terrorist attack on the nation's commercial nuclear power plants, in particular by al Qaeda and like-minded Islamic terrorist groups").

- On July 1, 2004, the FBI issued a bulletin to 18,000 law enforcement agencies nationwide warning that recent intelligence continued to show al-Qaeda's interest in attacking a range of facilities, including nuclear plants. *FBI's 4th Warning*, CBSNews.com (July 2, 2004), available at http://www.cbsnews.com/stories/2004/07/08/national/printable628204.shtml.

- On July 11, 2007, the NRC amended the operating license for Indian Point Unit 3 to require the licensee to address large fires and explosions including those caused by planes. Indian Point Unit 3 Operating License, DPR-64, Condition AC, Mitigation Strategy License Condition (July 11, 2007), ML052720273, at 8.

In 2005, the National Academy of Sciences released a report from a study it conducted at the request of Congress, with the sponsorship of the NRC and the Department of Homeland Security, of the security risks posed by the storage of spent fuel at nuclear plant sites. *See* Nat'l Acad. of Scis., *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report* (2006). Based upon information provided by the NRC, the National Academy of Sciences judged that "attacks with civilian aircraft remain a credible threat." *Id.* at 30. It noted that

terrorists might choose to attack spent fuel pools because they are "less well protected structurally than reactor cores" and "typically contain inventories of medium- and long-lived radionuclides that are several times greater than those contained in individual reactor cores." *Id.* at 36. The National Academy of Sciences concluded that the storage pools are susceptible to fire and radiological release from a wide range of conditions, including intentional attacks with large civilian aircraft. *Id.* at 49, 57. Similarly, the German Reactor Safety Organization, a scientific-technical research group that works primarily for nuclear regulators in Germany, found that large jetliners crashing into nuclear facilities under a variety of scenarios could cause uncontrollable situations and the release of radiation. German Reactor Safety Org., *Protection of German Nuclear Power Plants Against the Background of the Terrorist Attacks in the U.S. on Sept. 11, 2001* (Nov. 27, 2002), *translation available at* http://www.greenpeace.org/raw/content/ international/press/reports/ protection-of-german-nuclear-p.2.pdf.

Nuclear power plants in the United States, all of which were designed and built between the 1950s and 1980s, were not intended to withstand the impact of aircraft crashes or explosive forces. *See* 2/22/06 Comments of Nuclear Energy Institute to NRC in RIN 3150-AH60, at Enclosure 2, p. 10; *NRC: Nuclear Power Plants Not Protected Against Air Crashes*, Associated Press (Mar. 28, 2002); Director's Decision Under 10 CFR 2.206, at 12, *In the Matter of All Nuclear Power Reactor Licensees*, DD-02-04 (Nov. 1, 2002), *available at* http://www.nrc.gov/ reading-rm/doc-collections/petitions-2-206/ directors-decision/2002/ml022890031.pdf.

The NRC does not currently require existing nuclear power plants to develop protections against airborne attacks prior to the events of September 11, 2001. The NRC previously found the risks acceptable because of the low probability that an aircraft would *accidentally* hit a nuclear power plant. *See, e.g.,* Power Authority of the State of New York and Consolidated Edison Company, *Indian Point Probabilistic Safety Study* (1982) at 7.6-6 (concluding that the probability of an accidental crash was sufficiently low as to "present no significant hazard"). The NRC did not consider – or considered it extremely unlikely – that anyone would deliberately crash an airplane into a nuclear power plant.

Under current storage practices, the indefinite storage of spent nuclear fuel at power reactor sites long after the reactors have ceased power generation poses significant potential hazards. For example, in terms of volume there will be more spent fuel present after the end of power generation operations than during such power generation when such waste is still being generated and accumulating. Thus, the volume of any release of spent fuel could conceivably be greater during a post-operation phase. Also, by postponing the removal of waste from power reactor sites, NRC's proposed action essentially will extend the duration of the existence of such potential hazard at reactor sites.

In the aftermath of the September 11 attacks and other new and significant information, the NRC's outdated conclusion – that fuel pool storage risks are insignificant – is no longer defensible.

2. Given That the Premise Upon Which the Original Waste Confidence Finding Four Was Based Has Not Been Substantiated, Site-Specific Environmental Review of Each Reactor is Required

In light of the above information, the Commenting States object to the NRC's generic finding of safety in relation to temporary storage of nuclear waste. Instead, the Commenting States submit that site-by-site analysis of the potential for environmental impacts is appropriate, and required by the National Environmental Policy Act, given different security risks, seismic conditions, population densities, licensing periods, and differing histories of leaks at each of the nation's facilities. Moreover, the Commenting States submit that consideration of the quantity of waste generated in the renewed licensing term should be considered at license renewal, and urges the NRC to undertake a revision of 10 C.F.R. § 51.23(b) to implement this change. License renewals should consider – if not hinge upon – the facility's ability to store, for the indefinite period of time NRC foresees, all of the facility's spent nuclear fuel.

III. Federal Agency Reliance on Unsubstantiated Promises is Inappropriate in the Context of Nuclear Safety

The NRC and affiliated federal agencies addressing the problem of nuclear waste storage have failed on numerous occasions to follow through with date-certain commitments so many times that the public can no longer have any confidence in dates-certain at all.

The Atomic Energy Commission made "definite" the choice of a repository at Lyons in 1971, and said that Lyons could receive waste by 1975. The project was

aborted several months later. 1980 NY Statement of Position at 10. Then in the 1970s Carlsbad was chosen, and DOE predicted that a repository at Carlsbad would be available by 1978. *Id.* at 11. Then the Energy Research and Development Administration ("ERDA") told Congress that permanent storage of waste in salt would occur by 1985. ERDA told Congress a repository site would be chosen by 1978, and then 1979. *Id.* at 12. No site was chosen by 1978 or 1979. The NRC then promulgated its Waste Confidence Findings, which said that a repository would be ready by 2007. 49 Fed. Reg. 34658. When that failed to occur, the NRC then revised the Waste Confidence Rule to say that a repository would be available by 2025 ("within the first quarter of the twenty-first century."). Because that date will not be met either, the NRC once again asks the public to be confident – with no basis other than decades of failed assurances – that a repository will be chosen within 50-60 years of the end of the licensed life of a facility. In relation to the potential extended operational life of the nation's oldest reactor, Oyster Creek, the NRC asks for public confidence that spent fuel be stored safely –"temporarily" – at Oyster Creek until 2089, 129 years from the date of the facility's original license.

The NRC has realized how unsubstantiated its estimated dates are, and likely to remedy this problem, now proposes deleting any reference to dates-certain at all, asking the public to believe that despite decades of incomplete attempts to secure a repository location, one will nevertheless be chosen at some unknown date, and that until then – until that unknown date – spent nuclear fuel will be safe either on-site, at nuclear facilities which are unprepared to house the waste long-term, or at

undiscussed and nonexistent off-site locations. This alternative is speculative and unfounded.

IV. Comments on the Proposed Alternative Approach: The NRC's Confidence in Indefinite Storage is Unwarranted

The NRC seeks specific comments on an alternative approach, revising Finding Two without a reference to a timeframe for the availability of a repository.

As an initial matter, although the NRC proposes this as an "alternative" finding in the Waste Confidence Rule, it proposes to promulgate changes to 10 C.F.R. § 51.23 as though this has already been accepted. 73 Fed. Reg. at 59550. This is premature and inappropriate, as the public has not yet commented on the proposed 60-year time period for "temporary" storage, let alone indefinite storage. The Commenting States have provided additional comments alternative, indefinite approach in their accompanying comments on the NRC's Proposed Rulemaking Concerning Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation.

V. The NRC's Waste Confidence Decision Update Fails to Comply with NEPA and the AEA

NEPA, 42 U.S.C. §§ 4321-4347, and the implementing regulations adopted by the Council on Environmental Quality ("CEQ"), 40 C.F.R. Parts 1500-1508, place upon the NRC the obligation to consider every significant aspect of the environmental impact of a proposed action and ensures that the Commission will inform the public that it has indeed considered environmental concerns in its decisionmaking process. *Baltimore Gas & Elec. Co. v. Natural Res. Def. Counsel,*

Inc., 462 U.S. 87, 97 (1983). The NRC's Waste Confidence Decision Update, like its 1984 and 1990 predecessors, fails to comply with NEPA and the AEA.

Following NEPA's passage, CEQ promulgated regulations for Environmental Assessments, which are developed during a preliminary step in the environmental review process. *See* 40 C.F.R. § 1508.9. Environmental Assessments should "[b]riefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact." (40 C.F.R. § 1508.9(a)(1)) and identify alternatives to the proposed action (40 C.F.R. § 1508.9(b)). The NRC never published, and does not publish here, an Environmental Assessment of any kind.

Similarly, NRC has failed to meet CEQ's requirements for making a finding of no significant impact. 40 C.F.R. § 1508.13 defines a finding of no significant impact as:

> a document by a Federal agency briefly presenting the reasons why an action ... will not have a significant effect on the human environment and for which an environmental impact statement therefore will not be prepared. It shall include the environmental assessment or a summary of it and shall note any other environmental documents related to it. If the assessment is included, the finding need not repeat any of the discussion in the assessment but may incorporate it by reference.

40 C.F.R. § 1508.13. NRC never published a proper finding of no significant impact despite attempting, in Finding Four, to propose a finding of no significant impact that spent fuel can be stored for at least 30 years beyond the expiration of that reactor's operating license at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations, but it does so without

giving any evidence or analysis whatsoever for that finding. To the contrary, the Commenting States present here evidence that there may indeed be significant environmental impacts from long term spent fuel storage either onsite or offsite. NRC's Waste Confidence Decision update fails to comply with NEPA.

The NRC has consistently declined to review the environmental impacts, or potential environmental impacts, of spent fuel storage consistent with NEPA, the APA, and the AEA. Indeed, despite being titled "Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation," this proposed rule essentially evades meaningful environmental review of this important issue. The State of New York and the Commonwealth of Massachusetts have also challenged the NRC's refusal to undertake meaningful environmental review of spent fuel storage administratively and in federal court as well. *See State of New York, v. Nuclear Reg. Comm'n*, 08-3903-ag (2d Cir., Aug. 8, 2008); *Commonwealth of Massachusetts v. United States Nuclear Reg. Comm'n and United States of America*, 08-5571-ag (1st Cir. 2008); *see also Massachusetts v. NRC*, 522 F.2d 115 (1st Cir. 2008); August 13, 2007 State of New York Comments, PRM 51-13, Re: Proposed Amendment to 10 C.F.R. Part 51 rescinding finding that environmental impacts of pool storage of spent nuclear fuel are insignificant.

The Waste Confidence Decision Update fails to satisfy the requirements of the AEA as well as NEPA because any generic decision to allow for the storage of additional spent reactor fuel and other radioactive waste must be accompanied by (1) thorough, supported, and well-documented safety findings, and (2) an EIS that fully

assesses the environmental impacts of the uranium cycle, including health and environmental impacts and costs; and that examines a reasonable array of alternatives, including the alternative of not producing any additional radioactive waste. *See State of Minnesota v. NRC*, 602 F.2d 412. The NRC's proposed Waste Confidence Decision Update, which relies on speculation instead of science, does not comply with these requirements.

A. Neither Table S-3, Nor Any Other NRC Analysis, Properly Evaluates the Environmental Impact of Turning Reactor Locations Around the Country Into High Level Waste Repositories

In the 1970s the NRC decided that licensing boards should assume, for purposes of NEPA, that the permanent storage of certain nuclear wastes would have no significant environmental impact (the so-called "zero-release" assumption) and thus should not affect the decision whether to license a particular nuclear power plant. In 1979, the NRC published its final Table S-3 rule. 44 Fed. Reg. 45362 *et seq.* (1979). Table S-3 is a numerical compilation of the NRC's estimates of resources used and effluents released by fuel cycle activities supporting a year's operation of a typical light-water reactor. The State of New York and the Natural Resources Defense Council challenged Table S-3 as violating NEPA and the APA in combined proceedings which were ultimately appealed to the United States Supreme Court. *See Baltimore Gas & Elec.*, 462 U.S. 87. As the Supreme Court explained, the NRC in its Final S-3 Rule "summarized the major uncertainties of long-term storage of nuclear wastes, noted that the probability of intrusion was small, and found the

evidence 'tentative but favorable' that an appropriate storage site could be found." *Id.* at 94. The NRC adhered to the zero-release assumption in its final rule, confident that the solidified waste would not escape and harm the environment once the repository was sealed. The NRC acknowledged that this assumption was uncertain because of the "remote" possibility that water might enter the repository, which was then projected to be in a bedded-salt environment, dissolve the radioactive materials, and transport them to the biosphere. *Id.*

The Commenting States submit that some of the crucial bases upon which Table S-3 was created, and upheld by the Supreme Court – namely, that a repository location was certain and ascertainable, and that transuranic and high level nuclear waste would end up in the federal repository – have been eroded or abolished by subsequent developments. Specifically, (1) no site has been established, even twenty-five years after the Supreme Court considered and upheld Table S-3; (2) the NRC is currently evaluating only one repository location, which is not bedded-salt; and (3) the NRC is now seeking approval to store nuclear waste on-site – in perpetuity – as opposed to in a repository. In light of the lack of confidence in a repository nearly fifty years after the process began, and twenty-five years after *Baltimore Gas and Electric*, the NRC must now analyze what is actually happening: 104 reactor sites around the country are poised to become long-term high-level waste repositories.

B. The 30-Year-Old Table S-3 Can No Longer Support the Commission's Current Policy Preference

Additionally, the Commenting States submit that in light of the foregoing, Table S-3, and the bases upon which it was upheld by the Court, are obsolete and that the Table should be re-designed to take into account current conditions.

Now that it is apparent that there is little or no basis for NRC or the public to have confidence about the future of high level waste disposal, and that the NRC may force high level nuclear waste to remain at reactor sites indefinitely, there is no technical or scientific basis for using the generic approach in Table S-3 to address those impacts that are site specific and arise as a result of these changed circumstances. In particular, each nuclear power reactor site could now face the potential for a radiation release due to leakage or failure of on-site storage systems whose useful lives will have to go well-beyond the initially-envisioned 30-year window beyond the reactor's shutdown. Thus, the NRC must perform a Design Basis Threat ("DBT") Analysis and Severe Accident Mitigation Analysis ("SAMA"), and must analyze all potential impacts and alternatives for each nuclear plant. Similarly, off-site land impacts will now have to be considered for each plant with the focus on lost economic development potential and lost tax base increases caused by the indefinite storage of high level nuclear waste sites that will adversely impact land values. Finally, now that it is known that the bases upon which the initial waste confidence findings were made have not proven true, the NRC must prepare a supplemental environmental impact statement for every operating nuclear power

plant, as well as for all plants seeking to increase their initial projected nuclear waste production, to include the site specific evaluations of impacts not previously considered. In short, NRC should no longer rely on the 30-year-old Table S-3 to support its current waste disposal policy.

VI. Conclusion

The Commenting States do not support the NRC's revised Waste Confidence Findings Two and Four, which are grounded in neither technology nor science, which disregard recent occurrences which call into question the safety of extended temporary on- or off-site storage of spent fuel, and which violate the National Environmental Policy Act, the Atomic Energy Act, and the Administrative Procedure Act. The Commenting States urge the NRC to require and perform a site-specific evaluation of the environmental impacts of spent fuel pool storage at each reactor location across the country, taking into account environmental factors including population density, water resources, seismicity, and subsurface geology.

Dated: February 6, 2009

Respectfully submitted,

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PR 51
(73FR59547)
(73FR59551)

24

PRAIRIE ISLAND INDIAN COMMUNITY
LEGAL DEPARTMENT

February 6, 2009

Secretary
US Nuclear Regulatory Commission
Attn: Rulemaking and Adjudications Staff
Washington, DC 20555-0001

VIA EMAIL
Rulemaking.Comments@nrc.gov

Re: Comments Regarding Proposed Revisions of the Waste Confidence Rule (Docket ID NRC-2008-0404) and the Waste Confidence Decision (Docket ID-2008-0482)

Dear Rulemaking and Adjudications Staff:

The Prairie Island Indian Community would like to offer the following comments regarding the Nuclear Regulatory Commission's (NRC) proposed revision of the Waste Confidence Rule (10 CFR 51.23(a)), pursuant to the notice in the Federal Register on October 9, 2008 (73 FR 59547), and a related update and proposed revision of its 1990 Waste Confidence Decision (73 FR 59551).

Community Background

The Prairie Island Indian Community is a federally-recognized Indian tribe organized under the Indian Reorganization Act of 1934. The tribe is governed under the terms and conditions of the Prairie Island Indian Community's Constitution and By-Laws adopted by tribal members on May 23, 1936, and approved by the Secretary of the Interior on June 20, 1936. The Constitution and By-laws provide that the Community Council (sometimes referred to as the "Tribal Council") shall be the governing body for the Community. The five-member Tribal Council consists of a President, Vice-President, Secretary, Treasurer, and Assistant Secretary/Treasurer, each of whom serves a two-year term.

Our homeland is located on Prairie Island, which is formed at the confluence of the Vermillion and Mississippi Rivers in southeastern Minnesota (approximately 35 miles southeast of the Twin Cities of Minneapolis and St. Paul, Minnesota). The Mdewakanton, "those who were born of the waters," have lived on Prairie Island for countless generations. The size of the Prairie Island Indian Community land base (including both trust and fee lands) has grown through several federal acts and direct purchases by the Tribal Council, and now totals over 3,000 acres (including both land and water). Approximately 1,986 acres of trust land are located in the immediate vicinity of the Prairie Island Nuclear Generating Plant (PINGP). (Figure 1).

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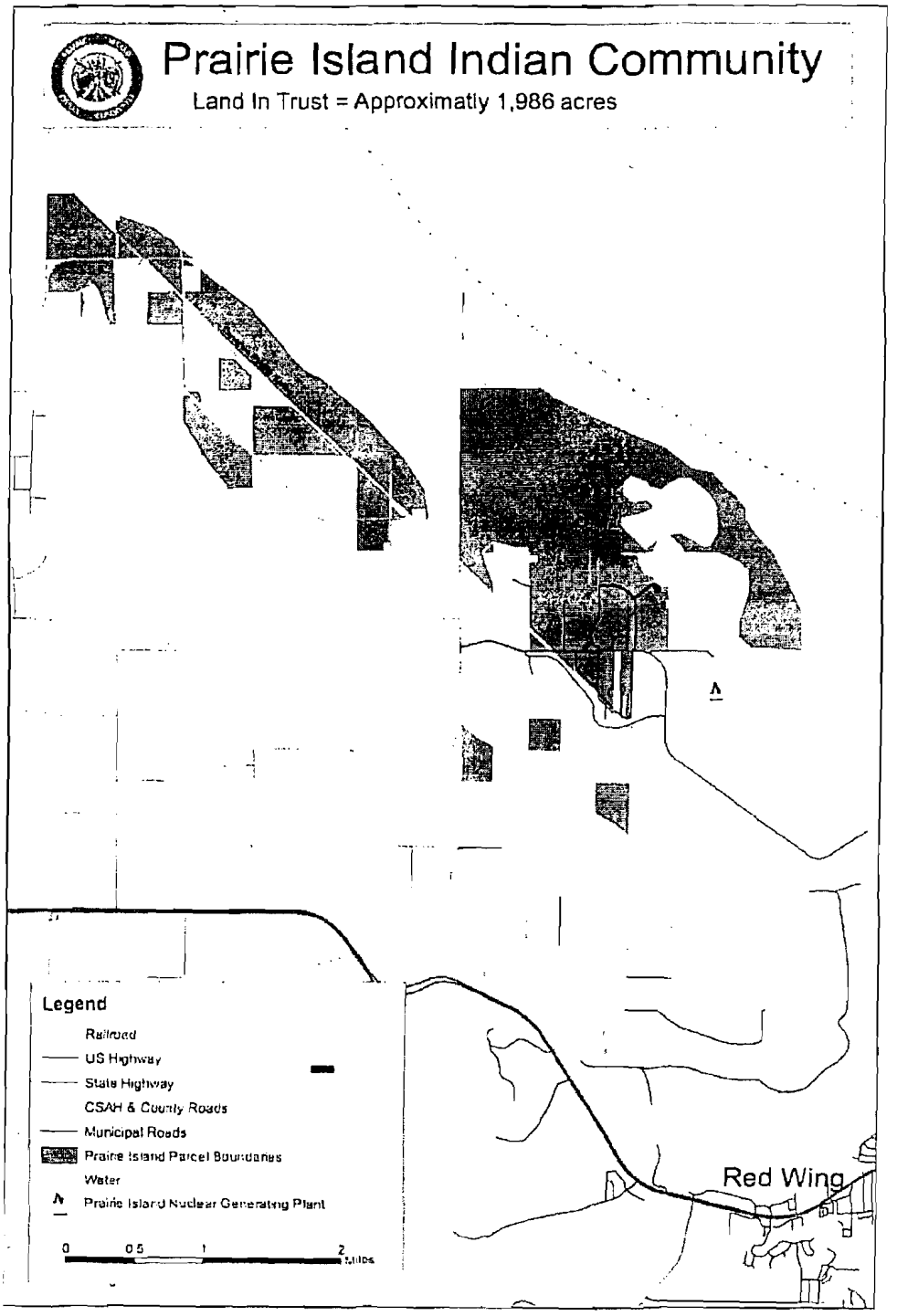
Prairie Island Indian Community
Land In Trust = Approximatly 1,986 acres
Legend
Railroad
US Highway
State Highway
CSAH & County Roads
Municipal Roads
Prairie Island Parcel Boundaries
Water
Prairie Island Nuclear Generating Plant
0 0.5 1 2 Miles
Red Wing

Figure 1

Nuclear Waste on Prairie Island

The PINGP, which is located less than 600 yards away from our homeland (see Figure 1), is currently licensed by the NRC to store spent fuel in up to 48 dry casks at an Independent Spent Fuel Storage Installation (ISFSI) on plant property. The owner of the PINGP and ISFSI, Northern Sates Power (NSP), anticipates needing to expand the ISFSI to accommodate 98 casks over the plant's lifetime to support license extension and decommissioning.

It is important to note from the outset how the waste confidence issue has evolved. As noted in the NRC's discussion of the current proposed revision, "[p]rior to NRC's original Waste Confidence proceeding, the Commission had stated that, as a matter of policy, it '***would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely.***'" 73 FR 59547, 59548 and 73 FR 59551, 59552 (quoting *Natural Resources Defense Council; Denial of Petition for Rulemaking*, 42 FR 34391, 34393 (July 5, 1977) (emphasis added)). More than 30 years later, with no operational federal repository, no other plan to dispose of nuclear wastes, and no reasonable estimate for when such a repository or other disposal method will be available, there's little reason to have any confidence in the Commission's Waste Confidence Rule as it currently reads or as the Commission proposes to amend it.

During the initial licensing processes in the early 1990s, we expressed our concerns regarding the long-term storage of spent fuel in dry casks and the possibility that the waste would never leave Prairie Island. We were assured at that time that the ISFSI was to be an ***interim*** or ***temporary*** solution until the national repository, Yucca Mountain, could begin accepting waste. The proposed revision of the Waste Confidence Rule validates the concerns we expressed during the initial licensing process and exposes the false assurances that the ISFSI is an interim or temporary solution. Unfortunately, it's becoming increasingly clear that the waste will not be removed from Prairie Island during the lifetime of those Tribal members and leaders who initially fought against interim or temporary storage.

According to the proposed revisions to Finding 2 of the Waste Confidence Decision, waste could conceivably be stored at on-site for 60 years beyond the licensed life of the reactor. In the case of the PINGP ISFSI, this would mean that 98 casks will be on-site until 2094, a date that is completely unacceptable to our people. Given that the first cask was loaded and stored in early 1995, according to Finding 2, this waste will remain on Prairie Island for 100 years, hardly the *interim* or *temporary* solution promised in the 1990s.

As we are painfully aware, the deadline for receiving spent fuel at the Yucca Mountain Repository has been slipping away and continues to be extended with each successive revision of the Waste Confidence Rule. There appears also to be some expectation (on the part of the NRC) that Yucca Mountain may possibly be abandoned all together and that the process will begin anew for a new disposal facility. Yucca Mountain won't be scrapped because of technical infeasibility but because of a lack of political will and societal support. Until the political and societal objections are addressed, no waste will be moved from its current, at-plant location. What possible confidence can the Commission have that all of the political issues or societal

objections can ever be satisfactorily resolved, much less within the estimated time? Considering that the original estimates for completion of a disposal facility have not and will not be realized, on what basis can the Commission possibly find "reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor"?

The Proposed Waste Confidence Rule Amendments

The Commission proposes to amend 10 CFR 51.23(a) as follows:

> The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts ~~for at least 30 years~~ beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations until a disposal facility can reasonably be expected to be available. ~~Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high level waste and spent fuel originating in such reactor and generated up to that time.~~

The lack of progress to date on the Yucca Mountain Repository calls into question what confidence, if any, one can have in the current Waste Confidence Rule. The Commission's proposed response to this reality, however, is to simply climinate any reference to a specific time that the spent fuel generated in any reactor can be stored safely and without significant environmental impacts beyond the licensed life for operation (which may include the term of a revised or a renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite ISFSIs. Indeed, despite the fact that no one can predict if, much less when, the Yucca Mountain Repository or any other disposal facility will be available, the proposed amendment states that the waste can be stored safely and without significant environmental impacts "until a disposal facility can reasonably be expected to be available." In effect, the Waste Confidence Rule would be premised on the pure *speculation* that a disposal facility will be available at some unknown point in the future.

The costs of proposed rule changes

The cost of the proposed rule change is only briefly and minimally discussed. The significant cost (to the taxpayers) of stranding this waste for an additional 50 to 60 years at over 100 sites across the country cannot be overlooked. The Department of Energy (DOE) has a statutory and contractual obligation to remove spent fuel from commercial nuclear power plants to a national repository. Indeed, the nation's ratepayers have paid more than $31 Billion into the Nuclear Waste Fund (NWF) for the development of a safe and secure national storage facility (Yucca Mountain).

In recent years, the utilities have had to turn to the courts to recover costs associated with developing, licensing, and maintaining on-site spent fuel storage facilities. The Government's on-going liability associated with the DOE's delay in opening a national repository is estimated to be $11 Billion (the so-called Judgment Fund), assuming that Yucca Mountain will be open by 2020. Stranding the waste for an additional 50 to 60 years will only increase that liability.

The Federal Register notice contains no discussion about the implications of this rule to the ratepayers, who are getting short-changed. First, they have paid into the NWF to develop the repository ($31 Billion paid in this far) and have seen nothing for the money they have paid into the fund. Second, ratepayers are also assessed fees to cover the costs of on-site interim storage. Third, ratepayers are responsible for decommissioning costs (Decommissioning Fund). Finally, the taxpayers (which includes the ratepayers) will be responsible for the Government's breach of contract liability (the Judgment Fund).

We recommend that the full cost of implementing this rule be completely evaluated by the NRC under the NRC Regulatory Analysis Guidelines and the legislative requirements for assessing the impacts of proposed rules which have a certain threshold cost.

Stranding spent nuclear fuel indefinitely at over one hundred sites across the nation, as this rule proposes, does not provide a safe, secure and long-term solution to the waste disposal problem; it merely keeps moving the target date to future generations.

Proposed Finding 2

> *The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial HLW and spent fuel originating in such reactor and generated up to that time.*

The Prairie Island Indian Community has deep concerns regarding the bases for this finding. First, as the Federal Register notice discusses, the Nuclear Waste Policy Act (NWPA) sets a 70,000 metric tons heavy metal (MTHL) statutory capacity limit for the national geologic repository. This issue has been recently evaluated by the DOE in the agency's "Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository," released December 2008. The report points out that Yucca Mountain would, in fact, be able to accommodate all the spent nuclear fuel from the existing fleet of reactors, even if their licenses were to be extended. This capacity does not include spent fuel that will be generated at new reactors. The statutory capacity, however, must be lifted by Congressional action. Increased capacity at Yucca Mountain through legislative action is not guaranteed. In recent years, we have seen consistent efforts to block legislation continuing funding for the Yucca Mountain project, slowly killing the project for which the ratepayers have already paid billions of dollars.

How can the NRC be assured that increased sufficient capacity will be available (either through a legislative increase or a second repository) when the first geologic repository (Yucca Mountain) is now 11 years overdue and has an uncertain future?

It is not clear how the proposed rule change helps decommissioned plants. The proposed language change states "mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor...." According to the recent DOE "Report to Congress on the Demonstration of the Interim Storage of Spent Nuclear Fuel from Decommissioned Nuclear Power Plants," there are nine decommissioned nuclear power plants in the United States. The earliest decommissioning took place in 1976 at Humbolt Bay (NRC Information Digest 2007). If one were to add an optimistic 50 years (instead of the more conservative estimate of 60 years) to 1976, the date would be 2026, just one year beyond the current language in the current Waste Confidence Rule (10 CFR 51.23(a)). Would that mean that waste would be leaving Humbolt Bay by then? Would waste from other plants be leaving by that date as well? If that is possibly the case, why the rule change?

Our intention in mentioning this is that when it comes to the storage of spent fuel at a national repository, there are no certainties or assurances. We cannot be sure that the Yucca Mountain license application will even move forward, that the program will receive adequate funding, or that storage capacity beyond 70,000 MTHM will be available.

Proposed Finding 4

> *The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and either onsite or offsite independent spent fuel storage installations.*

This proposed revision seems to provide for the possibility that Yucca Mountain will not receive a license from the NRC. When the ISFSI at Prairie Island was first licensed in the 1990s, it was to be temporary measure, only for a period of years, to keep the plant running and people working until Yucca Mountain was open. As you may be aware, Minnesota law requires approval from the Public Utilities Commission (PUC) and the State Legislature before a utility can use on-site dry cask storage. The legislative hearings for the Prairie Island ISFSI were highly contentious and divisive. It is highly doubtful that NSP would have received state approval then if legislators believed that the waste would be on-site for 100 years.

We would like to point out to the Commission that these ISFSIs are not located in remote parts of the country. Many are located near population centers. In our case, the ISFSI is located right next to us, 600 yards away from our homes, community center and business. As we mentioned earlier, Prairie Island is our only homeland, the land promised to us by the United States government. We cannot simply relocate to another place away from a nuclear waste dump.

Finding 5

In regard to Finding 5, the Commission should convene a national dialogue on the alternative to on-site storage or a geologic repository. Regional away-from-reactor storage is an alternative that would avoid the singular problems of a repository at Yucca Mountain and also remove the waste from the reactor sites around the country. The science for regional storage may provide more certainty that a geologic repository, and even though still difficult, presents less of a political challenge than siting a repository. Even though the initiation of such a solution may rest with others, it is the Commission's responsibility to provide leadership in this area because of Finding 5.

We are members of the Nuclear waste Strategy Coalition (NWSC), which is an ad hoc groups of state utility regulators, state attorneys general, electric utilities and associate members representing 47 member/affiliate organizations in 31 states. The NWSC also recommends that spent fuel and high-level radioactive waste be moved to a centralized interim storage facility.

New Reactors

We understand that nuclear utilities have expressed intention to file license applications for up to 34 new reactors by 2010. The waste from the future plants has not been calculated into the storage problem. In our view, as the closest neighbor to a nuclear power plant, it is completely irresponsible to develop new plants when there is no available national repository for the spent fuel from the first generation of nuclear power plants. We cannot hope that some future generation will find a solution to this decades old problem. Writing a rule that simply allows the waste to remain on-site indefinitely is not the answer.

We appreciate this opportunity to provide comments to the Commission on this important issue.

Respectfully,

Philip R. Mahowald
General Counsel

cc: The Honorable Amy Klobuchar
The Honorable John Kline
The Honorable Timothy Walz
The Honorable Erik Paulsen
The Honorable Betty McCollum
The Honorable Keith Ellison
The Honorable Michele Bachman
The Honorable Collin Peterson
The Honorable James Oberstar
The Honorable Tim Pawlenty
The Honorable Margaret Anderson Kelliher
The Honorable Marty Seifert
The Honorable Lawrence Pogemiller
The Honorable David Senjem
The Honorable John Howe

Rulemaking Comments

From: Phil Mahowald [pmahowald@piic.org]
Sent: Friday, February 06, 2009 6:43 PM
To: Rulemaking Comments
Subject: Comments on Docket Nos. 2008-0404 and 2008-0482
Attachments: SKMBT_C35109020616560.pdf

Dear Secretary and Rulemakings and Adjudication Staff:

Attached please find the comments of the Prairie Island Indian Community on the NRC's Proposed Revisions of the Waste Confidence Rule (Docket No. 2008-0404) and the NRC's Proposed Revisions of the Waste Confidence Decision (Docket No. 2008-0482).

Hard copies will follow by mail.

Sincerely,

Philip Mahowald

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Subject: Comments on Docket Nos. 2008-0404 and 2008-0482
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Thread-Index: AcmItIMXqTnAioF/Sb22mPRH12NX0g==
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To: <Rulemaking.Comments@nrc.gov>
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Return-Path: pmahowald@piic.org

PR 51
(73FR59547)
(73FR59551)

23

NRDC
THE EARTH'S BEST DEFENSE

February 6, 2009

Via Electronic and First Class Mail

Annette L. Vietti-Cook, Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
Attn: Rulemakings and Adjudications Staff
Electronic Mail: Rulemaking.Comments@nrc.gov

RE: Natural Resources Defense Council Comments on the Proposed Waste Confidence Rule and the Proposed Temporary Storage Rule (Docket IDs 2008-0482, 2008-0404)

Dear Secretary Vietti-Cook:

The Natural Resources Defense Council (NRDC) writes today to comment on the Nuclear Regulatory Commission's (NRC) Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation (hereinafter "Proposed Temporary Storage Rule"), 73 Fed. Reg. 59547 (October 9, 2008), and the NRC's Waste Confidence Decision Update, (hereinafter "Proposed Waste Confidence Rule"), 73 Fed. Reg. 59551 (October 9, 2008).

I. Summary of Comments

Over the next several years, the NRC is likely to have before it several relicensing decisions for existing reactors and, potentially, several decisions on whether to license new nuclear facilities. In these proposed actions, the NRC is revisiting whether or not (1) there is an adequate technical and legal foundation for "confidence" that there will be a final disposal option for spent nuclear fuel; (2) there is an adequate regime for temporary storage of spent nuclear fuel during the pendency prior to final disposal; and (implicitly) (3) if there is confidence in the related conclusion that the entire uranium fuel cycle has no significant impact on the environment. The NRC has failed to provide an in-depth analysis of the underlying technical, institutional, and legal bases that could serve as a justification for these proposed conclusions.

The Proposed Waste Confidence Rule and the Proposed Temporary Storage Rule fail to comply with the requirements of the Atomic Energy Act (AEA), 42 U.S.C. § 2011 et

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seq., and the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq. The two agency actions are, in effect, generic licensing decisions that allow for the production of additional spent reactor fuel and other radioactive waste associated with the uranium fuel cycle – essentially in perpetuity.

In contrast to the NRC proposals, there is no basis for confidence in the ultimate disposal of spent nuclear fuel; there is no basis for a safety finding that temporarily stored nuclear waste will have no significant impact on the environment; and there is no basis for continued reliance on an outdated uranium fuel cycle rule – which itself is contingent upon the Waste Confidence Rule – that depends on assumptions long since proven wrong or, simply, no longer applicable by virtue of current law. Generic licensing decisions such as these must be accompanied by thorough, supported, and well-documented safety findings. Any generic licensing decision that allows for the production of spent nuclear fuel and other associated waste streams from the uranium fuel cycle must also be accompanied by a Generic Environmental Impact Statement (GEIS) that fully assesses the environmental impacts of the entire uranium fuel cycle, including health and environmental impacts and costs, and that examines a reasonable array of alternatives, including the alternative of not producing any additional radioactive waste.

II. NRDC Statement of Interest

NRDC is a national non-profit membership environmental organization with offices in Washington, D.C., New York City, San Francisco, Chicago, Los Angeles and Beijing. NRDC has a nationwide membership of over one million combined members and activists. NRDC's activities include maintaining and enhancing environmental quality and monitoring federal agency actions to ensure that federal statutes enacted to protect human health and the environment are fully and properly implemented. Since its inception in 1970, NRDC has sought to improve the environmental, health, and safety conditions at the nuclear facilities operated by DOE and the civil nuclear facilities licensed by the NRC and their predecessor agencies.

III. Background on Proposed Waste Confidence Rule and the Proposed Temporary Storage Rule

The issue of whether or not the availability of permanent geologic disposal should factor into the NRC licensing of commercial nuclear power plants has been with us for decades. A compromise on how the issue would be addressed in a scientific and publicly acceptable manner was reached nearly twenty five years ago and the basic framework of that compromise has not changed substantially over the years.

But the basis for that compromise – what was at that time a thorough, ongoing and technical review of the safety and environmental impacts of storing spent fuel until such time as a permanent geologic repository was available – lacks legal and scientific foundation. For a host of technical, institutional, and social reasons (none of which bears sole responsibility) this country is no closer to a solution for spent fuel than it was 30 years ago and the NRC is wrong to assert confidence in the ultimate safe management

and disposal of nuclear waste without a new, thorough, and searching environmental review.

A. Initial History of the Waste Confidence Decision

In June of 1977, the NRC denied a NRDC petition that forced the question of whether there should be (1) a rulemaking proceeding to determine whether high-level radioactive wastes generated in nuclear power reactors can be permanently disposed of without undue risk to public health and safety; and (2) withholding of action on pending and future applications for operating licenses for nuclear power reactors until such time as an affirmative determination has been made. We then petitioned the United States Court of Appeals for the Second Circuit to review the NRC decision. The 2nd Circuit found in pertinent part:

> [I]t is neither necessary nor reasonable for the Commission to insist on proof that a means of permanent waste disposal is on hand at the time reactor operation begins, so long as the Commission can be reasonably confident that permanent disposal (as distinguished from continued storage under surveillance) can be accomplished safely when it is likely to become necessary. Reasonable progress towards the development of permanent disposal facilities is presently being accomplished. Under these circumstances a halt in licensing of nuclear power plants is not required to protect public health and safety.

Natural Resources Defense Council v. NRC, 582 F.2d 166, 169 (2nd Cir. 1978). And so it was in 1978. A similar situation remains in place today – i.e., that there is "reasonable confidence" in the progress and development of a permanent disposal facility – and the NRC's decisions under review in these comments would engrave such confidence in stone.

That sense of "progress" noted by the 2nd Circuit on the development of permanent disposal facilities provided the basis for what would become the "Waste Confidence Determination" and the compromise described above. In a parallel action only one year later, the State of Minnesota challenged an NRC decision granting two operators of nuclear plants amendments to licenses to expand on-site spent fuel storage without first determining whether the federal government could permanently dispose of the nuclear waste. The United States Court of Appeals for the D.C. Circuit held that NRC could properly consider the complex issue of nuclear waste disposal in a generic proceeding such as a rulemaking and then apply its determinations in subsequent adjudicatory proceedings, noting the NRC's "reasonable assurance" a permanent solution would be found. Minnesota v. NRC, 602 F.2d 412, 416 (D.C. Cir. 1979).

Importantly, the D.C. Circuit remanded the matter before the particular parties to the NRC for further proceedings to determine whether those reasonable assurances existed. Id. at 419.

B. The Original Waste Confidence Findings

These cases gave rise to the NRC's "waste confidence" rulemaking. In 1984, after varying rounds of development, the NRC made the five following findings that constituted the waste confidence decision:

> (1) The Commission finds reasonable assurance that safe disposal of high level radioactive waste and spent fuel in a mined geologic repository is technically feasible.
>
> (2) The Commission finds reasonable assurance that one or more mined geologic repositories for commercial high-level radioactive waste and spent fuel will be available by the years 2007-09, and that sufficient repository capacity will be available within 30 years beyond expiration of any reactor operating license to dispose of existing commercial high level radioactive waste and spent fuel originating in such reactor and generated up to that time.
>
> (3) The Commission finds reasonable assurance that high-level radioactive waste and spent fuel will be managed in a safe manner until sufficient repository capacity is available to assure the safe disposal of all high-level radioactive waste and spent fuel.
>
> (4) The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of that reactor's operating licenses at that reactor's spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.
>
> (5) The Commission finds reasonable assurance that safe independent onsite or offset spent fuel storage will be made available if such storage capacity is needed.

49 Fed. Reg. 34659 (Aug. 31, 1984) (emphasis added). On the basis of these findings, the NRC made a generic determination that spent fuel generated at any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the expiration of any Commission license. The NRC amended 10 CFR § 51 by adding this generic determination as 10 CFR § 51.23(a).

C. Waste Confidence Revisions

The NRC revised the waste confidence rule in 1990, leaving much in place but amending the second and fourth findings as follows:

> Finding 2: The Commission finds reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and that sufficient repository capacity will be available within 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level radioactive waste and spent fuel originating in such reactor and generated up to that time.
>
> Finding 4: The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

55 Fed. Reg. 38474 (Sept. 18, 1990), see also a revised 10 CFR § 51.23(a).

In 1999 the NRC again confirmed these findings and stated that it would revisit the Waste Confidence issue if "significant and pertinent unexpected events occur, raising substantial doubts about the Decisions continued viability." 64 Fed. Reg. 68005 (Dec. 6, 1999).

D. The Proposed Waste Confidence Rule

The NRC is revisiting waste confidence again and this time specifically seeks to amend finding (2) to read:

> The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time.

73 Fed. Reg. 59551 (emphasis added).

The Commission seeks to amend finding (4) to read:

> The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

73 Fed. Reg. 59551 (emphasis added). Findings 1, 3, and 5 of the Waste Confidence Decisions remain unchanged.

E. The Proposed Temporary Storage Rule

Published the same day as the proposed Waste Confidence Decision, the NRC has issued the Proposed Temporary Storage Rule that, in essence, acts a "finding of no significant impact" (FONSI). Reflecting and tracking closely the past and currently proposed findings of the Proposed Waste Confidence Rule, the Proposed Temporary Storage Rule proposes to find that if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent fuel storage installations until a disposal facility can reasonably be expected to be available. 73 Fed. Reg. 59547 (Oct. 9, 2008).

F. The Uranium Fuel Cycle Rule

Contemporaneous with the initial efforts at a Waste Confidence policy, the NRC performed an analysis of the environmental impacts of the uranium fuel cycle in WASH-1248, Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle, a Task Force Report (October 1976). The NRC's initial Waste Confidence policy concluded that spent fuel could be disposed of in a bedded salt repository without causing any radioactive releases after the repository was sealed. Based on that assumption, the NRC concluded in WASH-1248 that radioactive releases from a repository, after it was sealed, would be zero. The NRC codified this finding in the Uranium Fuel Cycle Rule and Table S-3. Final Rule, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management, 44 Fed. Reg. 45,362 (August 12, 1979). Table S-3 also estimated negligible releases from other forms of radioactive waste in the uranium fuel cycle. The table was incorporated into NRC regulation 10 C.F.R. § 51.51(a), which provides that:

> Under § 51.50, every environmental report prepared for the construction permit stage or early site permit stage or combined license stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S-3 shall be included in the environmental report and may be supplemented by a discussion of the

> environmental significance of the data set forth in this table as weighed in the analysis for the proposed facility.

The Uranium Fuel Cycle Rule's finding of no significant health impacts fundamentally supports the Waste Confidence Decision because its estimate of zero radioactive releases from a repository is based on the Commission's then-current Waste Confidence finding, that "a suitable bedded-salt repository site or its equivalent will be found." 44 Fed. Reg. at 45,332. As the Commission explained in a subsequent policy statement, it based that finding on its "confidence" in the integrity of a repository:

> As the Commission noted in promulgating the [final uranium cycle rule], events which might lead to major releases from the bedded-salt repository used as the model for the S-3 rule appear remote in probability while any releases which might reasonably be expected eventually to occur appear very small. Accordingly, the Commission found that the staff's assumption that the integrity of the repository would be maintained after sealing was a reasonable description of the performance of a properly sealed repository and, when taken together with the staff's highly conservative assumption that all volatile fission products in reactor spent fuel would be released to the atmosphere prior to repository sealing, left Table S-3 overall a conservative description of fuel cycle impacts. *See* 44 FR 45369, col. 2. Considering the rule's limited purpose and taking into account the Commission's "waste confidence" proceeding, the Commission continues to believe that the record of the final S-3 rulemaking contains adequate information on waste disposal uncertainties to support continued use of the fuel cycle rule.

Policy Statement, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts, 47 Fed. Reg. 50,591, 50,593 (Nov. 11, 1982). In the 1990 update to the Waste Confidence Rule, the Commission also acknowledged that if it were to change its waste confidence decision, it would have to revisit the adequacy of Table S-3. 55 Fed. Reg. at 38,490.

The NRC has not meaningfully updated Table S-3 or WASH-1248 for decades. As the Commission recently explained, a planned update:

> [w]as delayed because, by the mid-1980's, there were no new applications for construction of nuclear power plants, nor, at that time, were any future ones predicted. Consequently, there was no regulatory need to update Table S-3 and competing priorities for rulemaking resources eventually resulted in the cessation of activities on the table. Since the mid-1980's, the NRC has revisited the issue of revising the value for radon-222 in Table S-3 on more than one occasion, but in each case higher priority rulemakings led to a halt in these efforts.

New England Coalition on Nuclear Pollution; Denial of Petition for Rulemaking, 73 Fed. Reg. 14,946, 14,947 (March 20, 2008).

G. The Baltimore Gas & Electric Decision

As described above, in 1979, the NRC published its final Table S-3 rule. 44 Fed. Reg. 45362 et seq. (1979). Table S-3 is, in brief, a numerical compilation of the NRC's estimates of resources used and effluents released by fuel cycle activities supporting a year's operation of a typical light water reactor. From this, the NRC decided that NRC Licensing Boards should assume, for the purposes of NEPA review, that permanent storage of nuclear waste would have no significant environmental impact (the so-called "zero release assumption"), reactor operations would have no significant impact on the environment, and thus none of these issues should affect the decision whether to license nuclear power plants. NRDC and the State of New York challenged Table S-3 as a violation of NEPA and the Administrative Procedures Act (APA), the proceedings were combined, and ultimately, the Supreme Court ruled on the issue. At the "heart of the dispute" was the viability of Table S-3, 44 Fed. Reg. 45362 et seq. (1979). Baltimore Gas & Electric v. NRDC, 462 U.S. 87 (1983).

The Supreme Court reversed a Court of Appeals ruling for NRDC and New York, finding that the NRC, in its final S-3 Table, "summarized the major uncertainties of long-term storage of nuclear wastes, noted that the probability of intrusion was small, and found the evidence 'tentative but favorable' that an appropriate storage site could be found." Id. at 87. The central holding of BG&E is straightforward – the NRC complied with NEPA's requirements of consideration and disclosure of the environmental impacts of its licensing decisions. Id. at 88. But as discussed in comments below, the fundamental bases upon which the Supreme Court relied to find the NRC's actions lawful are no longer valid or applicable, and such a situation has a significant impact on the NRC's NEPA obligations for the relicensing of existing facilities and licensing of new facilities.

IV. The Proposed Waste Confidence Rule and the Temporary Storage Rule Fail To Comply with the AEA and NEPA

A. Legal Requirements

1. Safety determination under the AEA

The AEA precludes the NRC from licensing any new nuclear power plant or re-licensing any existing nuclear power plant if it would be "inimical . . . to the health and safety of the public." 42 U.S.C. § 2331(d). In conformance with this requirement, the Commission has stated that it will only license a new nuclear power plant "so long as the Commission can be reasonably confident that permanent disposal (as distinguished from continued storage under surveillance) can be accomplished safely when it is likely to become necessary." NRDC v. NRC, 582 F.2d 166 (2d Cir. 1978). In the Proposed Waste Confidence Rule, the Commission has repeated it commitment not to license new nuclear power plants unless it can make this finding ("[The Commission] would not continue to

license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely.") 73 Fed. Reg. at 59,552. In licensing nuclear power plants, the Commission must also make a predictive finding that spent fuel can be stored safely pending ultimate disposal. Proposed Waste Confidence Findings 3, 4 and 5 address this requirement and effectively constitute a licensing determination that spent fuel storage risks are not inimical to public health and safety.

2. NEPA environmental review

Separate from the AEA, NEPA requires that before licensing or re-licensing nuclear power plants, the NRC must evaluate the environmental impacts of its licensing decision in an EIS. 42 U.S.C. § 4332(C); 10 C.F.R. § 51.20(b)(2). An EIS must address the environmental impacts of the proposed action and connected actions, including cumulative impacts. 10 C.F.R. § 51.71(d). It must also weigh the costs and benefits of a reasonable array of alternatives for avoiding or mitigating the consequences of the proposed action. Id.

Thus, in proposing to license or re-license nuclear power plants, the NRC must examine the environmental impacts of the radioactive waste generated by the plants. It must also evaluate the relative costs and benefits of alternatives for avoiding or mitigating those impacts, including denying licenses so that the radioactive waste is not produced. Id. The environmental impacts that must be examined by the NRC include the risks posed by spent fuel storage and disposal.

3. Procedural requirements for compliance with AEA and NEPA

While the NRC may make a licensing determination through a notice-and-comment rulemaking, it must provide adequate support for its determination to satisfy the requirements of the Administrative Procedures Act. State of Minnesota, 602 F.2d at 419. And while the NRC may make environmental determinations generically, it must comply with the procedural requirements of NEPA, including preparation of an environmental impact statement EIS for actions having a significant adverse impact on the human environment. BG&E v. NRDC, 462 U.S. 87, 99 (1983). Where the NRC considers environmental impacts to be insignificant to warrant preparation of an EIS, it must show that it has taken a "hard look" at those impacts, and it must comply with the procedural requirements for an environmental assessment ("EA"). 10 C.F.R. §§ 51.30-51.35.

B. There is no basis for confidence that the ultimate disposal of spent nuclear fuel will be achieved – What is technically feasible is not necessarily institutionally achievable

1. The proposed amendment to Finding 2

The NRC proposes to amend Finding 2 of the Proposed Waste Confidence Rule to read:

> The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time.

73 Fed. Reg. 59551 (emphasis added).

2. The history of the repository program demonstrates that there should be no assurance that there will be sufficient mined geologic repository capacity at any time

a. The first failed efforts

In 1957-1958, the Atomic Energy Commission (AEC) conducted the first site specific study of the disposal of high-level radioactive waste in salt at Hutchinson, Kansas. Between 1961 and 1963, the AEC conducted experiments at the Cary salt mine at Lyons, Kansas. In 1970 the AEC, along with the Kansas governor, announced tentative selection of the Cary salt mine for a demonstration high-level waste repository. Opposition, primarily by the Kansas Geological Survey, and concerns over conditions in the mine, the presence of numerous oil and gas well in the vicinity, and the fact that there was solution mining at an operating adjacent salt mine operated by American Salt Company forced the AEC to abandoned the site by 1972.

Following the demise of the Lyons repository effort, the AEC announced in 1972 that it intended to develop a 100-year Retrievable Surface Storage Facility (RSSF). This proposal was opposed by the Environmental Protection Agency (EPA) and others because in their view it would divert attention and resources from efforts to find a permanent means of geologic disposal. As a consequence of this opposition the Energy Research and Development Agency (ERDA) gave up its plans for a RSSF in 1975. Between 1975 and 1982, ERDA and the DOE continued to search for potential repository sites in various rock types in the states of Michigan, Ohio, New York, Utah, Texas, Louisiana, Mississippi, Washington, and Nevada. Various degrees of resistance from state and local representatives combined with geological and technical problems stalled efforts to find a repository site. In 1976 President Gerald Ford halted the reprocessing of commercial nuclear fuel. In the following year President Jimmy Carter reinforced the ban on commercial reprocessing and tried to halt the development of commercial breeder reactor development. These actions reinforced the need for prompt development of a geologic repository. In 1977 ERDA also announced that it would accept custody of commercial spent fuel and store it at Away From Reactor (AFR) storage facilities. It never happened.

b. The IRG Process

In the mid-1970s it became clear that commercial spent fuel reprocessing was uneconomical, environmentally unsound, and represented a serious proliferation risk.

President Gerald Ford refused to subsidize the completion of the Barnwell reprocessing plant, and then President Jimmy Carter pulled the plug on reprocessing. The actions by Presidents Ford and Carter gave a new urgency to finding a site suitable for geologic disposal of both spent fuel and high-level radioactive waste. In the late 1970s President Carter initiated an Interagency Review Group (IRG) process to solve once and for all the nuclear waste problem in the United States. The IRG process involved numerous scientists, extensive public involvement, and a consultation and concurrence role for the states. The outcome of the IRG effort was a two-track program. The DOE was tasked with the responsibility for identifying the best repository site in the country, and the EPA and the NRC were tasked with developing nuclear waste disposal criteria against which the selection and development of the final repository site would be judged.

c. The Nuclear Waste Policy Act

In 1982, Congress enacted the NWPA, which embodied in law the principal recommendations that grew out of the IRG process, including a commitment to geologic disposal, two repositories, and characterization of three sites before final selection of the first repository. The NWPA established a comprehensive program for the disposal of spent nuclear fuel and high-level radioactive waste (HLW) from the nation's commercial reactors and nuclear weapons complex.

At the time the NWPA was passed nearly 25 years ago, the U.S. Government enjoyed fairly widespread support from within the Congress, the environmental community and state governments for the site selection and development process proposed by the IRG.[1] Now, decades later, the U.S. Government has little, if any, support from the State of Nevada, and virtually no public support from the environment and public health community for the proposed Yucca Mountain project.

d. What else went wrong

A whole host of things, but suffice to say that over the last twenty years, a substantial segment of the environmental community believes the process of developing, licensing, and setting environmental and oversight standards for the proposed repository have been, and continue to be rigged or dramatically weakened to ensure the licensability of the site rather than provide safety for the length of time the waste is dangerous. The site selection process and the radiation standards are examples that illuminate this perspective and conclusively demonstrate that the NRC has no basis for finding reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available at any time, even within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the

[1] Importantly, this sense of fairly widespread support from Congress, the public interest community, a number of states and other entities for the nascent repository effort was well understood at approximately the time the Supreme Court was deciding the BG&E matter. Indeed, see note 14 in the Court's 1983 decision where in a discussion of the "separate and comprehensive series of programs" to address these issues, the Court takes note of the ongoing waste confidence proceeding and the (at that time) recently enacted NWPA. BG&E v. NRDC, 462 U.S. at 102.

commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time.

i. Site Selection

First, DOE and then the Congress corrupted the site selection process. The original strategy contemplated DOE choosing the best four or five geologic media, then selecting a best candidate site in each media alternative, then narrowing the choices to the best three alternatives, and then picking a preferred site for the first of two repositories. Site selection guidelines were strongly criticized as DOE was accused of selecting sites that they had previously planned to pick. In May of 1986 DOE announced that it was abandoning a search for a second repository, and it had narrowed the candidate sites from nine to three, leaving in the mix the Hanford Reservation in Washington (in basalt), Deaf Smith Co., Texas (in bedded salt), and Yucca Mountain in Nevada (in unsaturated volcanic tuff).

All equity in the site selection process was lost in 1987, when the Congress, confronted with a potentially huge cost of characterizing three sites, amended the NWPA of 1982, directing DOE to abandon the two-repository strategy and to develop only the Yucca Mountain site. At the time, Yucca Mountain was DOE's preferred site. The abandonment of the NWPA site selection process led directly to the loss of support from the State of Nevada, diminished Congressional support (except to ensure that the proposed Yucca site remains the sole site), and less meaningful public support for the Yucca Mountain project. The situation has only deteriorated since that time.

ii. Radiation Standards

The second track of the process has, if possible, fared worse. Section 121 of the NWPA of 1982 directs EPA to establish generally applicable standards to protect the general environment from offsite releases from radioactive materials in repositories and directs the NRC to issue technical requirements and criteria. Unfortunately, it has been clear for years that the projected failures of the geologic isolation at Yucca Mountain are the determining factor in EPA's standards.

EPA repeatedly issued standards that are concerned more with licensing the site than establishing protective standards. EPA's original 1985 standards were vacated in part because the EPA had failed to fulfill its separate duty under the Safe Drinking Water Act, 42 U.S.C. §300h, to assure that underground sources of water will not be "endangered" by any underground injection. Natural Resources Defense Council v. Environmental Protection Agency (NRDC v. EPA), 824 F.2d 1258 (1st Cir. 1987).

EPA's second attempt to at setting standards that allow for a projected failure of geological isolation was again vacated, this time by the United States Court of Appeals for the D.C. Circuit. The D.C. Circuit found that EPA's Yucca Mountain rule (and the corresponding NRC standard), which ended its period required compliance with the terms of those rules at 10,000 years was not "based upon or consistent with" the

recommendations of the National Academy of Sciences ("NAS") as required by the 1992 Energy Policy Act and therefore must be vacated. Nuclear Energy Institute, Inc. v. EPA, 373 F.3d 1251 (2004).

Giving significant deference to the agency, the D.C. Circuit did not vacate EPA's strangely configured compliance boundary for the Yucca Mountain site. See Appendix A to these comments for a map of EPA's compliance boundary (inside the oddly drawn line, the repository need not protect water quality and radiation can leak in any amount). The dramatically irregular line that represents the point of compliance has little precedent in the realm of environmental protection, and its shape is perhaps more reminiscent of gerrymandered political districts. Rather than promulgate protective groundwater standards, EPA pieced together a "controlled area" that both anticipates and allows for a plume of radioactive contamination that will spread several miles from the repository toward existing farming communities that depend solely on groundwater and perhaps through future communities closer to the site.

EPA's next proposed and revised rule, issued in 2005, retained the 15 millirem/year and groundwater standards for the first 10,000 years, but then establishes 350 millirem/year standard for the period after 10,000 years and does away with the groundwater standard entirely. This two-tiered standard failed to comply with the law and fails to protect public health, especially if the repository's engineered barriers were to fail earlier than DOE predicts. On October 15, 2008, EPA published the final version of its revised Yucca Mountain rule in the Federal Register ("2008 Yucca Mountain rule," 73 Fed. Reg. 61255-61289). The 2008 Yucca Mountain rule's two-tiered individual protection annual dose standard establishes an initial 15 millirem first-tier limit, but weakens that limit to 100 millirem in the period after 10,000 years, when EPA projects peak dose to occur. Peak dose could occur significantly earlier if engineered barriers fail earlier than DOE and EPA have projected.

The final status of EPA's most recent two-tiered rule remains fundamentally uncertain. In an action pending in the District of Columbia Circuit (State of Nevada v. Environmental Protection Agency, No. 08-1327, consolidated with No. 08-1345), Nevada has challenged EPA's 2008 Yucca Mountain rule as once again failing to honor EPA's statutory duty to protect public health and safety, and to proceed consistently with the National Academy of Seience's recommendations.

iii. Limits of the repository and a potential need for a second repository

Even more troubling, the NRC's continued confidence in a reasonable assurance of a repository being available 50 or 60 years after license expiration of any commercial reactor is contingent entirely upon Congress revising (1) the current law that limits the United States to one repository, the proposed Yucca Mountain site; and (2) the spent fuel and high-level waste stored at this one repository will be limited to 70,000 metric tons of heavy metal equivalent. Therefore, the current, and only repository under review in this country, could not even accommodate all of the spent fuel from existing reactors without

new legislation, much less spent fuel from any new reactors that might be built.[2] A second repository would also require new legislation and, as the proposals acknowledge, such a situation would almost certainly require new NRC regulations. Moreover, the NRC has failed to analyze the impact on future repository requirements of this proposed decision which would potentially place no limits on the total inventory of spent fuel generated by existing and future reactors.

iv. The NRC's proposed assurance that there will be sufficient mined geologic repository capacity at some point in the future is without merit

Finally, there is no assurance – nor should there be as the matter has yet to be adjudicated – that the proposed Yucca Mountain repository will ever be licensed. The DOE has only recently submitted a license application to the NRC and the State of Nevada has submitted hundreds of contentions. We are not involved in the licensing proceeding and at this juncture take no position on the merits, but if Yucca Mountain is found not to be a suitable site for a repository, this would leave the country (in whatever year that decision is made), with no agreed upon disposal site at all. Ironically, such a decision will come more than sixty years after the federal government began its search for a suitable site, the precise time frame of the NRC's continued confidence that a site for the disposal of waste will be identified, sited, and developed.

Since geologic disposal of high-level radioactive waste was first proposed by the National Academy of Sciences just over 50 years ago, there have been two institutional – as opposed to technical – failures related to the disposal of high-level radioactive waste and spent fuel. First, there was the abandonment of Project Salt Vault at Lyons, Kansas by the AEC in 1972. Second, there was the abandonment of the proposed Retrievable Surface Storage Facility (RSSF) by the Energy Research and Development Agency (ERDA) in 1975. We are now potentially on the verge of the third institutional failure – the problematic Yucca Mountain project. There is no basis for assuming that there will not be one, two, or three similar institutional failures during the next 50, 100, or 150 years, and there is no in-depth analysis by the Commission to conclude that similar institutional failures will not prevent the licensing of a geologic disposal facility for a period well beyond that contemplated by the proposed Finding 2.

[2] DOE has already generated 12,800 tons of waste, and commercial power reactors have generated over 58,000 tons, and this figure increases by approximately 2,000 tons per year. See, The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, December 2008, at 5. DOE estimates the total waste from current fleet of operating reactors will total between 109,300 and 130,000 tons, depending on license extensions. We are betting on the high side of those figures. Yucca Mountain is statutorily limited to hold only 77,000 tons of waste. 42 U.S.C. § 10101 et seq., § 114(d). Just this past year, the head of DOE's civilian nuclear waste disposal program told Congress that within two years (2010), the amount of waste produced by the countries current operating reactors (plus defense waste) will exceed Yucca Mountain's statutory limits. DOE has requested that Congress lift the cap on the amount of waste to be emplaced at Yucca Mountain.

NRDC and the public do not bear the burden of demonstrating either the feasibility or the infeasibility of a proposed repository. Rather, the NRC has not provided sound factual or analytical basis for its finding that there is reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time. Had NRC performed even a cursory analysis of the institutional failures surrounding spent fuel disposal, the agency would have taken note of the fact that the original Waste Confidence Finding 2 was in error. Thus, why are we to believe that the current proposal – the second modification of Finding 2 – is not in error?

C. There is no basis for a safety finding that "temporarily" stored nuclear waste will have no significant impact on the environment

1. The proposed amendment to Finding 4 reflects the proposed Temporary Storage Rule

The Commission seeks to amend finding (4) to read:

> The Commission finds reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin, or at either onsite or offsite independent spent fuel storage installations.

73 Fed. Reg. 59551 (emphasis added). Tracking the proposal for amending Finding 4 closely, but with no limitation with respect to time, the Proposed Temporary Storage Rule proposes to find that if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent fuel storage installations until a disposal facility can reasonably be expected to be available. 73 Fed. Reg. 59547 (Oct. 9, 2008).

2. The NRC lacks foundation for the finding that there is reasonable assurance that, if necessary, spent fuel generated in any reactor can be stored safely and without environmental impact for 60 years

As a first point, the issue is not whether spent fuel "can" be stored safely. The issue is whether spent fuel "will" be stored safely. We agree that spent fuel can be stored safely, but that's not what should be before the Commission. In concluding that spent fuel "will" be stored safely and without significant environmental impacts for at least 60 years (or without any time limits whatsoever) beyond the expiration of that reactor's operating license, the Commission considered four major issues: (1) the long-term integrity of spent

fuel under water pool storage conditions; (2) structure and component safety for extended facility operation; (3) the safety of dry storage; and (4) potential risks of accidents and acts of sabotage at spent fuel storage facilities.

a. Numerous examples of problems at operating spent fuel pools require a "hard look" at the long-term environmental impacts

Several commenting parties have cited examples of unsafe or environmentally damaging practices at densely crowded spent fuel pools at operating nuclear facilities. For example, the State of New York has submitted this day an extensive listing of leaking spent fuel pools at facilities around the country. See Comments from the State of New York.[3] Specifically, the State of New York identifies leaks of radioactive concern at Indian Point Units One and Two, Brookhaven National Laboratories, Seabrook, Point Beach Nuclear Power Plant, and the Salem Nuclear Station in Delaware. Those leaks have contaminated groundwater and public waterways and have called into serious question the integrity of spent fuel under water storage conditions. The crucial issue is the NRC's continued acceptance of the premise that high-density fuel storage pools pose no risks. Without a searching and public environmental review of the current technical and regulatory safety regime, this acceptance is unfounded.

b. Security concerns must be taken into account in the NEPA examination and licensing of spent fuel storage facilities

In both the proposed Waste Confidence Decision and in the Proposed Temporary Fuel Storage Rule, the NRC continues to deny that temporary spent fuel storage poses significant environmental risks, ignoring a wealth of government reports showing that high-density fuel storage pools are vulnerable to catastrophic fires that may be caused by accidents or intentional attacks. Instead of confronting this information in a detailed GEIS (and in a site-specific supplemental EIS), the NRC terms these issues a security matter and shrouds them in an unjustifiably broad mantle of security-related secrecy.

As the State of California correctly points out in comments on these matters:

> [T]he NRC, in its discussion of the justification for its proposed changes to the Waste Confidence findings at 73 Fed. Reg. 59548-59549, appears to base its proposed regulation principally on information it cited in its decision to deny the petitions of California and Massachusetts. That decision heavily relied on the "Sandia Studies," 73 Fed. Reg. 46207, fn 6 (August 8, 2008). The NRC states that these studies performed after September 11, 2001, support its finding that the risk of a successful terrorist attack is very low. This study has been withheld from the public, and a version that was made available to the public via a response to a

[3] Testimony submitted today on behalf of Texan's for a Sound Energy Policy by Dr. Gordon Thompson also addresses this issue in detail.

> Freedom of Information Act request is so redacted as to be worthless. Instead of solely relying on studies that the public is not allowed to see and whose conclusions are not reviewable, the NRC should have, as Commissioner Jaczko noted in his dissenting view, considered the information supplied by the petitioners and should have used the information as part of its analysis." 73 Fed. Reg. 46212 (August 8, 2008).

State of California, Department of Justice, Comments on Proposed Waste Confidence Decision Update (Docket ID-2008-0482), February 5, 2009, at 3.

The NRC may not use security concerns as an excuse for failing to comply with the basic requirements of NEPA for a FONSI, such as addressing the regulatory requirements for an EA, identifying the documents on which it relies for its decision, and disclosing all portions of its decision-making documents that are non-exempt under the FOIA. San Luis Obispo Mothers for Peace v. NRC, 449 F.3d 1016, 1034-35 (9th Cir. 2006).

In these proposed actions the NRC fails to explain why it is justified in continuing to allow licensees to use dangerous high-density fuel storage pools to store spent fuel under protective measures whose adequacy is, at best, suspect. Equally important, none of these contentions can be publicly verified, when it would be possible to virtually eliminate the danger by using low-density pool storage for appropriate periods of time and then hardened on-site dry storage of spent fuel once that fuel could be removed from the pools. This is a matter that could be rectified by a transparent public process and the NRC's stance is unlawful, corrosive to the NRC's system of accountability through open decision-making, and potentially dangerous because the decision-making process was both secret and restricted to a limited group of individuals with a vested interest in minimizing the cost of safety and environmental protection measures.

c. The Proposed Temporary Storage rule is contrary to NRC regulations

The Proposed Temporary Storage Rule proposes to find that if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts ... until a disposal facility can reasonably be expected to be available. 73 Fed. Reg. 59547. This formulation of the proposed Temporary Storage Rule dispenses with a time limit on the Commission's finding that any current – or yet to be generated spent fuel – can be stored safely and without significant environmental impacts. As described in comments above, it's been nearly 60 years since the first efforts began in this country to identify a geologic repository for spent fuel and HLW, and it could easily be another 30, 40, or even many more years, if ever, if the proposed Yucca Mountain site is found unsuitable.[4]

[4] Even the NRC tacitly acknowledges this fact in its discussion of the proposed rule. See 73 Fed. Reg. 59549.

Such a finding – a finding that essentially exists in perpetuity – is contrary to the NRC's long-standing policy of at least some minimal time limitation on the actions of its licensees with respect to active institutional controls at nuclear facilities. In its Technical Requirements for Land Disposal Facilities, the regulations state in pertinent part: "The period of institutional controls will be determined by the Commission, but institutional controls may not be relied upon for more than 100 years following transfer of control of the disposal site to the owner." 10 C.F.R. § 61.59(b). A proposed rule that finds that spent nuclear fuel can be safely managed, for all intents and purposes in perpetuity, is contrary to law.

D. There is no basis for continued reliance on an outdated uranium fuel cycle rule – which itself is contingent upon the Waste Confidence Rule – that depends on assumptions long since proven wrong or, simply, no longer applicable by virtue of current law

Finally, the NRC's lack of a basis for any determination that there is "confidence" in a final disposal option for some or all of the nation's spent fuel fatally undermines Table S-3 of the NRC's Uranium Fuel Cycle Rule, which depends on the assumption that radioactive releases from a repository will be zero. Final Rule, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management, 44 Fed. Reg. 45,362 (August 12, 1979).

1. The rationale for the BG&E decision no longer spares NRC from having to perform a GEIS/NEPA review for addressing the environmental impacts of the storage of nuclear waste

In 1983, the Supreme Court found that the NRC, in its final S-3 Table, "summarized the major uncertainties of long-term storage of nuclear wastes, noted that the probability of intrusion was small, and found the evidence 'tentative but favorable' that an appropriate storage site could be found." BG&E v. NRDC, 462 U.S. at 87. The central holding of BG&E is straightforward – the NRC complied with NEPA's requirements of consideration and disclosure of the environmental impacts of its licensing decisions." Id. at 88. But in dicta, the Supreme Court explained that the zero-release assumption and, indeed, the entirety of Table S-3 rule was made for a limited purpose, and that it would be supplemented with an explanatory narrative. Id. at 101. Also, a separate and comprehensive set of programs has been undertaken to serve the broader purposes of long-term waste disposal technology and site selection. Id. See note 1, supra. Second, the Court emphasized that the zero-release assumption is but a single figure in an entire Table, which the Commission expressly designed as a risk-averse estimate of the environmental impact of the fuel cycle. Id. at 102 and 103. And third, the Court was careful not to tread into the area of the NRC's special expertise. Id.

The crucial bases for the Supreme Court's decision to uphold the NRC's defense of the validity of Table S-3 are no longer valid, and the NRC must revisit this decades-old Table S-3 and all associated decisions regarding the environmental impacts of the uranium fuel

cycle with new, "hard look" NEPA review. As the Court itself noted, "no one suggests that the uncertainties are trivial or the potential effects insignificant if time proves the zero-release assumption to have been seriously wrong. After confronting the issue, though, the Commission has determined that the uncertainties concerning the development of nuclear waste storage facilities are not sufficient to affect the outcome of any individual licensing decision." Id. at 98 (emphasis added).

a. The bases for Table S-3, including the zero release assumption, are no longer technically supportable, accurate or consistent with policy

At the time of BG&E decision, the NRC considered bedded salt as suitable for disposal either of reprocessed high-level waste or un-reprocessed spent fuel. Yet, the Proposed Waste Confidence rule of 2008 states that salt formations are not being considered for spent fuel disposal for technical reasons. Hence, the technical underpinning of Table S-3 is inconsistent with current law and the NRC's own understanding of salt repositories. Indeed, disposal in salt, which was the original basis for the S-3 Table in estimating the environmental impact of high-level waste or spent fuel disposal, is only considered suitable for high-level waste resulting from reprocessing, but reprocessing is not the current policy, and nor should it be.[5] Rather, direct disposal of spent fuel, for which the NRC would not consider salt formation, is now the current policy.

More pointedly, presuming "zero release" of radioactivity when disposing of spent fuel runs directly counter to all established scientific understanding of the expected performance of any geologic setting. One glance at Appendix A to this filing demonstrates this fact. Radioactivity will be released from a repository – the dose and timing of such release is a matter for standards and licensing, but the point remains. Radioactive dose is the result of positive releases of radionuclides into the human environment. As far back as 1983, the report on geologic isolation prepared for the DOE by the National Research Council shows positive doses attributable to both fission products as well as actinides in un-reprocessed spent fuel as well as from fission products in reprocessed high-level waste in all settings other than salt that were evaluated – tuff, granite, and basalt. The Supreme Court's concerns – that the problems would be neither trivial nor insignificant if the zero-release assumption turned out to be wrong – were well taken. Where, for example, is the Commission's analysis of the estimated range in the collective dose from the proposed Yucca Mountain repository, and what is the basis for concluding that the Table S-3 is still valid in light of this collective dose range?

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[5] Spent-fuel reprocessing and plutonium-fueled fast reactors are well-proven commercial disasters. The United States, Europe, and Japan spent tens of billions of dollars in the 1970s and 1980s trying to develop plutonium fast-breeder reactors (like the proposed Global Nuclear Energy Partnership "advanced burner reactors," but with uranium "blankets" added to "breed" more plutonium than is consumed in the reactor). These fast reactors proved to be uneconomical, highly unreliable, and prone to fires due to leaking liquid sodium coolant, which burns spontaneously when it comes in contact with air or water. For a full discussion, see http://www.nrdc.org/nuclear/gnep/agnep.asp.

Moreover, the original scope of Table S-3 (and the underlying document in WASH-1248) is inadequate and outdated. Along with failing to address the environmental impacts of spent fuel disposal, the table looks only at the health impacts of an individual plant licensing decision. The Table fails to account for the cumulative impacts of licensing many plants, the economic costs of disposing of all waste generated by the uranium fuel cycle, or even adding those costs to the other costs of a nuclear power plant. Nor does the Table compare the total costs of building and operating a new nuclear facility (and ultimately disposing of associated waste and funding the decommissioning costs) with the costs of the no action alternative or with other alternative sources of energy.

b. Development of the repository has proven to be problematic

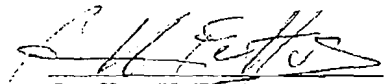
The separate and comprehensive set of programs that the Supreme Court in 1983 relied upon in the BG&E decision led us to where we are today. This history is detailed in Sections IV.B.2. of these comments, which make clear there is no reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50-60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial high-level nuclear waste and spent fuel originating in such reactor and generated up to that time.

V. Conclusion

For the reasons noted above, NRDC requests that the Proposed Waste Confidence Rule and the Proposed Temporary Storage Rule be withdrawn until such time as they comply with AEA and NEPA. To comply with the law, both actions must be supported by thorough, publicly available, and well-documented safety findings and accompanied by a Generic Environmental Impact Statement that fully assesses the environmental impacts of the entire uranium fuel cycle, including health and environmental impacts and costs, and that examines a reasonable array of alternatives, including the alternative of not producing any additional radioactive waste.

We appreciate the opportunity to comment. If you have any questions, please do not hesitate to contact us.

Sincerely,



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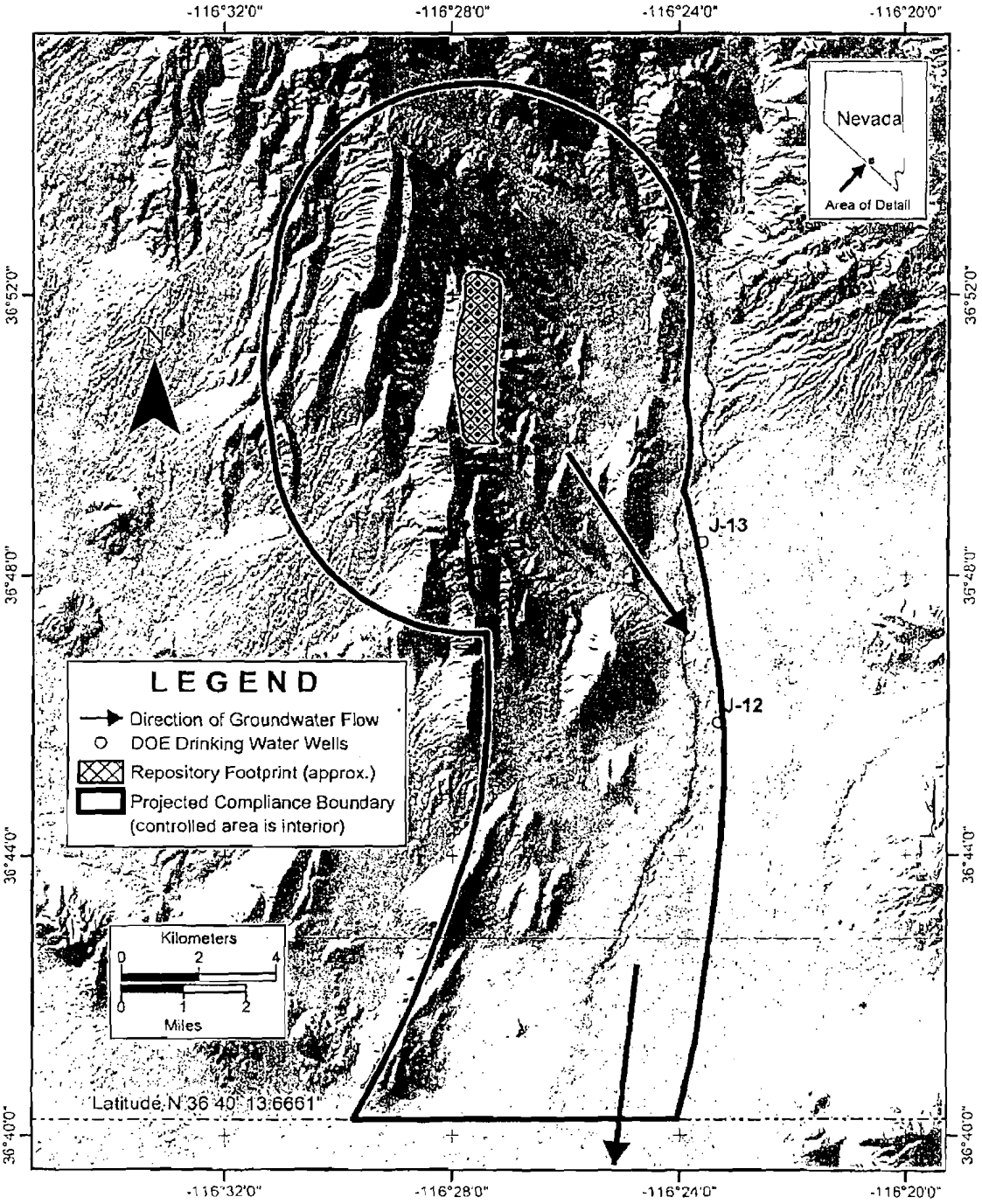
Projected Groundwater Standards Compliance Boundary for Spread of Radioactive Contamination at the Yucca Mountain Project

Measurement of Radioactive Contamination Takes Place Outside of Controlled Area



NRDC produced this visual representation from the following information:
"The controlled area may extend no more than 5 km in any direction from the repository footprint, except in the direction of groundwater flow. In the direction of groundwater flow, the controlled area may extend no farther south than latitude 36 40' 13.6661" North ... [T]he size of the controlled area may not exceed 300 square km." 66 Fed Reg. at 32117 (June 13, 2001). The direction of groundwater flow is from FEIS (February 2002) at 5-21, Figure 5-3. The repository footprint is from the Yucca Mountain Science and Engineering Report, DOE/RW-0539, at 1-17, Figure 1-3, and the area is approximately 4.27 square km. The area within the projected compliance boundary, as shown in this map, is about 230 square km. The relief image was created from a 1 arc-second Digital Elevation Model from the USGS National Elevation Dataset, April 2002. This map is based on a Nevada State Plane Central projection, North American Datum 1927.

Rulemaking Comments

From: Go, Alyssa [ago@nrdc.org]
Sent: Friday, February 06, 2009 5:59 PM
To: Rulemaking Comments
Cc: Fettus, Geoffrey
Subject: NRDC Comments on the Proposed Waste Confidence Rule and the Proposed Temporary Storage Rule
Attachments: NRDC Comments PWCR and PTSR 2009-2-6.PDF

Hello,

Please find attached a copy of NRDC's comments on the Proposed Waste Confidence Rule and the Proposed Temporary Storage Rule (Docket ID-2008-0482 and NRC-2008-0404).

This document was also sent via First Class Mail.

Please let me know if you have any problems with the file.

Alyssa Go

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Temporary Storage Rule
Thread-Index: AcmIroKgYAWdjvckS1upkEbBdwuGAQ==
From: "Go, Alyssa" <ago@nrdc.org>
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February 6, 2009

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE SECRETARY

Waste Confidence Decision Update 10 C.F.R. Part 51 73 Fed. Reg. 59,551 (Oct. 9, 2008)	)	Docket ID – 2008-0482
Proposed Rule: Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation Of Reactor Operation 10 C.F.R. Part 51 73 Fed. Reg. 59,547 (Oct. 9, 2008)	)	RIN: 3150-A147 Docket ID – 2008-0404

COMMENTS BY TEXANS FOR A SOUND ENERGY POLICY, ALLIANCE FOR NUCLEAR RESPONSIBILITY, BEYOND NUCLEAR, BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE, C-10 RESEARCH AND EDUCATION FOUNDATION, DON'T WASTE MICHIGAN, ENVIRONMENTAL COALITION ON NUCLEAR POWER, FRIENDS OF THE EARTH, FRIENDS OF THE COAST OPPOSING NUCLEAR POLLUTION, GRANDMOTHERS, MOTHERS AND MORE FOR ENERGY SAFETY, NEW ENGLAND COALITION, NUCLEAR INFORMATION AND RESOURCE SERVICE, NUCLEAR FREE VERMONT BY 2012, NUCLEAR WATCH SOUTH, PILGRIM WATCH, PUBLIC CITIZEN, SAN LUIS OBISPO MOTHERS FOR PEACE, THE SNAKE RIVER ALLIANCE, SOUTHERN ALLIANCE FOR CLEAN ENERGY, AND THE SUSTAINABLE ENERGY AND ECNOMIC DEVELOPMENT COALITION
REGARDING NRC'S PROPOSED WASTE CONFIDENCE DECISION UPDATE AND PROPOSED RULE REGARDING CONSIDERATION FOF ENVIRONMENTAL IMPACTS OF TEMPORARY STORAGE OF SPENT FUEL AFTER CESSATION OF REACTOR OPERATIONS

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TABLE OF CONTENTS

TABLE OF AUTHORITIES

COURT CASES

NRC CASES

STATUTES

REGULATIONS

FEDERAL REGISTER NOTICES

MISCELLANEOUS

I. INTRODUCTION

Texans for a Sound Energy Policy, Alliance for Nuclear Responsibility, Beyond Nuclear, Blue Ridge Environmental Defense League, C-10 Research and Education Foundation, Environmental Coalition on Nuclear Power, Friends of the Earth, Friends of the Coast Opposing Nuclear Pollution, New England Coalition, Grandmothers, Mothers and More for Safe Energy, Nuclear Information and Resource Service, Nuclear Free Vermont by 2012, Nuclear Watch South, Pilgrim Watch, Public Citizen, San Luis Obispo Mothers for Peace, Southern Alliance for Clean Energy, Snake River Alliance, and the Sustainable Energy and Economic Development Coalition (collectively "Commenters") hereby submit comments on the U.S. Nuclear Regulatory Commission's ("NRC's") proposed Waste Confidence Decision Update, 73 Fed. Reg. 59,551 (October 9, 2008) ("Proposed Waste Confidence Decision"); and its proposed rule entitled: Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation, 73 Fed. Reg. 59,547 (October 9, 2008) ("Proposed Temporary Storage Rule").[1]

These comments are supported by two expert declarations and technical reports:

- the expert declaration of Dr. Arjun Makhijani, President of the Institute for Energy and Environmental Research ("IEER"), to which is attached his curriculum vitae and expert report entitled "Comments of the Institute for Energy and Environmental Research on the U.S. Nuclear Regulatory Commission's Proposed Waste Confidence Rule Update and Proposed Rule Regarding Environmental Impacts of Temporary Spent Fuel Storage" (February 6, 2009) ("IEER Comments"); and
- the expert declaration of Dr. Gordon R. Thompson, Executive Director of the Institute for Resource and Security Studies ("IRSS"), to which is attached his curriculum vitae and expert report entitled "Environmental Impacts of Storing Spent Fuel and High-Level Waste from Commercial Nuclear Reactors: A Critique of NRC's Waste Confidence Decision and Environmental Impact Determination" (February 6, 2009) ("Thompson Report").

As discussed below, Commenters believe that the Proposed Waste Confidence Decision and the Proposed Temporary Fuel Storage Rule fail to comply with the requirements of the Atomic Energy Act ("AEA") and the National Environmental Policy Act ("NEPA"), and therefore should be withdrawn. The Commission should cease to license the operation of any new nuclear power plants or re-license any existing nuclear power plants unless and until it is able to make a supportable determination that spent fuel can be safely stored and disposed of, and unless and until that determination is made in compliance with NEPA.

1 Some of the organizations who are participating in these comments have also filed other comments, in addition to these comments.

II. SUMMARY OF COMMENTS

Almost thirty years ago, the NRC issued its first proposed Waste Confidence Decision, concluding that spent reactor fuel could be safely disposed of and that in the meantime it could be safely stored at nuclear reactor sites. Notice of Proposed Rulemaking, Storage and Disposal of Nuclear Waste, 44 Fed. Reg. 61,372 (October 25, 1979). In a companion rulemaking, based on a previous Waste Confidence policy decision that spent fuel could be safely contained in a bedded salt repository, the NRC made a finding that the health impacts of the entire uranium fuel cycle – from uranium mining to spent fuel disposal – would have no significant adverse impacts on the human environment. Final Rule, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management, 44 Fed. Reg. 45,362 (August 12, 1979).

The NRC relied on these interdependent generic rules to license a whole generation of nuclear power reactors, and has re-licensed many of those reactors for additional twenty-year terms. These nuclear power plants have generated a total of 56,000 metric tons of spent fuel as of April 2008, and fueling them was responsible for the creation of 300,000 metric tons or more of depleted uranium tails, for which neither the NRC nor the U.S. Department of Energy ("DOE") has yet found a safe means of disposal. The DOE expects that spent fuel from existing reactors will increase to 119,000 metric tons by 2035. Meanwhile, at the site of every operating reactor in the United States, spent fuel accumulates in high-density fuel storage pools, which the government has admitted are vulnerable to catastrophic fire caused by intentional attacks and accidents. In addition, thousands of cubic meters of greater than class C ("GTCC") waste will be generated when reactors now in operation are decommissioned. The amount of GTCC waste will be much greater if spent fuel is reprocessed.

For almost thirty years after the Waste Confidence Rule was first proposed in 1979, the NRC did not receive any new applications to build or operate new nuclear power plants. As of today, however, the NRC now has a significant number of new reactor applications before it. In total, the NRC is considering applications for more than thirty new reactors, which together would produce about 30,000 metric tons more spent fuel, assuming the plants operate for 40 years, and 45,000 metric tons if they operate for 60 years. These plans would also generate correspondingly large amounts of depleted uranium tails, GTCC waste (due to decommissioning and reprocessing), and other radioactive waste. Yet, the NRC is no closer to a disposal solution than it was thirty years ago.

As discussed at length in IEER's Comments, the NRC simply has no technical basis for a finding of reasonable confidence that spent fuel can and will be safely disposed of at some time in the future. Therefore, under the Commission's own standard that "it would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely," the Commission must refuse to issue new licenses or renew existing licenses for nuclear power plants. 73 Fed. Reg. at 59,552 (citing 42 Fed. Reg. 34,391, 34,393 (July 5, 1977); *Natural Resources Defense Council v. NRC,* 582 F.2d 166 (2d Cir. 1978)).

The NRC's lack of a basis for any finding of confidence in the technical feasibility of a repository also fatally undermines Table S-3 of the NRC's Uranium Fuel Cycle Rule, which depends on the assumption that radioactive releases from a repository will be zero. Final Rule, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management, 44 Fed. Reg. 45,362 (August 12, 1979). Based on its own statement in the 1990 Waste Confidence rulemaking proceeding, the NRC, having arrived at a stage where any basis that it may have had for confidence in the safe disposal of spent fuel has clearly evaporated, must revisit the basis for Table S-3. *See* Review and Final Revision of Waste Confidence Decision, 55 Fed. Reg. 38,474, 38,491 (September 18, 1990) ("Unless the Commission, in a future review of the Waste Confidence decision, finds that it no longer has confidence in the technical feasibility of disposal in a mined geologic repository, the Commission will not consider it necessary to review the S-3 rule when it reexamines its Waste Confidence findings in the future.") Certainly, the Commission no longer has any basis whatsoever for the principal assumption underlying Table S-3, which is that spent fuel can be safely disposed of in a repository, having repudiated that assumption in the proposed Waste Confidence Decision. 73 Fed. Reg. at 59,555. *See also* IEER Comments.

In both the proposed Waste Confidence Decision and the Proposed Temporary Fuel Storage Rule, the NRC continues to deny that temporary spent fuel storage poses significant environmental risks, ignoring a wealth of government reports showing that high-density fuel storage pools are vulnerable to catastrophic fires that may be caused by accidents or intentional attacks. Instead of confronting this information in a detailed EIS, the NRC calls it a security matter and shrouds it in an unjustifiably broad mantle of security-related secrecy. But the NRC is not entitled to use security concerns as an excuse for failing to comply with NEPA. *San Luis Obispo Mothers for Peace v. NRC,* 449 F.3d 1016, 1034-35 (9th Cir. 2006).

In making a finding of no significant impact ("FONSI") with respect to spent fuel storage, the NRC has not even attempted to comply with the NRC's procedural requirements for a FONSI, such as preparing an environmental assessment ("EA") that addresses the purpose of and need for the proposed action and evaluates alternatives to the proposed action. The NRC also violates NEPA by failing to identify the documents on which it relies for its decision, and by failing to disclose all portions of its decision-making documents that are non-exempt under the Freedom of Information Act ("FOIA"). *San Luis Obispo Mothers for Peace* (Diablo Canyon Independent Spent Fuel Storage Installation), CLI-08-01, 67 NRC 1, 15-17 (2008) (citing *Weinberger v. Catholic Action of Hawaii,* 454 U.S. 139, 143 (1981)).

Perhaps most importantly, the NRC fails to explain why it is justified in continuing to allow licensees to use dangerous high-density fuel storage pools to store spent fuel under protective measures whose adequacy is suspect but cannot be publicly verified, when it would be possible to virtually eliminate the danger by using low-density pool storage and hardened dry storage of spent fuel. The NRC's secrecy is unnecessary, corrosive to the

NRC's system of accountability through open decision-making, and potentially dangerous because the decision-making process was not only secret but was restricted to the NRC and a limited group of individuals with a vested interest in minimizing the cost of mitigative measures, *i.e.*, reactor licensees.

The Proposed Waste Confidence Rule and the Proposed Temporary Fuel Storage Rule are utterly inadequate to satisfy the requirements of the AEA and NEPA for a generic licensing decision for new nuclear power plants. Any generic decision to allow the creation of additional spent reactor fuel and other radioactive waste associated with the uranium fuel cycle must be accompanied by thorough, supported, and well-documented safety findings; and it must also be accompanied by an environmental impact statement ("EIS") that fully assesses the environmental impacts of the uranium cycle, including health and environmental impacts and costs, and that examines a reasonable array of alternatives, including the alternative of not producing any additional radioactive waste.

III. DESCRIPTION OF COMMENTERS

The following is a description of the Commenter organizations. All of the organizations are neighbors of existing or proposed nuclear power plants, and most have either intervened or plan to intervene in NRC proceedings for the licensing or re-licensing of nuclear power plants.

Texans for a Sound Energy Policy ("TSEP") is a non-profit educational organization based in Victoria, Texas whose purpose is to identify and evaluate energy alternatives and their environmental, social and economic impacts, including but not limited to nuclear power, coal-fired power plants and other energy production facilities. Because Victoria is the proposed site of a new nuclear power plant, TSEP has an interest in ensuring that the environmental impacts and safety risks of spent fuel storage and disposal, taken together with the other safety and environmental risks posed by a new nuclear plant, will be adequately considered by the NRC.

Beyond Nuclear is a national watchdog organization on the nuclear power and radioactive waste industries, as well as on the federal government agencies which are supposed to protect the public and the environment from the risks of radiation and radioactive waste to human health and ecosystems. Beyond Nuclear aims to educate and activate the public about the connections between nuclear power and nuclear weapons and the need to abandon both to safeguard our future, including on the risks associated with the inevitable generation of radioactive waste by the nuclear industry. Beyond Nuclear advocates for an energy future that is sustainable, benign and democratic. It is headquartered in Takoma Park, Maryland, a Nuclear-Free Zone.

The Blue Ridge Environmental Defense League ("BREDL") is a 25-year-old regional, community-based non-profit environmental organization in the southeastern United States, whose founding principles are earth stewardship, environmental democracy, social justice, and community empowerment. BREDL encourages government agencies and citizens to take responsibility for conserving and protecting our natural resources.

BREDL advocates grassroots involvement to empower whole communities in environmental issues. BREDL also functions as a "watchdog" of the environment, monitoring issues and holding government officials accountable for their actions.

Established in 1991, C-10 Research and Education Foundation's mission is to monitor radiological emissions from the Seabrook nuclear reactor for use in assessing the plant's impact on human health and the environment. C-10 participated in the licensing proceeding for the Seabrook nuclear power plant.

Don't Waste Michigan is a state-based organization formed to stop Michigan from becoming a nuclear waste dumpsite.

Located in western Pennsylvania, the Environmental Coalition on Nuclear Power represents individuals and groups concerned about nuclear power and energy policy. Through educational, legal and political activities, the Coalition promotes a safe, non-nuclear U.S. energy policy.

Friends of the Earth is a leader in climate and energy solutions and in protecting human communities from environmental harm. It is the U.S. voice of an influential international network that operates in 70 countries. In South Carolina, Friends of the Earth has intervened in the NRC's licensing proceeding and the state regulatory proceeding for the V.C. Summer nuclear power plant.

Friends of the Coast-Opposing Nuclear Pollution is a Maine-based organization advocating for nuclear safety, safe storage of nuclear waste, and protection of the human environment from nuclear pollution. Friends of the Coast was the only environmental advocacy organization actively engaged in the decommissioning of Maine Yankee Atomic Power Station (1997-2005) and the only non-governmental organization involved in oversight of the Maine Yankee Independent Spent Fuel Storage Installation.

Since 1971, the New England Coalition ("NEC") has advocated for safe energy in New England and has provided education and resources for alternatives to nuclear power. NEC has also intervened in numerous NRC licensing proceedings involving the safety and environmental impacts of spent fuel storage at New England nuclear power plants.

Based in Atlanta, Georgia, Nuclear Watch South (formerly Georgians Against Nuclear Energy) is a regional, volunteer-based non-profit environmental group dedicated to phasing out nuclear power plants; abolishing nuclear weapons, safeguarding nuclear materials; and establishing ethical social policies for nuclear waste management.

Located in southeastern Massachusetts, Pilgrim Watch is a grassroots organization that serves the public interest in issues regarding the Pilgrim Nuclear Power Station in Plymouth, Massachusetts.

Public Citizen is a national, nonprofit consumer advocacy organization with over 70,000 members nationwide. Public Citizen's mission is to protect openness and democratic

accountability in government and the health, safety, and financial interests of consumers. Public Citizen advocates for policies that will lead to safe, affordable and environmentally sustainable energy.

Grandmothers, Mothers and More for Energy Safety is an action-oriented networking organization working for a safe, responsible, renewable energy future and against the re-licensing of Oyster Creek Nuclear Generating Station in Ocean County, New Jersey.

Nuclear Free Vermont by 2012 is a member organization of people living near the Entergy Nuclear Vermont Yankee reactor and waste dump in Vernon, Vermont, whose mission is to educate people about how nuclear power affects the health and safety of the public.

Nuclear Information and Resource Service ("NIRS") is a non-profit corporation with over 12,000 members across the United States. NIRS has a mission to promote a non-nuclear energy policy, and a concern for the health and safety of the people and ecosphere.

San Luis Obispo Mothers for Peace ("SLOMFP") is a non-profit organization concerned with the risks and hazards connected with the Diablo Canyon Nuclear Power Plant, and with the dangers of nuclear power, weapons and waste on national and global levels. An all-volunteer non-profit group, SLOMFP has challenged NRC licensing decisions within the NRC and in Federal Courts since 1973.

The Southern Alliance for Clean Energy ("SACE") is a coalition of environmental and citizen organizations promoting green energy in the southeastern United States. SACE has intervened in several NRC proceedings for the licensing of new nuclear power plants.

The Snake River Alliance is an Idaho-based grassroots group working through research, education, and community advocacy for peace and justice, the end to nuclear weapons, responsible solutions to nuclear waste and contamination, and sustainable alternatives to nuclear power.

The Sustainable Energy and Economic Development ("SEED") Coalition is a project of Texas Fund for Energy and Environmental Education, Inc., a statewide nonprofit organization with 5,000 members working for clean air and clean energy in Texas. The organization advocates for sustainable energy, including energy efficiency, renewable energy and conservation.

IV. LEGAL AND FACTUAL BACKGROUND

A. Requirements of the Atomic Energy Act and the National Environmental Policy Act With Respect to NRC Decisions Regarding Spent Fuel Storage and Disposal

1. Safety determination under the AEA

The AEA precludes the NRC from licensing any new nuclear power plant or re-licensing any existing nuclear power plant if it would be "inimical . . . to the health and safety of the public." 42 U.S.C. § 2133(d). In conformance with this requirement, the Commission has stated that it will only license a new nuclear power plant "so long as the Commission can be reasonably confident that permanent disposal (as distinguished from continued storage under surveillance) can be accomplished safely when it is likely to become necessary." *Natural Resources Defense Council v. NRC,* 582 F.2d 166 (2d Cir. 1978). In the Proposed Waste Confidence Decision, the Commission has repeated its commitment not to license new nuclear power plants unless it can make this finding ("[The Commission] would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely.") 73 Fed. Reg. at 59,552. Finding # 1 of the Proposed Waste Confidence Decision addresses this requirement and effectively constitutes a licensing determination that spent fuel disposal risks are not inimical to public health and safety.

In licensing nuclear power plants, the Commission must also make a predictive finding that spent fuel can be stored safely pending ultimate disposal. *State of Minnesota v. NRC,* 602 F.2d 412, 418-19 (D.C. Cir. 1979). Proposed Findings 3, 4 and 5 of the Proposed Waste Confidence Decision address this requirement and effectively constitute a licensing determination that spent fuel storage risks are not inimical to public health and safety.

2. Environmental analysis under NEPA

Separate from the AEA, NEPA requires that before licensing or re-licensing nuclear power plants, the NRC must evaluate, in an EIS, the environmental impacts of licensing decisions that have a significant environmental impact. 42 U.S.C. § 4332(C). NRC regulations include the licensing of nuclear power plants among actions that require the preparation of an EIS. 10 C.F.R. § 51.20(b)(2).

Even where an agency believes the environmental impacts of a proposed action are insignificant, an EIS may be required, depending up "'[t]he degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.'" *Foundation on Economic Trends v. Heckler,* 756 F.2d 143, 155 (D.C. Cir. 1985) (quoting 40 C.F.R. § 1508.27(b)(5)). *See also Blue Mountains Biodiversity Project v. Blackwood,* 161 F.3d 1208, 1213 (9th Cir. 1998) (noting that a project may have significant environmental impacts where its effects are "highly uncertain or involve unique or unknown risks."); *Morgan v. Walter,* 728 F.Supp. 1483, 1489 (D. Id. 1989).

An EIS must address the environmental impacts of the proposed action and connected actions and weigh the costs and benefits of a reasonable array of alternatives for avoiding or mitigating the consequences of the proposed action. 10 C.F.R. § 51.71(d). It must also address the cumulative impacts of the proposed action, *i.e.*, "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions . . ." 40 C.F.R. § 1508.7. *See also Hydro Resources, Inc.*, CLI-01-4, 53 NRC 31, 60 (2001).

To the extent possible, environmental impacts must be quantified; and where they cannot be quantified, they must be discussed in qualitative terms. 10 C.F.R. § 51.71(d).

3. Procedural requirements for compliance with AEA and NEPA

While the NRC may make a licensing determination through a notice-and-comment rulemaking, it must provide adequate support for its determination to satisfy the requirements of the Administrative Procedures Act ("APA"). *State of Minnesota,* 602 F.2d at 419. And while the NRC may make environmental determinations generically, those determinations must be made in compliance with the procedural requirements of NEPA, including preparation of an EIS for actions having a significant adverse impact on the human environment. *Baltimore Gas and Electric Co. v. Natural Resources Defense Council,* 462 U.S. 87, 99 (1983). In conducting supporting environmental analyses under NEPA, the NRC must comply with NEPA's procedural requirements for providing adequate notice to the public regarding the bases for its evaluation and decision, including the identification and disclosure of all reference documents that are not exempt from disclosure under the FOIA. *San Luis Obispo Mothers for Peace,* CLI-08-01, 67 NRC at, 15-17.

B. History of Waste Confidence Rulemaking

As recounted in the Proposed Waste Confidence Decision, as a result of a rulemaking petition proceeding and in response to the U.S. Court of Appeals for the D.C. Circuit's opinion on appeal of that rulemaking decision in *State of Minnesota,* 602 F.2d 412, the NRC has committed to periodically reassess "its finding of reasonable assurance that methods of safe permanent disposal of high-level radioactive waste (HLW) would be available when they were needed." 73 Fed. Reg. at 59,552. The Commission also committed that it would not continue to license reactors "if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely." *Id.*

The Proposed Waste Confidence Decision marks the third time since 1979 that the Commission has proposed to make positive findings regarding the prospects for safe disposal and storage of spent fuel. *See* proposed 1979 finding (44 Fed. Reg. 61,372 (October 25, 1979)); final 1984 finding (49 Fed. Reg. 34,658 (August 31, 1984)); proposed 1989 finding (54 Fed. Reg. 39,767 (September 28, 1989)); final 1990 finding

(55 Fed. Reg. 38,474 (September 18, 1990)). Each time, the NRC has re-iterated a finding that safe spent fuel disposal is technically feasible, and each time it has extended the period of time that it expects will be necessary to site a repository.

As discussed below in subsection IV.E, the NRC has relied on the Waste Confidence Decision to license and re-license many nuclear power plants, and therefore it constitutes a major federal action significantly affecting the environment. Yet, not one of the Waste Confidence Decision proposals was accompanied by an EIS that addressed the environmental impacts of spent fuel disposal.

C. Relationship Between Waste Confidence Rule and Table S-3 (Uranium Fuel Cycle Rule)

In 1979, the NRC promulgated a regulation concluding that the environmental impacts of the uranium fuel cycle were negligible. Final Rule, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management, 44 Fed. Reg. 45,362 (August 12, 1979). Estimates of radioactive releases from various stages of the uranium fuel cycle were presented in a table called "Table S-3." All of the estimated radiological releases were small. In the case of spent fuel disposal, the NRC estimated that radiological releases after the sealing of a repository would be zero. *See* Table S-3. The zero release estimate was based on two assumptions: first, that the repository would be located in a bedded salt deposit; and second, that no radioactivity would escape from the repository. 44 Fed. Reg. at 45,368.

Table S-3 was incorporated into NRC regulations at 10 C.F.R. § 51.51(b). 10 C.F.R. § 51.51(a) instructs that:

> Under § 51.50, every environmental report prepared for the construction permit stage or early site permit stage or combined license stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S-3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in this table as weighed in the analysis for the proposed facility.

The Uranium Fuel Cycle Rule's finding of no significant health impacts is related to the Waste Confidence Decision because its estimate of zero radioactive releases from a repository is based on the Commission's then-current Waste Confidence finding that "a suitable bedded-salt repository site or its equivalent will be found." 44 Fed. Reg. at

45,332. As the Commission explained in a subsequent policy statement, it based that finding on its "confidence" in the integrity of a repository:

> As the Commission noted in promulgating the [final uranium cycle rule], events which might lead to major releases from the bedded-salt repository used as the model for the S-3 rule appear remote in probability while any releases which might reasonably be expected eventually to occur appear very small. Accordingly, the Commission found that the staff's assumption that the integrity of the repository would be maintained after sealing was a reasonable description of the performance of a properly sealed repository and, when taken together with the staff's highly conservative assumption that all volatile fission products in reactor spent fuel would be released to the atmosphere prior to repository sealing, left Table S-3 overall a conservative description of fuel cycle impacts. *See* 44 FR 45369, col. 2. Considering the rule's limited purpose and taking into account the Commission's "waste confidence" proceeding, the Commission continues to believe that the record of the final S-3 rulemaking contains adequate information on waste disposal uncertainties to support continued use of the fuel cycle rule.

Policy Statement, Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts, 47 Fed. Reg. 50,591, 50,593 (Nov. 11, 1982).

In the 1990 update to the Waste Confidence Rule, the Commission also acknowledged that if it were to change its waste confidence decision, it would have to revisit the adequacy of Table S-3. 55 Fed. Reg. at 38,490.

The NRC has not updated Table S-3 since the 1970s. As the Commission recently explained, a planned update:

> was delayed because, by the mid-1980s, there were no new applications for construction of nuclear power plants, nor, at that time, were any future ones predicted. Consequently, there was no regulatory need to update Table S-3 and competing priorities for rulemaking resources eventually resulted in the cessation of activities on the table. Since the mid-1980s, the NRC has revisited the issue of revising the value for radon-222 in Table S-3 on more than one occasion, but in each case higher priority rulemakings led to a halt in these efforts.

New England Coalition on Nuclear Pollution; Denial of Petition for Rulemaking, 73 Fed. Reg. 14,946, 14,947 (March 20, 2008).

D. Relationship Between Waste Confidence Rule and FONSI With Respect to Environmental Impacts of Spent Fuel Storage

NRC regulation 10 C.F.R. § 51.23(a) reports that the Commission "has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that

reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations." This finding, in turn, is based on the Waste Confidence Decision and the environmental studies reported on in the Waste Confidence Decision. *See* Proposed Rule Regarding Temporary Fuel Storage, 73 Fed. Reg. at 59,549, 59,550.

E. NRC Reliance on Waste Confidence Rule and Table S-3 to License And Re-License Nuclear Power Plants

Since 1979, the NRC has used the Waste Confidence Decision as a generic licensing determination with respect to the safety and environmental impacts of storing and disposing of spent fuel. Therefore, in individual licensing proceedings, the NRC has rejected any contentions that question the safety or environmental impacts of spent fuel storage or disposal. For instance, in the following initial nuclear power plant licensing cases, the pendency of the Waste Confidence rulemaking was found to preclude the admission of contentions challenging the safety of onsite spent fuel storage and/or the prospects for safely disposing of spent fuel: *Carolina Power & Light Co. and North Carolina Eastern Municipal Power Agency* (Shearon Harris Nuclear Power Plant, Units 1 and 2), LBP-82-119A, 16 NRC 2069, 2081, 2102 (1982); *Virginia Electric and Power Co.* (North Anna Nuclear Power Station, Units 1 and 2), ALAB-584, 11 NRC 451, 465 (1980); *Public Service Electric and Gas Co., et al.* (Salem Nuclear Generating Station, Unit 1), ALAB-650, 14 NRC 43, 69 (1981).

The NRC has also relied on the generic findings of the Waste Confidence Decision and the related License Renewal Generic EIS (NUREG-1437, 1996) to preclude challenges to individual license renewal decisions. *See, e.g., Duke Energy Corp.* (Oconee Nuclear Station, Units 1, 2, and 3), CLI-99-11, 49 NRC 328, 344-45 (1999); *Florida Power & Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 and 4), CLI-01-17, 54 NRC 3, 21-23 (2001); *Nuclear Management Company, L.L.C.* (Palisades Nuclear Plant), CLI-06-17, 63 NRC 727, 734 n.29 (2006); *Entergy Nuclear Vermont Yankee, L.L.C. and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), and *Entergy Nuclear Generation Company and Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station), CLI-07-03, 65 NRC 13, 17-18 (2007); *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Station), LBP-08-13, __ NRC __ (July 31, 2008).

And in recent early site permit cases for new nuclear power plants, the NRC reached the same conclusion. *See, e.g., Dominion Nuclear North Anna, L.L.C.* (Early Site Permit for North Anna ESP Site), LBP-04-18, 60 NRC 253, 268-69 (2004); *Exelon Generating Company* (Early Site Permit for Clinton ESP Site), LBP-04-17, 60 NRC 229, 246-47 (2004); *System Energy Resources, Inc.* (Early Site Permit for Grand Gulf ESP Site), LBP-04-19, 60 NRC 277, 296 (2004).

Thus, since the first Waste Confidence rulemaking began, the Waste Confidence Decision has served as a surrogate for individual licensing determinations that storage and disposal of spent fuel can be conducted safely and without significant adverse environmental impacts.

The NRC also relies on Table S-3 and the Uranium Fuel Cycle Rule as a licensing determination that the environmental impacts of the uranium fuel cycle are benign and therefore do not warrant the denial or restriction of licenses. The NRC will deem a license application to be sufficient if it incorporates the very small (or in the case of spent fuel, zero) estimates of radiological releases from the uranium fuel cycle that are presented in the 30-year-old Table S-3, and then extrapolates them into correspondingly insignificant health and economic effects. The NRC has ruled that the quantitative figures in Table S-3 may not be challenged in individual licensing proceedings. *See, e.g., Tennessee Valley Authority* (Bellefonte Nuclear Power Plant, Units 3 and 4), LBP-08-16, __ NRC __, slip op. at 70-72 (September 12, 2008); *Philadelphia Electric Co.* (Limerick Generating Station, Units 1 and 2), LBP-83-6, 17 NRC 153, 154-56 (1983).

V. THE NRC'S GENERIC LICENSING DECISION THAT STORAGE AND DISPOSAL OF SPENT FUEL CAN BE ACCOMPLISHED SAFELY AND WITHOUT SIGNIFICANT ADVERSE ENVIRONMENTAL IMPACTS DOES NOT COMPLY WITH THE REQUIREMENTS OF THE AEA, NEPA, OR THE APA.

As discussed above in Section IV.E, the Waste Confidence Decision effectively constitutes a generic licensing decision that it is safe to license and re-license nuclear power plants because disposal and storage of the radioactive waste that they generate will not be inimical to public health and safety. As a licensing decision, the Waste Confidence Decision is subject to the requirements of both the AEA and NEPA.

A. The NRC's Generic Licensing Decision That Spent Fuel Can Be Safely Disposed of Does Not Comply with the AEA or NEPA.

1. NRC's safe disposal decision fails to comply with the AEA because its safety finding is unsupported.

As discussed in detail in the attached IEER Comments, the NRC lacks a basis for a reasonable level of confidence that disposal of spent fuel in a repository is technically feasible. A geologic repository is a mined system that is highly perturbed thermally, chemically, and mechanically from its original geological setting. In this system, three elements must be shown to work together: the waste and the waste encapsulation system, the backfill and sealant system, and the near- and far-field perturbed geologic environment. The NRC has not made such a demonstration. The research done so far on potential repositories has been completely inadequate to show any reasonable prospect for containment of radioactivity by a repository, in other words that a sealed geological repository with a large amount of spent fuel can contain radioactivity sufficiently to comply with safety, health and environmental standards.

2. NRC's safe disposal decision fails to comply with NEPA because it is not supported by an EIS that fully and accurately evaluates the environmental impacts of the uranium fuel cycle, including the impacts of spent fuel disposal.

NEPA requires that NRC licensing decisions with significant adverse environmental impacts must be supported by an EIS. Clearly, the generation of large quantities of highly radioactive spent fuel poses extremely grave risks to public health and safety, and therefore demands preparation of an EIS. In addition, the significant uncertainties that attend predictions of whether the radioactive waste will remain isolated for thousands of years warrant the preparation of an EIS. *See* 40 C.F.R. § 1508.27(b)(5)), *Blue Mountains Biodiversity Project,* 161 F.3d at 1213.

If the NRC wishes to continue to rely on the Waste Confidence Decision to allow the licensing of new nuclear power plants and the re-licensing of existing nuclear power plants, it must comply with NEPA to the "fullest" extent allowed by the law. *Calvert Cliffs Coordinating Comm. v. United States Atomic Energy Comm.,* 449 F.2d 1109, 1115 (D.C. Cir. 1971). The NRC therefore must support its generic decisions to license the future production of spent fuel and other radioactive waste by preparing a generic EIS that evaluates the environmental impacts of that decision. In compliance with 40 C.F.R. § 1502.22(b), the generic EIS must address all reasonably foreseeable environmental impacts, including the impacts of the entire stream of radioactive waste that will be generated by those plants, from mining to ultimate disposal, and including all intermediate stages.

The generic EIS must examine the cumulative impacts and costs of the entire amount of waste that will be generated, including the environmental impacts and costs of siting, building, and operating each additional repository. 40 C.F.R. § 1508.7. The EIS must also weigh the relative costs and benefits of licensing individual nuclear power plants – including the costs and benefits of generating and disposing of a significant quantity of radioactive waste – against the costs and benefits of other alternatives that would not involve the creation of that waste. 10 C.F.R. § 51.71(d). And because the evaluation of the environmental impacts of radioactive waste disposal involves predictions far into the future, the generic EIS must address the uncertainty that attends those predictions. 40 C.F.R. § 1508.27(b)(5). *See also* IEER Comments.

3. No existing EIS is sufficient to support the Waste Confidence Decision

No pre-existing EIS, already prepared by the NRC or the U.S. Department of Energy ("DOE"), is sufficient to support the Waste Confidence Decision. For instance, as discussed in IEER's Comments, the EIS prepared by the DOE in 1980 is insufficient in scope and grossly out of date.

Similarly, the documentation for the Uranium Fuel Cycle Rule, developed in the mid-1970s, only estimates radiation releases and does not evaluate human health impacts of

those releases. It is also addressed to the impacts of an individual nuclear power plant, and fails to address the cumulative impacts of significantly adding to the nation's inventory of radioactive waste. The Uranium Fuel Cycle Rule is also extremely outdated with respect to its assumptions about the radioactive emissions from various forms of radioactive waste, including spent fuel, depleted uranium tails, greater than class C (GTCC) waste, and uranium mining tails. Table S-3 also erroneously concludes that it is conservative to assume gaseous releases of certain radionuclides, notably I-129, from reprocessing prior to sealing of a repository rather than to assume their release into water after disposal of spent fuel. And the Uranium Fuel Cycle Rule also significantly underestimates human vulnerability to radiation. *See* IEER Comments.

Finally, there is no EIS or other environmental analysis document that addresses one of the key environmental questions raised by the proposed licensing and re-licensing of nuclear plants: what does it cost to manage and dispose of the radioactive waste generated in the process of operating nuclear plants, and is the cost justifiable in comparison to renewable energy alternatives such as wind and solar power? The lack of a credible cost analysis for waste means that alternatives to nuclear power cannot be fairly evaluated as required by NEPA. *See* IEER Comments.

Thus, no other EIS exists on which the NRC could rely to support the generic Waste Confidence licensing decision. Before licensing or re-licensing even one more nuclear power plant, the NRC must prepare an EIS that fully addresses the environmental impacts of the radioactive waste that will be generated as a result of that licensing decision, both with respect to the impacts of the individual plant and the cumulative impacts of that plant in combination with all other plants that are currently licensed or can reasonably be expected to be licensed.

B. Because the NRC Lacks a Basis for a Finding of Confidence in The Safety of Spent Fuel Disposal, It Must Re-Assess the Health Impacts of the Uranium Fuel Cycle as Set Forth in Table S-3 and the Uranium Fuel Cycle Rule.

As discussed above in Section IV.D, in licensing or re-licensing any nuclear power plant, the NRC relies on a generic determination, codified in Table S-3, that the human health impacts of disposing of the radioactive waste generated by that plant are insignificant. Further, as discussed above in Section V.A.2, the findings of Table S-3 are severely outdated, and the table significantly underestimates the human health impacts of the uranium fuel cycle, including the impacts of disposing of spent fuel. In addition, the assumptions on which Table S-3 depends include the asumption that spent fuel will be disposed of in a bedded salt repository. But in its Proposed Waste Confidence Decision, the NRC itself states that salt repositories are now considered suitable only for reprocessed high-level waste and not for spent fuel disposal. 73 Fed. Reg. at 59,555. As discussed in IEER's Comments, all other repository types are now considered likely to have radioactive releases after the repository has been sealed. The hypothesis that releases from spent fuel disposal could be zero has therefore been discredited. Indeed, there are plausible circumstances in which releases could exceed the requirements of safe

disposal as defined by radiation protection standards. In order to ensure that its licensing decisions for nuclear power plants comply with NEPA by fully addressing the environmental impacts of the radioactive waste they will generate, the NRC must completely overhaul Table S-3 and integrate it with a more comprehensive analysis of all of the environmental impacts and costs of the licensing of nuclear power plants, including the impacts and costs of the plants themselves and the wastes they will generate. *See* IEER Comments.

C. The NRC's Proposed Generic Finding That Spent Fuel Can Be Safely Stored Pending Ultimate Disposal Does Not Comply With the AEA or NEPA.

In past Waste Confidence Decisions, the NRC refused to acknowledge one of the most significant risks posed by operating nuclear power plants: the risk of a catastrophic fire caused by an attack or accident that leads to partial or complete drainage of a high-density spent fuel storage pool. Thompson Report, Section 5.1. The NRC has finally admitted the existence of this risk in the Proposed Waste Confidence Decision and Proposed Temporary Fuel Storage Rule. 73 Fed. Reg. at 59,564-68; 59,548. It also admits that since 2002 it has treated the risk as a site-specific issue, imposing new safety, security and environmental protection measures on a case-by-case basis, under secret licensing orders. Proposed Waste Confidence Decision, 73 Fed. Reg. at 59,567. *See also* Denial of Commonwealth of Massachusetts' Petition for Rulemaking, 73 Fed. Reg. at 46,209. As discussed below, the NRC's actions fail to comply with either the AEA or NEPA.

The NRC's violations of the law are significant, both with respect to existing nuclear power plants and future nuclear power plants. Currently, all nuclear power plant licensees in the United States store spent fuel in high-density storage pools. As discussed in Section 2 of Dr. Thompson's Report, likely trends in the operation of existing reactors show a substantial part of the fleet operating into the 2040s, with the last reactor shutting down in 2055. If, as appears likely, licensees of new reactors continue to use high-density pool storage for spent fuel, nuclear power plant operation will continue to pose a substantial risk of radiological harm.

1. NRC's safe storage finding does not qualify as a generic licensing determination under the AEA or NEPA.

In the Proposed Decision, the Commission demonstrates that it considers the risk of a pool fire to be specific to each nuclear plant, and asserts that it has taken site-specific measures to reduce those risks to an acceptable level, separately for each nuclear power plant. The Commission also states that it began to take these site-specific actions as long ago as 2002. 73 Fed. Reg. at 59,567.

Yet in the years that have passed since 2002, the Commission has repeatedly relied on the generic determination of the Waste Confidence Decision and 10 C.F.R. § 51.23 to deny hearing requests regarding the safety and environmental impacts of spent fuel storage in

individual licensing cases. *See, e.g., Entergy Nuclear Vermont Yankee, L.L.C. and Entergy Nuclear Operations, Inc.* CLI-07-03, 65 NRC 13 (Pilgrim and Vermont Yankee, 2007); *Entergy Nuclear Operations, Inc.*, LBP-08-13 (Indian Point, 2008); *Nuclear Management Company, L.L.C.*, CLI-06-17 (Palisades, 2006).

Having acknowledged that its findings regarding safe spent fuel storage are site-specific and not generic in nature, the NRC should withdraw its proposed generic finding. The Commission must also re-open the individual licensing cases in which it relied on the Waste Confidence Rule and 10 C.F.R. § 51.23 in failing to address the environmental impacts of spent fuel storage in the EIS for that licensing decision. The EIS should identify all documents on which the NRC relied, and the NRC must offer the public an opportunity for a hearing on the adequacy of the EIS.

Any EIS that is prepared for a new nuclear power plant, for which the applicant proposes to rely on high-density pool storage of spent fuel, must also address the environmental impacts of spent fuel storage at that individual site.

2. The NRC has failed to justify its refusal to prepare an EIS for spent fuel storage.

After years of denying the credibility of catastrophic spent fuel pool fires, the NRC now concedes that, as a general matter, high-density fuel pools are vulnerable to fire caused by accidents and attacks. Proposed Waste Confidence Decision, 73 Fed. Reg. at 59,565. Having effectively conceded that pool storage of spent fuel poses significant environmental risks, the NRC should prepare an EIS to address those risks, as required by 42 U.S.C. § 4332(C).

The NRC apparently believes it can avoid the preparation of an EIS by taking credit for mitigation measures that allegedly reduce the level of risk posed by spent fuel pool accidents to an acceptable level. 73 Fed. Reg. at 59,565. But the NRC has not, in fact, made such a showing. Neither the Proposed Waste Confidence Decision nor the Proposed Temporary Fuel Storage Rule gives any indication of the standard by which the NRC decided that spent fuel pool storage risks were insignificant or acceptable and it gives no indication of what measures were taken, even to the extent of identifying the decision documents. The NRC has therefore completely failed to justify is refusal to prepare an EIS.

The NRC has also failed to provide the public with an adequate opportunity to be heard with respect to the adequacy of the NRC's basis for its proposed FONSI. Under Section 189a of the Atomic Energy Act, 42 U.S.C. § 2239(a), the NRC must provide the public with an opportunity for a hearing on the adequacy of its NEPA determination. While the NRC may offer this hearing in the form of a notice-and-comment rulemaking, the rulemaking must comply with the APA, NEPA, and the NRC's own regulations for the implementation of NEPA. *Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council,* 435 U.S. 519, 543, 548 (1978). Here, the NRC has failed to provide the public with a fair opportunity to comment on its proposed FONSI, as required by the

APA, because it has not complied with its own minimal procedural requirements for disclosing the basis for the FONSI.

For instance, under 10 C.F.R. § 51.32(a)(1), a FONSI must "identify the proposed action." While the Proposed Temporary Fuel Storage Rule does state that the purpose of the proposal is to reach a conclusion that spent fuel can be safely stored at or away from nuclear power plant sites, that statement is only a conclusion about one of the impacts of the agency action. The agency action is the licensing of nuclear power plants, which will in turn lead to the production of spent fuel. The NRC violates NEPA by *assuming* that it will take the licensing action that permits the production of spent fuel and then defining the scope of the proposed action as what must be done to cope with the environmental impacts that flow from the licensing action.

The NRC also violates its own NEPA regulations by failing to support the FONSI with an EQ, as required by 10 C.F.R. § 51.32(a)(4). No document is identified as an EA, nor can the required contents of an EA be found in either the Proposed Waste Confidence Decision or the Proposed Temporary Fuel Storage Rule.

The required contents of an EA are set forth in 10 C.F.R. § 51.31(a):

> (1) A brief discussion of:
> (i) The need for the proposed action;
> (ii) Alternatives as required by section 102(2)(E) of NEPA;
> (iii) The environmental impacts of the proposed action and alternatives as appropriate; and
> (2) A list of agencies and persons consulted, and identification of sources used.

With respect to the "need for the proposed action," the NRC discusses the need for long-term spent fuel storage, but this is more of the same circular reasoning the NRC engages in with respect to its characterization of the proposed action. The NRC completely fails to address the question of whether it is necessary to allow the generation of spent fuel for which it has no effective means of disposal, and which it must therefore store at nuclear power plant sites for a potentially indefinite period of time.

In addition, the NRC provides no discussion of why it believes it needs to continue to allow licensees and new applicants to use the most dangerous method of fuel storage that exists: high-density pool storage of spent fuel. And no discussion at all can be found of alternatives to the use of high-density pool storage of spent fuel. This is an egregious omission, since the severe environmental impacts of a pool fire could be almost completely avoided by the abandonment of high-density pool storage and substitution of low-density pool storage and hardened dry storage. Thompson Report, Section 8. The benefits of low-density pool storage and hardened dry storage, which must be addressed in an EA, would include not only the virtual elimination of the risk of a catastrophic fire, but the elimination of the need for secrecy about the measures that the NRC allegedly has taken to reduce the risk of a pool fire to an acceptable level. *Id.*, Section 9. While licensees are privy to the contents of these measures, the public has no means of holding

the NRC to account for their effectiveness in protecting public health and the environment. The adverse effect of this unnecessary secrecy on the integrity of the NRC's regulatory process is a significant concern that should be addressed in the EA.

Contrary to the requirement of 10 C.F.R. § 51.30(a)(1)(iii), the Proposed Decision also completely fails to address the reasonably foreseeable and potentially catastrophic environmental impacts of a pool fire. To illustrate those impacts, the offsite costs arising from a pool fire at the Indian Point site have been estimated at $460 billion. That estimate was non-conservative, and consideration of additional factors could lead to a substantially higher estimate of costs. Thompson Report, Section 5.4.

In addition, neither the Proposed Decision nor the Proposed Temporary Fuel Storage Rule contains a list of the reference documents on which it relies for its finding of no significant impact. Thus, there is no means by which a member of the public could discern the technical basis for the NRC's decision or request the documents under the FOIA. While some documents are discussed in the text of the Proposed Waste Confidence Decision and the Proposed Temporary Spent Fuel Storage Rule, it is clear that the NRC relied on numerous other documents for its determination that spent fuel storage poses no significant environmental impacts, including technical studies and licensing actions taken by the NRC.

The Proposed Temporary Spent Fuel Storage Rule is also defective because it relies on the NRC's decision denying the Commonwealth of Massachusetts' rulemaking petition regarding spent fuel storage risks, 73 Fed. Reg. 46,204 (August 8, 2008), which also fails to identify the reference documents on which it relies. As the Commission has ruled, failure to identify or produce non-exempt portions of reference documents relied on for an EA constitutes a violation of NEPA. *San Luis Obispo Mothers for Peace,* CLI-08-01, 67 NRC at 15-17. The fact that some of the documents contain security-related information does not excuse the NRC from complying with NEPA. *San Luis Obispo Mothers for Peace v. NRC,* 449 F.2d at 1034-35. The NRC's proposed FONSI with respect to spent fuel storage therefore is fatally defective and should be withdrawn.

Having failed to address its own fundamental requirements for the justification of a decision not to prepare an EIS, the NRC cannot claim to have complied with NEPA or to have offered the public a meaningful opportunity to comment on its decision.

VI. CONCLUSION

For thirty years, the NRC has relied on the Waste Confidence Decision to generically license activities resulting in the generation of significant quantities of high-level radioactive waste and other forms of radioactive waste that are difficult, expensive and dangerous to store or dispose of. After 30 years of studying the prospects for safe disposal of spent fuel, the NRC is still far from having any basis for a reasonable assurance the spent fuel can be disposed of safely. The NRC's Proposed Waste Confidence Decision therefore fails to meet the requirements for an adequately supported licensing decision under the AEA.

The NRC's Proposed Waste Confidence Decision also fails to comply with NEPA because it is not supported by a generic EIS that thoroughly evaluates the individual and cumulative environmental impacts of NRC licensing decisions with respect to the generation of spent fuel and other forms of radioactive waste. The limited environmental studies that were prepared in the 1970s are now grossly out of date and completely insufficient to support the licensing of an entire new generation of nuclear power plants.

Finally, the NRC's generic determination that it is safe to store spent fuel at reactor sites or away-from-reactor sites pending its disposal fails to comply with the AEA, the APA, or NEPA.

Therefore NRC should withdraw the Proposed Waste Confidence Decision and the Proposed Temporary Spent Fuel Storage Rule. It should also suspend all future action on applications for new nuclear power plant licenses or the renewal of existing licenses, unless and until it has complied with the AEA, the APA, and NEPA.

Respectfully submitted on behalf of the foregoing Commenters,

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Comments of the Institute for Energy and Environmental Research on the U.S. Nuclear Regulatory Commission's Proposed Waste Confidence Rule Update and Proposed Rule Regarding Environmental Impacts of Temporary Spent Fuel Storage[1]

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6 February 2009

The following are the comments of the Institute for Energy and Environmental Research (IEER) on the Nuclear Regulatory Commission's (NRC's) proposed Waste Confidence Decision Update[2] and the associated Consideration of Environmental Impacts of Temporary Storage of Spent Fuel after Cessation of Reactor Operation.[3]

The proposed Waste Confidence Decision warrants careful examination, because it serves as the underpinning to several key safety and environmental findings regarding the operation of nuclear power plants and the disposal of the wastes that they generate.

- First, the Waste Confidence Decision presents a safety finding, under the Atomic Energy Act, that the NRC has reasonable assurance that disposal of spent fuel will not pose an undue risk to public health and safety. It does so via the finding that disposal is technically feasible and can be done in conformity with the assumption of zero releases in Table S-3 at 10 CFR 51.51, which specifies the environmental impacts associated with nuclear reactor operation, including those associated with nuclear wastes and emissions.
- Second, the Waste Confidence Decision provides the basis for a key assumption in the uranium fuel cycle rule that spent fuel can be isolated in a repository, with no radioactive releases. That finding, in turn, is key to the NRC's conclusion that the environmental impacts of the entire uranium fuel cycle are insignificant.[4]

[1] These comments were prepared at the request of Texans for a Sound Energy Policy.
[2] NRC 2008
[3] NRC 2008b
[4] 10 CFR 51.51 2008 and its Table S-3 2008

- Finally, the Waste Confidence Decision provides the basis for the NRC's Finding of No Significant Impact (FONSI) regarding the environmental impacts of temporary spent fuel storage pending its disposal in a repository.

As discussed below, IEER believes that the NRC lacks adequate support for the Waste Confidence Decision's first and second proposed findings. The NRC has simply failed to address currently available information which shows that the NRC currently does not have an adequate technical basis for a reasonable level of confidence that spent fuel can and will be isolated in a geological repository.

The NRC's lack of support for Findings 1 and 2 of the Waste Confidence Decision also fatally undermines the viability of the uranium fuel cycle rule promulgated in 1979.[5] In that rule, the NRC declared that the environmental impacts of the entire uranium fuel cycle would be negligible. The finding was based in part on the assumption that spent fuel would have no radioactive releases after it was placed in a repository. That assumption was based in turn on two other assumptions: (i) that disposal of spent fuel or reprocessing high-level waste would be in a salt repository, and (ii) that releases of radioactivity from that repository would be zero. In its draft Waste Confidence Decision, the NRC has acknowledged that salt is not a suitable medium for spent fuel disposal. Investigations of Yucca Mountain and other non-salt repositories have concluded that there are likely to be some releases of radioactivity due to spent fuel disposal. This invalidates the basis of the uranium fuel cycle rule and the Waste Confidence Decision that is associated with it. Other assumptions and findings contained in the 30-year-old uranium fuel cycle rule are also demonstrably invalid today, such as the assumption that greater than class C (GTCC) waste and depleted uranium (DU) tails can be disposed of in a shallow land burial as low-level radioactive waste (LLRW) under present rules. On the contrary, special permitting processes, including environmental impact evaluations will be necessary to dispose of these wastes. The NRC must re-evaluate all of these assumptions and findings in light of new information which shows that they are incorrect. And the NRC must re-evaluate its overall conclusion that the health impacts of the uranium fuel cycle are negligible.

In addition, the NRC's lack of an adequate basis for Findings 1 and 2 undermines the NRC's basis for a finding that spent fuel can be safely stored on reactor sites pending the opening of a repository. The NRC must conduct a new environmental analysis that examines the impacts of onsite spent fuel storage for a much longer period than 50 to 60 years after the cessation of reactor operations. This must include considerations relating to the potential deterioration of onsite storage canisters and the potential for transfers to new onsite storage canisters.

Finally, taken together, the Waste Confidence Decision, the uranium fuel cycle rule, and the NRC's environmental analysis of the impacts of temporary fuel storage completely fail to address one of the key environmental questions raised by the proposed licensing and re-licensing of nuclear plants: what does it cost to manage and dispose of the radioactive waste generated in the process of operating nuclear plants, and is the cost

[5] NRC 1979

justifiable in comparison to renewable energy alternatives such as wind and solar power? The lack of a credible cost analysis for waste means that alternatives to nuclear power cannot be fairly evaluated as required by NEPA.

A. Comments on Finding 1

The NRC proposes to reaffirm Finding 1 unchanged from 1990. Finding 1 reads as follows:

> Finding 1: The Commission Finds Reasonable Assurance That Safe Disposal of High-Level Radioactive Waste and Spent Fuel in a Mined Geologic Repository Is Technically Feasible.[6]

Three terms in Finding 1 are critical:

- "reasonable assurance"
- "safe disposal", and
- "technically feasible"

The term "safe disposal" involves (i) the safety of building the repository, putting the waste in it, and backfilling and sealing it, and (ii) the performance relative to health and environmental protection standards for a long period after the repository is sealed. It should be noted that the requirements of showing that there is "reasonable assurance" that "safe disposal" of "high-level waste and spent fuel" is "technically feasible" are much greater than would be the case if the problem were simply to show that it is possible to dig a deep mine, put spent fuel in it, and backfill it. That would be nothing more than dumping. In the case of a geologic repository system, it is essential to show a reasonable basis for confidence that the public and the environment far into the future will be adequately protected from the effects of disposal at a specific site and a specific engineered system built there.

A scientific explanation of the term "reasonable assurance" requires either physical proof that such a facility exists and has operated within expected performance rules or a statistically valid argument based on real-world data that would show (i) that all the elements for a repository system exist and (ii) that they would work together as designed, as estimated by validated models. The evidence must be sufficient to provide a reasonable basis to conclude that the durability of the isolation arrangements would be sufficient to meet health and environmental standards for long periods of time – hundreds of thousands of years with a high degree of assurance, or in other words, with a high probability. In statistical terms, this means that the upper bound estimate of health and environmental damage should be below the maximum allowable limit with a high level of confidence. At present these uncertainties are very large, which means that it is reasonable to conclude that under some circumstances the damage could be higher than the norms of radiation protection. See below for examples.

[6] NRC 2008, p. 59553.

The task of determining whether there is an adequate basis for a reasonable assurance of technical feasibility is very difficult. A large part of the difficulty so far as assessing long-term integrity and performance arises from the fact that three elements of a mined system that is highly perturbed thermally, chemically, and mechanically from its original geologic state must be shown to work together to provide "safe disposal" – that is to provide disposal that will conform to an agreed and settled radiation protection standard for the public and that will also protect workers during the construction period of the repository according to prevailing norms for worker protection. The three elements are:

- The waste and the waste encapsulation system.
- The backfill and sealant system.
- The near- and far-field perturbed geologic environment.

We will show that it is a very difficult and complex task to assess the performance of each of these elements under the conditions of spent fuel disposal in a repository and that a wide range of radiation doses can be estimated from the same general repository type and location, including doses that are above regulatory limits.

1. Lack of realistic demonstration of the technical feasibility of a thermally perturbed, sealed repository system

To date, no large-scale demonstration of a system that has been thermally perturbed by spent fuel and then back-filled and sealed has been carried out even for a limited period of time. Much less has there been a demonstration over a few decades that a highly thermally perturbed and sealed system with large amounts of spent fuel would function in the long-term as estimated on paper or via the results of limited experiments. Moreover, many of the experiments that have been proposed, even in highly regarded repository programs, are simply inadequate or inappropriate for estimating performance. For instance, an expert team of geologists put together by IEER[7] concluded that both the thermal and mechanical aspects of the research designed to study the suitability of the French repository location were deficient in essential respects, despite the fact that the program had many strong points:

> A crucial problem for research is that the model must estimate performance not of the natural setting but of a geologic system that has been considerably disturbed by a large excavation, which may induce fractures not originally present, by the introduction of (thermally) hot wastes, and by the addition of various backfill materials and seals. *Hence, the system being modeled is no longer the original geologic system, but a profoundly perturbed system.* .... Estimation of performance of a system under these conditions with some confidence poses challenges that are, in many ways, unparalleled in scientific research.
>
> In the specific case of the Bure site, the host rock is argillite, a hard rock consisting of clayey minerals, carbonates (mainly calcites), and quartz. The intact rock is not very porous, leading to expectation of diffusive flow in the

[7] See Attachment B for the Curriculum Vitae of the team members.

> absence of fractures and in the absence of disturbance by mining. Such flow would be very slow and the expected travel time of radionuclides released from waste packages could be very long.
>
> However, the IEER team's evaluation of (i) the documents, (ii) argillite rock properties under conditions of heat and humidity, and (iii) the research done to model the site performance indicated that the actual conditions prevailing in an actual repository could be very different from diffusive flow. Failure of certain components, notably repository seals, could result in rapid (in geological terms) transport of radionuclides to the human environment.
>
> ANDRA's own estimate of dose under conditions of seal failure was higher than the allowable limit of 0.25 millisieverts (25 millirem) per year. In this context, IEER concluded that ANDRA's scenario for human exposure was not necessarily conservative, in that doses to an autarchic farmer family (also called "subsistence farmer family") using groundwater in certain locations could be even higher than the dose at the surface water outcrop estimated by ANDRA.[8]

Note that as of the date of the IEER report on the Bure site in France, ANDRA's own estimate of dose exceeded its regulations in the event of seal failure. In this context, research on characterizing the long-term integrity of seals becomes critically important. And IEER found ANDRA's research program in this very area to be deficient. One of its principal conclusions about the research on seals was that it seemed to of "marginal value" and was far from adequate to enable a sound determination of repository performance:

> One crucial problem is that the simulated slot sealing test in the underground laboratory may be of marginal value and utility. The test is planned to be done very early on after excavation and only over a very short period of time relative to the duration of performance requirements and even relative to the time lapse over which the actual EDZ [Excavated Damaged Zone] will develop, prior to seal installation. This is neither convincing nor satisfactory. It is difficult to see how and why increasing the stress component parallel to the gallery walls will reduce the permeability in that direction or how a flatjack can simulate a bentonite seal, except in the most crude of approaches.[9]

Similarly, there has been considerable skepticism about the DOE's proposed disposal configuration for Yucca Mountain. DOE proposes disposal in the unsaturated zone in a configuration in which boiling of water is expected for "the first few hundred years after closure...in the drift vicinity."[10] The DOE expects the effects to be as follows:

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[8] Makhijani and Makhijani 2006. Italics in the original. This article is based on the full report, which is in French: *Examen critique du programme de recherche de l'ANDRA pour déterminer l'aptitude du site de Bure au confinement géologique des déchets à haute activité et à vie longue : Rapport Final.* Hereafter cited as IEER 2005. The qualifications of the team members are found in Attachment C.

[9] IEER 2005, p. 59, in Chapter 2. Retranslated from the final French report by Annie Makhijani.

[10] DOE 2008 p. 2.3.3-58 in Chapter 2

> Thermal expansion of the rock matrix induces thermal stresses and associated changes in flow properties near emplacement drifts.... Thermally-driven effects also cause dissolution and precipitation of minerals, which may affect flow properties (thermal-hydrologic-chemical effects).[11]

While the DOE believes that these processes will not prevent satisfactory repository performance, Dr. Don Shettel, an expert geochemist and consultant for the State of Nevada, has concluded that a hot temperature design is "fatally flawed."[12] This was extensively discussed at the May 18, 2004, meeting of the U.S. Nuclear Waste Technical Review Board (NWTRB):

> We've talked about thermal concentration of brines and boiling point elevation. We can get fingering of concentrated solutions in fractures, thereby increasing the probability and percentage of thermal seepage waters that might reach the drift on the EBS [Engineered Barrier System]. We have mixed salt deliquescence [absorption of water vapor by solid salts so as to dissolve them], not so much from the dust that's on the canisters, but from the increased amount of thermal seepage water that we believe can reach the EBS. And, if these evaporated or concentrated solutions can reach the EBS before the thermal peak, then they can become, even after the thermal peak, get hydrated salts with thermal decomposition, with the evolution of acidic solutions and vapors. And, **one of the most important aspects of this model is the wet-dry cycling or intermittent seepage**. If you get some seepage on the canisters, and it evaporates to some extent, dries out, the addition of water to that can generate acid.
>
> ....We believe that the **high temperature design for the repository is fatally flawed** for the number of reasons that I've discussed, and that **emplacement in the saturated zone would be much better, because that's essentially where DOE has tested their metals at.** And, the saturated zone is also the much less complicated in terms of processes and modeling.[13]

It is clear from the above, that there are scientists who have carefully studied the problem who believe that DOE has tested the metals mainly in an environment [saturated] that is fundamentally different than the proposed disposal environment [unsaturated]. According to them the proposed DOE design is "fatally flawed" and the Yucca Mountain repository site is "not adequate." Dr. Shettel also stated that an entirely different disposal concept in the saturated zone would be "much better."[14]

Testing, experiments, and models that seem to bypass essential questions were a problem that the IEER team discovered in relation to sealants, as quoted above (proposed tests were "neither convincing nor satisfactory"). Moreover, the problem of wet-dry cycling and inadequate modeling was also cited by the IEER team as a significant problem in the French repository research program:

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[11] DOE 2008 p. 2.3.3-58 in Chapter 2

[12] Don Shettel is Chairman and Geochemist, Geoscience Management Institute, Inc.

[13] Shettel 2004. Emphasis added.

[14] Also see below for further discussion of the corrosion problem.

> No evidence is found for any model evolution from simple, scoping, or conceptual models into design base models that result in conceptual design and site evaluation. Model evaluation potentials against direct, experimental results have been omitted. The simple models described in the documents do not seem to be adequate for the evaluation/verification of thermophysical site properties.
>
> It is not clear why one-dimension model results are included in the inverse modeling of in situ experiments; the heat flow is not remotely a linear, one-dimensional problem. Even the two-dimensional, analytical model result for an infinite heater length is a very poor model for the arrangement involving a 2 m-long heater only. The large difference between the two-dimensional, analytical, and three-dimensional, numerical models disqualifies the other models. It is even questionable whether the model condition of a three-dimensional domain assuming homogeneous and isotropic material/physical properties is adequate, since the stratigraphy of the Bure site is layered with different properties in different directions.
>
> The thermal conductivity, one of the most important thermophysical site characteristic, has not been adequately established. The standard deviation of this parameter is unusually high, leaving a large margin of uncertainty in the heat-rejecting capacity of the site. The number of samples used for establishing thermophysical site properties based on laboratory samples appears to be low, especially considering the potential spatial variation of these properties over the proposed storage area.
>
> Although the temperature regime according to the baseline design is below-boiling, above-boiling operation is not impossible. A bi-stable system, involving either below boiling or above boiling conditions in the emplacement area, is quite possible under some circumstances. A steam cycle therefore is possible under certain heat load conditions, namely, if the backfill buffer material cannot saturate and the damaged zone cannot re-saturate due to vapor-phase water loss caused by the condensing zones of the emplacement area.
>
> Since above-boiling point temperatures are expected in the Type C and spent fuel modules for long periods of time in the preferred design selection, these modules may develop continuous steam cycles within the emplacement area for centuries.[15]

There is experimental evidence that result of wet-dry cycling at Yucca Mountain could result in very rapid corrosion of the C-22 alloy containers. While the DOE believes the contrary, Dr. Roger Staehle, who worked as a consultant for the State of Nevada with a research team including other experts and Catholic University of America faculty, made a presentation to the NWTRB during which he went through the team's experimental findings for the NWTRB; he concluded with a set of stark "warnings":

[15] IEER 2005, pp. 101-102, Chapter 3. Retranslated from the final French report by Annie Makhijani.

Warnings

1. There is an abundance of warnings as well as solid quantitative data that demonstrate that corrosion of the C-22 alloy is *inevitable and rapid.*

2. A good paradigm for the warnings about C-22 can be found with Alloy 600 that was widely used in the nuclear industry as tubing in steam generators and as structural components. Alloy 600 has broadly failed in these applications, and present failures could easily have been predicted from past occurrences.

3. There are now *abundant warnings that that C-22 alloy is not adequate nor is the present design of the repository adequate.* Such warnings are founded on warnings, some of which are 15 years old.

4. Further, there is abundant evidence that the YM site itself is not adequate.

5. The analogies of warnings from the present nuclear industry are abundant and apply directly to whether the present design at YM is adequate. *The answer is that it is not.*

6. Some of the warnings from experience of the water cooled nuclear reactor industry apply directly to the design and development of the Yucca Mountain facility. These should be carefully assessed, e.g. as they apply to heated surfaces.

7. Finally, the incapacity to inspect the YM containers requires assurances of reliable performance that are higher than those of normal industrial expectations.[16]

The problem of adequacy of the research program or lack thereof points up the critical need to have confidence in each of the three elements of geologic disposal. In the above examples, we have shown that in the case of Yucca Mountain the behavior of the containers as well as the rest of the Engineered Barrier System has not been characterized to the point that independent scientists could agree that Yucca Mountain is a suitable disposal site, even though the DOE believes it is. On the contrary, there is quite a bit of evidence that Yucca Mountain is not a suitable site, and may even be "fatally flawed," since the containers are essentially the only effective barrier preventing radionuclide releases to the environment.

The Nuclear Waste Technical Review Board considered the question of the potential for severe corrosion due to deliquescence at length following the May 2004 meeting from which the above presentation is drawn. While the twists and turns that the issue took are technically interesting and illustrate the uncertainties, the most important point to note here is that, in the end, the DOE decided to entirely ignore the issue because it believes it to be "insignificant":

> Although deliquescence of salts on the waste package surface is expected to occur, this process has been excluded from TSPA [Total System Performance Assessment] because the effects of such deliquescence have been determined to be insignificant to performance (Table 2.2-5, FEP 2.1.09.28.0A, Localized corrosion on waste package outer surface due to deliquescence). The physiochemical characteristics of brines produced through deliquescence of minerals in deposited dusts are not expected to generate an environment favorable for the initiation of localized corrosion and

[16] Staehle 2004. Italics added.

> propagation for Alloy 22 (UNS N06022) waste packages. In addition, at elevated temperatures (greater than 120°C), only small quantities of brine will form from the available dust, and brine volume will limit the extent of localized corrosion damage should it initiate.[17]

And again:

> Modeling of evaporative evolution of potential seepage waters shows that corrosive calcium and magnesium-chloride brines are not expected to form. As noted above, although deliquescence-induced brine formation is expected to occur, this process has been excluded from TSPA because the effects of such deliquescence have been determined to be insignificant to performance.[18]

The Nuclear Waste Technical Review Board, the expert oversight body appointed by Congress to oversee the Yucca Mountain program, came to a somewhat different conclusion regarding whether deliquescence-induced corrosion should be excluded from DOE's license application:

The NWTRB's report was sent to Congress with a letter dated August 2008, two months after the DOE had submitted its license application concluding that deliquescence-induced corrosion could be ignored in performance assessment because it was judged to be insignificant. For this very reason, the report is worth quoting at length:

> The Board's January 12, 2007, letter [to the DOE Office of Civilian Radioactive Waste Management] and its attached report contained the following additional findings:
>
> - *Cumulative damage due to the combined effects of deliquescence-induced localized corrosion and seepage-based localized corrosion merits some analysis.*
> - *Including seepage-based localized corrosion in TSPA-LA while excluding deliquescence-induced localized corrosion is incongruous because the process (localized corrosion) is the same in both cases.*
> - *Deliquescence-induced general corrosion of Alloy 22 should be included in TSPA-LA.*
> - Anomalies among recent experiments at high temperatures, such as unexpectedly high general corrosion rates and a maximum of general corrosion rate with respect to temperature, require explanation.
> - Effects of waste package surface condition on the corrosion of the waste package surface may need more investigation.
> - *Including deliquescence-induced localized corrosion in TSPA-LA would add to its completeness, robustness, and credibility.*
>
> In a follow-up letter to OCRWM dated July 10, 2007 (Garrick 2007c), the Board pointed out that the dust settling on waste package surfaces during ventilation would contain significant amounts of organic materials and that reactions between these materials and nitrate in the dust could affect the amount of nitrate, which inhibits

[17] DOE 2008, p. 2.3.5-10
[18] DOE 2008, p. 2.3.5-12

> localized corrosion if present in large enough quantities relative to chloride. The Board stated that the Project should analyze the effects of the full range of factors (e.g., organics in dust, acid-gas devolatilization, and radiolysis) that could influence whether inhibitive nitrate-to-chloride ratios persist under repository conditions.
>
> OCRWM responded to the Board's January 12, 2007, and July 10, 2007, letters in a November 20, 2007, letter (Sproat 2007c). Although the Board agrees with some of the points mentioned in the letter, **in several instances OCRWM did not address points brought up by the Board. For example, in its January 12 letter, the Board addressed the apparent incongruity of excluding deliquescence-induced localized corrosion while including seepage-based localized corrosion despite the fact that both are the same process, i.e., localized corrosion**. In its November 20, 2007, letter, the Project reiterated the differences in the environments between deliquescence-induced and seepage based localized corrosion. The Board concurs that the environments are quite different, but the processes are not. **Regardless of whether NRC regulations allow a process to be split in two and one part to be discarded, doing so still remains incongruous.**
>
> In addition, the Project refers to components of the dust deposited on waste package surfaces as "reactants" or "limited reactants" in several places in its November 20 letter. Although the Board agrees that many components in the dust could be reactants, it seems that the principal reactants in general or localized corrosion would be either the water component of deliquescent brines or oxygen dissolved in the brines. Both water and oxygen are essentially limitless in supply. If they are consumed by the brine in corrosion reactions, they simply will be replenished rapidly by dissolution or deliquescence. The Board would welcome additional information from the Project about what other components of the dust undergo reactions. **Finally, although OCRWM claimed that it had addressed Board concerns about the effects of organic materials on the nitrate-to-chloride ratio in the November 20 letter, the basis for this claim is unclear.**
>
> **In sum, despite the workshop in September 2006 and the exchange of letters in 2007, the issue of deliquescence-induced localized corrosion, although apparently tractable, remains open.**[19]

In other words, on perhaps the most critical scientific uncertainty for the entire Yucca Mountain program, the DOE has

- failed to follow the advice of the Congressionally mandated Technical Review Board
- submitted a license application that dismisses as "insignificant" the very process that the NWRTB asked it to include and address further and that has led some scientists with considerable expertise to conclude that Yucca Mountain is not an adequate site or that the design is "fatally flawed."

There is no evidence in the draft Waste Confidence Decision that the NRC has taken any of this information and analysis into account in reiterating Finding 1 that there is "Reasonable Assurance That Safe Disposal of High-Level Radioactive Waste and Spent Fuel in a Mined Geologic Repository Is Technically Feasible." Further, the NRC draft

[19] NWTRB 2008, pp. 27-28, italics and bold emphasis added.

Decision also notes that salt repositories are unsuitable for disposal of spent fuel (see below).

2. Uncertainty in performance results and the question of technical feasibility

The technical feasibility of "safe disposal" of waste in a geologic disposal system with "reasonable assurance" must be judged according to technically sound and legally valid performance criteria. There are two issues that relate to "technical feasibility" in this context

a. What is the nature of the performance standards that must be met? This relates to the radiation protection standard set to protect the health and environment of future generations from the effects of waste disposal.
b. Is there reasonable assurance that the performance standard can be met and that other safety goals, such as worker safety during constructing, waste emplacement, and sealing, can also be met? This relates to a reasonable level of scientific and statistical confidence that the performance standard in terms of health and environmental protection will be met in practice.

a. Nature of the Performance Standard

The history of the process of specifying the standards of performance, such as maximum allowable dose, the pathways via which that dose must be assessed, and the period over which performance must be evaluated, in the United States undermines the NRC's claim of technical feasibility. The claim is also undermined by estimates of performance that cover a wide range and include at the upper limit large exceedance of the current EPA radiation dose requirement.

EPA standards for disposal of spent fuel, high-level waste, and transuranic waste were first promulgated in 1985 and amended later on to include drinking water protection.[20] The rule specified a period of protection of 10,000 years. Yet the National Research Council study done for the DOE in 1983[21] had already criticized the EPA proposal before its finalization and advocated extending the period of performance for all time, judging compliance for the proposed period of 10,000 years to be "rather easy."[22] The National Research Council also advocated a maximum individual dose approach rather than a population dose approach.

The EPA essentially ignored the National Research Council's advice and adopted the 10,000 year limit and limits on total releases of certain radionuclides including carbon-14. The EPA standard was to be the fundamental performance criterion for public health and environmental protection for spent fuel, high-level waste, and transuranic waste disposal.

[20] The regulation is 40 CFR 191, and can be found on the Web at http://www.access.gpo.gov/nara/cfr/waisidx_08/40cfr191_08.html.
[21] NAS-NRC 1983 Chapter 8.
[22] NAS-NRC 1983 p. 236.

Further study showed that the National Research Council's conclusion that a 10,000 year limit would make compliance "rather easy" to be incorrect with respect to unsaturated repositories like Yucca Mountain with respect to the specific standard adopted by the EPA. Specifically, the EPA set a limit of carbon-14 emissions of 100 curies per 1,000 metric tons of heavy metal in spent fuel or equivalent high-level waste.

An EPA panel was convened to examine the question of carbon-14 releases from unsaturated repositories like Yucca Mountain. In 1993, the Science Advisory Board of the EPA cast considerable doubt on whether Yucca Mountain, a proposed unsaturated repository, could meet the carbon-14 emission limit in the EPA standard:

> ...[I]t is not possible on the basis of presently available information to predict with reasonable confidence whether releases from an unsaturated repository would be less than or greater than the Table 1 (40 CFR 191) release limits. (The Table 1 release limit is one-tenth of the inventory.)[23]

Instead of looking for a new repository that might meet the standard, Congress mandated special standards for Yucca Mountain, which may, in light of the process, be fairly called a double-standard-standard. The scientific basis of these standards was to be provided by the National Academy of Sciences.

The National Research Council of the National Academies issued a report in 1995 advocating a period of performance extending to the peak dose and a rather complex method of estimating the peak dose.[24] The latter itself generated sufficient controversy that one of the panel members, Professor Thomas Pigford, one of the most prominent nuclear engineers in the United States (and one of the authors of the 1983 National Research Council report), wrote a dissent. He concluded that the methods of dose calculation "in Appendix C are not mathematically valid."[25] He concluded that the method adopted

> would introduce unjustified and unprecedented leniency in public health protection from radioactive waste.

and that

> probabilistic exposure scenario [in Appendix C of the National Research Council's 1995 report] will be perceived by many as a disguised means of reducing the calculated individual doses below the high values (ca. 10 rem per year) that were presented to the committee. **Better repository design is the proper means of obtaining low doses, not by nonscientific policy fixes. Policy makers must reject pressures for short-term expediency and economy, lest, by enacting policy that compromises scientific**

[23] Loehr, Nygaard, and Watson 1993
[24] NAS-NRC 1995, Appendix C.
[25] NAS-NRC 1995, Appendix E, p. 177.

> **validity and credibility, it undermines public confidence** and puts and end to all further nuclear development and research.[26]

In 2001, the EPA proposed a new standard that applied only to Yucca Mountain. Contrary to the advice of the National Research Council report of 1995, it limited the period of performance to 10,000 years.[27] This was invalidated in court and then the EPA proposed a revised draft standard in 2005.[28] That proposed standard was far more lax for the period from 10,000 to 1 million years than any radiation protection standard protecting today's population. At 350 millirem per year, the lifetime risk of fatal cancer to women would be as high as 1 in 62. Higher doses to some people were permitted. For a small minority, doses as high as 2 rem would be permitted leading to a lifetime fatal cancer risk of 1 in 10.[29]

The EPA published its final rule in 2008. It limits doses in the first 10,000 years to 15 millirem per year committed effective dose equivalent, and to 100 millirem per year in the 10,000 to 1 million year period.[30]

The State of Nevada has sued the EPA over these final standards.[31] It should be noted in this context that the courts have twice before invalidated EPA "final" rules in regard to deep geologic repositories. Further the NRC has also changed its rules. In the early stages, following the 1980 DOE EIS on geologic disposal it was assumed that the containers would be the main barrier for an initial period, such as 1,000 years, but that the geologic setting would perform the main job of preventing long-lived radionuclides from reaching the human environment.

In sum, after more than a quarter of a century of trying to come up with a standard that would apply to spent fuel disposal at a proposed repository (40 CFR 191 applies to spent fuel disposal but no repository is proposed to which it might apply and it does not apply to the only one that is proposed), the matter of a final standard is still unsettled in that it is under litigation. Without a final standard that is clear of court challenges, performance assessment must necessarily rest on guesses about what it might be; this is not a basis on which "reasonable assurance" of the technical feasibility of "safe disposal" can be given, for the simple reason that there is no accepted definition of safe in relation to Yucca Mountain as yet. This is the current situation even if it could be shown that Yucca Mountain could conform to postulated rather than actual settled dose limits.

And, as it happens, there is no reasonable assurance as yet that Yucca Mountain can meet the final standard that the EPA has now in place at 40 CFR 197.

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[26] Pigford 1995, emphasis added.
[27] EPA 2001.
[28] EPA 2005
[29] Makhijani and Smith 2005. The original standard 40 CFR 191 has no specified public health protection beyond 10,000 years.
[30] EPA 2008
[31] Nevada v. EPA 2008 (State of Nevada v. Environmental Protection Agency (D.C. Cir., No. 08-1327, consolidated with No. 08-1345))

b. Evaluating performance

We will assume for the purpose of this section that the EPA standard for Yucca Mountain at 40 CFR 197 is the one against which "safe disposal" is to be judged as it concerns protection of future generations. In this limited context, a reasonable assurance of the technical feasibility of safe disposal at Yucca Mountain must show that there is a high probability that the standard will be met. This requires that the performance assessment that estimates the dose be generally accepted in the scientific community and that reasonable technical questions raised by experts on critical issues have been resolved. This is not the case with Yucca Mountain.

Analysis provided to the Nuclear Waste Technical Review Board indicates that the geologic setting of Yucca Mountain contributes essentially nothing to the performance of the site. This can be seen from the set of DOE graphs in Attachment A, which is a part of these comments. Specifically, Graph A, the first one in Attachment A, shows that in the absence of the container, a dose limit of 15 millirem would be greatly exceeded in much less than 10,000 years. Graph A shows that a 25 millirem per year dose limit, which was the norm against which the DOE was assessing compliance at the time, would be exceeded as soon as 2,000 years after closure and the peak dose would be on the order of 1,000 millirem well before 10,000 years. This is more than 60 times the EPA dose limit for the period less than 10,000 years. All of the other graphs show that if the container stays intact, the failure of another part of the overall system would not affect doses much in the first 10,000 years. (The peak dose beyond 10,000 years exceeds the limit in 40 CFR 197 in all cases in this set of DOE graphs – see below).

This puts a premium on the integrity of the container because it is the one element that would ensure compliance (according to the DOE model) in the period less than 10,000 years. This DOE conclusion that the container is practically the only barrier to the release of radioactivity has also been expressed before the Nuclear Waste Technical Review Board by an independent expert, Roger Staehle (also quoted above):

> The central question that we're all considering here is really the integrity of the container. So, whatever we're thinking about has to be directed toward the integrity of the container, because that's **the primary or virtually the only barrier to release of radioactivity**. [32]

As we have noted above, the question of whether the containers will endure for very long is, at best, an open one. There is clear evidence that they may corrode quickly relative to time scales required for assessing performance.

If they do corrode quickly, then the situation described in Graph A of Attachment A, that is, doses tens of times greater than the present final EPA standard prior to 10,000 years will prevail. The DOE itself has calculated doses for the repository that vary widely, indeed, wildly. For instance, the most recent estimate, in DOE's license application for the Yucca Mountain repository shows peak doses that would be more than 100 times

[32] Staehle 2004 p. 241.

lower than the final EPA standard of 100 millirem per year (beyond 10,000 years) discussed above.[33] But the peak doses shown in Attachment A (base case), prepared by the DOE for the NWTRB, are about an order of magnitude higher than the 100 millirem standard – that is, they are a thousand times bigger than the estimate in the DOE license applications. As another example, the DOE had estimated doses as high as 10 rem in a presentation to the National Research Council, or ten thousand times higher than the estimate in the license application (see Dr. Pigford's quote above). Finally, DOE's peak dose estimates in its 2002 Final Environmental Impact Statement for Yucca Mountain are also much higher than the 100 millirem per year dose to the maximally exposed individual. The Table below is reproduced from DOE's Final EIS for Yucca Mountain. Even the mean dose to the "reasonably maximally exposed person (RMEI)" is greater than 100 millirem. The 95 percentile dose for the "reasonably maximally exposed person" is far higher – 510 millirem. Should the population 18 kilometers from Yucca Mountain be in the thousands, many individuals would be expected to have doses considerably in excess of 500 millirem, since this value is a 95th percentile estimate. We note that even 30 kilometers away, where people live today, the 95 percentile peak dose is much greater than 100 millirem per year.

Table 5-12. Impacts for an individual from groundwater releases of radionuclides during 1 million years after repository closure for the lower-temperature repository operating mode.

	Mean		95th-percentile	
Individual	Peak annual individual dose (millirem)	Time of peak (years)	Peak annual individual dose (millirem)	Time of peak (years)
At RMEI location[a]	120[b]	480,000	510[c]	410,000
At 30 kilometers[d]	83[e]	NC[f]	350[e]	NC
At discharge location[g]	48[e]	NC	240[e]	NC

a. The RMEI location is approximately 18 kilometers (11 miles) downgradient from the repository.
b. Based on 300 simulations of total system performance, each using random samples of uncertain parameters.
c. Represents a value for which 285 out of the 300 simulations yielded a smaller value.
d. 30 kilometers = 19 miles.
e. Estimated using scale factors as described in Section 5.4.1.
f. NC = not calculated (peak time would be greater than time given for the RMEI location).
g. 60 kilometers (37 miles) at Franklin Lake Playa.

Source: "Chapter 5: Environmental Consequences of Long-Term Repository Performance," p. 5-29, in Volume I of *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250 (U.S. Department of Energy, February 2002), on the Web at http://www.ocrwm.doe.gov/documents/feis_a/vol_1/eis05_bm.pdf.

In sum, at the present juncture, it is impossible to say with any reasonable assurance what the radiation doses to the public from a Yucca Mountain repository would be. The DOE itself has in the last few years calculated doses that are different by a factor of 1,000, ranging from compliance to non-compliance. The DOE has dismissed the potential for severe corrosion due to deliquescence as insignificant. But that possibility cannot be ruled out on the basis of present scientific evidence. As discussed above, the DOE chose to disregard the advice of the NWTRB on this matter.

[33] DOE 2008, Table 2.4-2, p. 2.4-357.

This demonstrates that there is not enough scientific basis for "reasonable assurance" that waste can be disposed of at Yucca Mountain safely for the durations envisaged. On the contrary, the uncertainties continue to be high and the possibility that Yucca Mountain could suffer a complete failure (be "fatally flawed") cannot be reasonably excluded. The NRC does not assume that Yucca Mountain will be licensed. But its draft Finding 1 has not taken into account the data and analysis that indicate the potential that it may not meet EPA's standard and therefore cannot be any part of the basis for its Finding.

Another example throws considerable light on the issue. For decades it was assumed that salt was a suitable medium for high-level waste and spent fuel disposal. Salt sites were part of the DOE's first round set under the Nuclear Waste Policy Act (NWPA). Over the decades DOE has investigated several sites in salt formations. One of the top three sites that DOE selected for characterization for spent fuel disposal was a salt site (in Texas); the others were on federally controlled land in Washington State (the basalt site at Hanford) and Nevada (the volcanic tuff site at Yucca Mountain).[34] But now the NRC itself considers salt as unsuitable for spent fuel disposal. According to the draft waste confidence rule:

> Salt formations currently are being considered as hosts only for reprocessed nuclear materials because heat-generating waste, like spent nuclear fuel, exacerbates a process by which salt can rapidly deform. This process could potentially cause problems for keeping drifts stable and open during the operating period of a repository.[35]

The problem of salt being an inappropriate medium for spent fuel disposal is linked to a larger problem of waste confidence as it relates to assessment of the environmental impact from the licensing of reactors. This issue concerns the obsolescence and incorrectness of the governing regulation for reactor licensing, 10 CFR 51, which sets forth "environmental protection regulations applicable to NRC's domestic licensing and related regulatory functions."[36] It is connected to the Waste Confidence Rule and is discussed in Section C below.

The NRC also did not consider the third geologic formation that was in the DOE's top three: the basalt formation at the Hanford Washington site. Many serious defects of the site, including very serious problems in safety, were noted by one of the leading geologist in the United States, Donald E. White, who was a member of the National Research Council panel that wrote a report for the DOE on geologic isolation. In regard to safety Dr. White noted three "threatening effects" including "rock bursting," "costly and troublesome drainage problems" and the following:

> Construction of the repository at very high in-site temperatures, estimated by Rockwell to be 57°C but possibly considerably higher. Refrigeration on a scale seldom if ever attempted in world mining may be necessary. **The costs in time, money, energy, and lives of men are likely to be very high.**

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[34] See Nevada timeline 1999
[35] NRC 2008, p. 59555.
[36] 10 CFR 51.1 2008

> **Even if each of the above [threatening effects] is individually tractable, all in combination may be intolerable.** More satisfactory alternatives probably can be found elsewhere.[37]

The DOE ignored this 1983 analysis and went ahead and selected basalt at Hanford as one of the top three sites it would characterize.

In the case of granite, the medium in which DOE hoped to find second repository locations for characterization, the DOE proceeded with a screening program that was so technically deficient that the ranking results were not credible. Essentially, the scoring system adopted by the DOE in its Delphi consultation gave zero weight to criteria for which no information was available. This made them equivalent to criteria which were "unimportant" or "judged to be poorly measured." In other words, if the DOE did not know anything about it then it could be ignored. As a result, the sites for which the least was known would tend be ranked higher than those about which there were more data and adverse as well as positive or partly positive characteristics could be evaluated. In other words, the DOE essentially used an "ignorance is bliss" approach to site ranking in order to determine which sites it would characterize."[38] The second repository program was abandoned in 1986.

We may also cite the example of France in regard to performance, which has the second largest number of reactors of any country in the world (after the United States) and which has a repository program that has been attempting to characterize a site. We have already noted that the program's research in regard to seals and thermal effects is deficient in certain critical aspects. We note here than ANDRA, the French agency charged with repository characterization and development, itself had found that doses would be greatly exceeded in the event of a seal failure. Calculated peak doses in that scenario due to chlorine-36 in Class B waste (the approximate equivalent of U.S. Greater Than Class C waste) would be 300 millirem per year and those from due to iodine-129 in spent fuel would be 1,500 millirem per year.[39] Both of these are greatly in excess of the French limit of 25 millirem per year and even of the more lax U.S. final EPA standard for Yucca Mountain of 100 millirem per year beyond 10,000 years.

These examples illustrate that it is essential to take into account the specific aspects of repository research that are important to assessing whether a given disposal system can perform to specified standards for health and environmental protection.

With the exception of salt sites, which the NRC itself rejects for spent fuel, the NRC has failed to take the specific scientific evidence about the U.S. repository program and the potential for it to meet performance, safety, and health criteria for protecting public health, worker safety, and the environment into account. By failing to examine the available evidence in regard to the elements of a repository system relevant to the United

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[37] White 1983, p. 25, reprinted as an appendix to Makhijani and Tucker 1984, emphasis added.
[38] See Makhijani 1986
[39] ANDRA 2001, p. 139.

States, the NRC has not met the minimal requirements of a scientifically based analysis that is necessary to arrive at a conclusion that there is "reasonable assurance" that safe disposal of spent fuel in a repository is technically feasible.

We are not persuaded by the NRC appeal to the fact that 24 countries have repository programs..[40] The fact that all countries with nuclear power programs have to deal with the intractable problem of nuclear waste and have chosen to believe that disposing it of in deep underground will solve the problem is not a scientific demonstration of technical feasibility of safe disposal of nuclear spent fuel in a geologic repository. In its Waste Confidence Decision Update, the NRC has used information from other countries to argue the unexceptionable point that social and political factors are important. The fact remains that no country has a repository for spent fuel or even high-level waste disposal. Further, the NRC has not presented technical evidence from the many repository programs to show that there are enough data for each of the three elements described above – the waste and waste packages, the back fill and sealing system, and the near- and far-field environment – in these programs to come to a reasonable conclusion that each is sound and that they will function together as modeled with reasonable assurance. Nor has it presented any scientific analysis of how these programs are technically relevant to the specific conditions in the United States in terms of assisting the NRC's ability to buttress Finding 1 in regard to the three elements and the modeling of their functioning together.

By contrast, we have shown that the U.S. Yucca Mountain site may well not meet established radiation protection norms and may even be fatally flawed. The geologic setting is not likely to play a significant role in containment of radionuclides, even according to the DOE's own assessment. Among other things, the basalt site at Hanford presents severe safety issues, which the NRC did not address. The second round repository investigation for granite sites in the United States was a failure, for a variety of reasons.

IEER's detailed review of the French repository program research indicated that the research was significantly deficient in certain critical areas – seals and thermal perturbation modeling. And we have shown that ANDRA's own estimates of doses in case of failure of seals would result in doses that would greatly exceed both French and U.S. disposal standards. The NRC itself has deemed salt unsuitable for spent fuel. Yet it did not explore the implications of that conclusion for the Waste Confidence Decision Update or for its reactor licensing program (see Section C below). The NRC mentions that the German salt dome repository program at Gorleben was suspended "[a]fter decades of intense discussions and protests,"[41] but mentioned none of the adverse technical factors that made the choice of Gorleben controversial or the fatal accident that occurred in 1987.[42]

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[40] NRC 2008, p. 59559.
[41] NRC 2008, p. 59559.
[42] For a discussion of some of the technical factors and the accident see Franke and Makhijani 1987.

3. Conclusions regarding Finding 1

In sum, in reiterating Finding 1, the NRC has not taken into account a mountain of data and analysis that are relevant to it that show that it is far from assured that safe disposal of spent fuel in a geologic respistory is technically feasible. The NRC has not met either of the criteria we set forth at the beginning of this section for assessing whether there was reasonable assurance that safe disposal is technically feasible. In the absence of data from a repository that has been sealed after spent fuel has actually been disposed of – and such data does not exist because no such repository exists – the NRC must provide data on and analysis of the major elements of a site that could be developed in the United States and show that the three elements required in any repository system would work together satisfactorily (i.e., meet radiation protection standards) and that such a repository could be safely built. The NRC has not done this. It has not evaluated the severe problems that the U.S. repository program has encountered and the many twists and turns that rules and regulations have taken as a result, notably with respect to Yucca Mountain. Indeed, the NRC has provided no scientific evidence in its Draft Decision that there is reasonable assurance in the scientific and statistical sense of the term that there is reasonable assurance safe disposal of spent fuel in a geologic repository is technically feasible.

In view of the above, we conclude that the NRC's Finding 1 should be modified. This is necessary on its own, but it is especially necessary in view of the fact that Finding 2 depends on Finding 1. We recommend that Finding 1 be modified to read:

1. While some of the elements of deep geologic disposal have been studied to a sufficient degree that they may be viable elements of a disposal system, an entire thermally and mechanically perturbed system has never been tested. The data on the individual elements of the perturbed and sealed system and for their combined functioning are not yet sufficient to determine the performance of a repository for safe spent fuel disposal with reasonable assurance.
2. The DOE has been pursuing study and characterization of repositories for decades and essential technical questions in relation to performance continue to be in doubt. Under some circumstances, the impact of disposing of spent fuel in a geologic repository could be significant.
3. Considerable further work remains to be done before there can be reasonable assurance that safe disposal of spent fuel and high-level waste in a deep geologic repository in the United States is technically feasible.

We have also concluded that a new generic environmental impact statement is needed to address the fundamental deficiencies of Table S-3. Licenses for new reactors and extension of licenses of existing reactors cannot be properly granted on the basis of the existing Table S-3.

B. Comments on Proposed Finding 2

The proposed Finding 2 states:

> The Commission finds reasonable assurance that sufficient mined geologic repository capacity can reasonably be expected to be available within 50–60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of any reactor to dispose of the commercial HLW and spent fuel originating in such reactor and generated up to that time.[43]

The NRC has made an unwarranted leap from its "Finding 1"[44] that a geologic repository for disposal of high-level waste and spent fuel is technically feasible to the conclusion that there is "reasonable assurance" of the actual availability of a repository within 50 or 60 years beyond the operating license of any commercial reactor in the United States.

In order to proceed from a finding that a geologic repository is technically feasible to the conclusion that one will be available within a specified time frame (in this case ~100 to 150 years), at least three additional demonstration elements are necessary. First, it must be shown that the requisite work of finding, characterizing, licensing and developing an actual site suitable for disposal of the actual amounts of waste to be generated is possible within the stipulated time. Second, a demonstration of financial feasibility and reasonableness is needed. And thirdly, a demonstration of political and social acceptability is also necessary. We will consider this last question first.

1. Social and Political Acceptability

The NRC has provided a survey of various country programs in order to review the issue of social and political acceptability.[45] This survey itself shows that there can be no confidence that the necessary social and political conditions exist in the United States to provide any assurance that a repository can be developed in any foreseeable time frame. Second, the NRC's survey is partly inaccurate. Third, the NRC's survey is essentially incomplete in that it omits the country that is often held up as being exemplary for nuclear power – France.

We discuss the NRC's survey before proceeding to the specific discussion of the situation in the United States.

1. United Kingdom:

The NRC appears to believe that the United Kingdom had a repository program for high level waste and spent nuclear fuel in the 1990s. Specifically the draft rule states the following

[43] NRC 2008, p. 59561.
[44] NRC 2008, p. 59553. See below for comments on Finding 1.
[45] NRC 2008, pp. 59559-59561.

> In the United Kingdom, in 1997, an application for the construction of a rock characterization facility at Sellafield was rejected, leaving the country without a path forward for long-term management or disposal of HLW or SNF. In 1998, an inquiry by the UK House of Lords subsequently endorsed geologic disposal, but specified that public acceptance was required.[46]

The NRC appears to have its facts about the UK repository program wrong. According to a timeline and status report by Alan Hooper of Nirex, Britain's waste management company, the geological investigations for a high-level waste repository were short-lived; they did not involve an application for a rock characterization facility:

- 1976—The Royal Commission on Environmental Pollution (Flower's Report) recommended the creation of a National Waste Disposal Corporation.
- 1979—Start of program of geological investigations for HLW disposal.
- 1981—**Termination of the geological investigations and suspension of a decision on high-level waste disposal for 50 years.**
- 1982—Nuclear Industry Radioactive Waste Executive (NIREX) created to implement Government policy on intermediate-level waste (ILW) and low-level waste (LLW).
- ...
- 1987—Abandonment of the near-surface program and adoption of new policy that all ILW and LLW should go deep...; new deep site selection process started.
- ...
- 1991—Nirex decides to focus investigations on Sellafield in Cumbria.
- 1992—Nirex announces plans for a Rock Characterisation Facility (RCF) at Sellafield; the plans were eventually considered at a public inquiry which ended in 1996.
- 1997—Decision by Government not to allow Nirex to proceed with the RCF, thus terminating the UK's siting program.[47]

As can be seen, the UK terminated its HLW geologic disposal investigations in 1981. The rock characterization facility to which the NRC refers was for Intermediate Level Waste (similar to Greater Than Class C waste in the United States), which is also mandated for deep geologic disposal. However, the geologic requirements for disposal of ILW are much less stringent than for high-level waste or spent fuel, because the characteristics of these wastes are very different. For instance, the specific activity of high-level waste and spent fuel is generally much higher, as is the heat generation.

The UK formed a Committee on Radioactive Waste Management as a vehicle for public consultation and exploration of the issue of long-term waste management. As the NRC

[46] NRC 2008, p. 29559.
[47] Hooper 2006, pp. 249- 250. Emphasis added.

noted, the most recent evidence is that this is also failing. According to the draft waste confidence rule:

> This [program] led to the initiation of a national public consultation, and major structural reorganization within the UK program. In 2007, the Scottish Government officially rejected any further consultation with the UK Government on deep geologic disposal of HLW and SNF. Discussions may continue on issues of interim storage only. This action by the Scottish Government effectively ends more than 7 years of consultations with stakeholders from communities near Scottish nuclear installations and represents another major setback for the UK program.[48]

Actually, the Scottish government press release does not mention high-level waste or spent nuclear fuel explicitly, but "higher activity" waste,[49] which includes intermediate level waste in the UK. In point of fact, the UK has no active repository program that is looking at a specific site for high-level waste or spent nuclear fuel and has not had any since 1981.

In other words, even though British nuclear waste authorities may believe that a repository is technically feasible, the program is at a dead end and only interim storage is on the table. So far the public consultation program has failed to elicit any progress towards a high-level waste repository. In the meantime, the decommissioning and clean-up of its main reprocessing site (Sellafield) is estimated to take more than 100 years and costs have skyrocketed to 73 billion pounds (roughly $100 billion).[50] While Sellafield was born as a nuclear weapons materials production site, most of the work there and most of the waste there has been generated in the past few decades from reprocessing of British and (more recently) foreign spent fuel. These costs do not include waste disposal or repository development costs.

2. Germany

The German repository program began investigating a salt dome at Gorleben in 1977. Major construction and characterization activities were carried out. The NRC described its status as follows:

> After decades of intense discussions and protests, an agreement was reached in 2000 between the utilities and the government to suspend exploration of Gorleben for at least three, and at most, ten years. In 2003, the Federal Ministry for the Environment set up an interdisciplinary expert group to identify, with public participation, criteria for selecting new candidate sites.[51]

There is as yet no specific site being characterized. After more than three decades, the program is moribund.

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[48] NRC 2008, p. 59559.
[49] Scottish Government 2007
[50] Irish Times 2008
[51] NRC 2008, p. 59559-59560.

3. Switzerland

The Swiss have done a quarter century of geologic repository research. In 1998, the Swiss was authorities found that a repository was technically feasible and that it has been successfully demonstrated, the repository was rejected in a referendum in the canton.[52] The Swiss authorities have no firm date for the opening of a repository, but, according to the NRC, they "do not expect [that] a deep geologic repository will be available in their country before 2040."

4. Canada

An independent commission, empanelled by the Canadian government found in 1998 that a geologic repository was technically feasible and that the concept had been sufficiently demonstrated. Yet, public acceptance is not assured. Canadian law requires public consultation. In 2007, Canada adopted an approach of public consultation with communities, which will supposedly be "community-driven" and "collaborative." No site has been selected as yet for characterization. The authorities recognize that the process will take time. According to the NRC, the Canadian waste authority "*assumes* the availability of a deep geological repository in 2035"[53] An assumption is clearly not the same as a reasonable assurance. It simply allows financial calculations to be made. Given that the authorities are still on square-one in regard to public acceptance after 37 years of implementing a program and considerably more than that of nuclear reactor experience, the date of 2035 can only be considered notional. It is not based on an actual program of characterization on the ground or the acceptance of a particular community located at a specific site.

5. Finland

Finland is the only country with an active nuclear power program and an active repository program where the host community government has approved of the repository site and agreed to host it. The opening of the deep repository is expected in 2020.[54]

6. Sweden

Two municipalities in Sweden have agreed to be potential hosts of a geologic repository and an application for repository development is estimated to be filed in 2009.[55] However, it should be noted that Sweden has had a national moratorium on the construction of new nuclear power plants.[56] Therefore, its entire public consultation process has been carried out in the context that the waste stream would be limited to that

[52] NRC 2008, p. 59560.
[53] Both quotes are from NRC 2008, p. 59560, italics added.
[54] NRC 2008, p. 59560.
[55] NRC 2008, p. 59560.
[56] Lundqvist 2006 p. 227

from its existing reactor fleet. It is an open question whether public acceptability would be forthcoming should Sweden reconsider its moratorium and rescind it.

7. France

The NRC has described the above six cases as part of its discussion of Finding 2 and the proposed update of this finding. It is interesting that the NRC did not discuss the French program (other than a passing mention in a footnote). In fact, the French program has faced serious public opposition and its history is somewhat similar to the one in the United States. The original intent was to characterize more than one site. Only one site, in north-eastern France is being characterized. It has faced considerable local opposition. The selection of a second site (in western France) for characterization was abandoned after serious public opposition.[57] The French appear to be as averse to having high-level nuclear waste in their backyards as people in other countries. Further, as noted above, there are serious technical questions about how ANDRA, the French nuclear waste agency, is proceeding to characterize the site and whether the results will be adequate to provide a satisfactory scientific basis for performance assessment. In other words, the public's skepticism about official technical work may not be misplaced, contrary to the NRC's implication that public and political non-acceptance of a geologic repository is somehow not based in science.[58]

2. Political and Social Acceptance Issues in the United States

Political and social acceptance is as essential in a democracy as technical feasibility. We have already discussed that the NRC has not provided the basis for its finding that there is reasonable assurance that a repository is technically feasible. We discuss here the social and political aspects of feasibility, which are also important for estimating a schedule. The NRC now acknowledges that in developing a repository schedule:

> The Commission's proposed revision of Finding 2 is based on its assessment not only of our understanding of the technical issues involved, but also **predictions of the time needed** to bring about the necessary societal and political acceptance for a repository site.[59]

The U.S. program has been beset with difficulties that are well known. Some of them are described in the discussion of the proposed update to the NRC's waste confidence findings. Some others have been discussed above. The failure of the second repository program provides another example. It was, in large measure, due to public opposition; but at least some of that opposition was technically well-founded since there were many technical problems with the approach that the DOE used to select the sites in its Draft

[57] CNE 2001, pp. 53-55.
[58] The proposed waste confidence rule states "International developments have made clear that technical experience and confidence in geologic disposal, on their own, have not sufficed to bring about the broader societal and political acceptance needed to realize the authorization of a single national repository." NRC 2008, p. 59559.
[59] NRC 2008, p. 59561, emphasis added.

Area Recommendation Report. (An unscientific element in the DOE's approach to site ranking, an essential technical element of site section, is briefly discussed above as an example of the problems in the report). The narrowing of site characterization to one site in Nevada was also political. As discussed above and below, the Yucca Mountain site has characteristics that make it unsuitable for a repository. But in the present context of a discussion of the proposed revision to Finding 2, it is sufficient to note that the State of Nevada and its representatives have been vigorously opposed to it on a bipartisan basis. Further, the political position of those representatives is considerably stronger today than it was when the 1987 amendments to the 1982 Nuclear Waste Policy Act (NWPA) were passed. Senator Harry Reid of Nevada is now Majority Leader of the U.S. Senate.

The Yucca Mountain Project also faces serious budgetary constraints. DOE's announced timetable of an opening by 2020 is contingent on Congressional appropriations. There is no basis in present political reality to assume that the DOE would get what it wants for site development. The United States program is also mired in litigation. Though a final EPA standard has been issued, it is not a given that it will hold up in the courts or that the Yucca Mountain site can meet the limits that the EPA has set.

The vigorous opposition of the people of Nevada and also of many along the transportation routes to Nevada is a fact that does not bode well for the eventual operation of the Yucca Mountain repository. Only one repository program is proceeding with a specific site where a repository may be assumed to open with reasonable assurance. That is the Finnish program, which was undertaken with both national and local approval. There is no other repository program that is on a road that would allow a conclusion that a repository would open with "reasonable assurance." Indeed, the NRC's revision of Finding 2 is not now dependent on the opening of Yucca Mountain, but on the opening of some repository within 50 to 60 years of the termination of the license of any operating reactor.[60]

We now have a President of the United States who is on the record as having stated that the Yucca Mountain site is unsuitable. President Obama has written:

> I want every Nevadan to know that I have always opposed using Yucca Mountain as a nuclear waste repository, and I want to explain the many reasons why I've held that view.
>
> In my state of Illinois, we have faced our own issues of nuclear waste management. There are some who believe that Illinois should serve as a repository for nuclear waste from other states. My view on this subject was made clear in a 2006 letter to Sen. Pete Domenici, who at the time was chairman of the Senate Energy Committee. "States should not be unfairly burdened with waste from other states," I wrote. "Every state should be afforded the opportunity to chart a course that addresses its own interim waste storage in a manner that makes sense for that state."
>
> That is a position I hold to this day when it comes to both Illinois and Nevada.

[60] NRC 2008, p. 59558 and p. 59561.

> After spending billions of dollars on the Yucca Mountain Project, there are still significant questions about whether nuclear waste can be safely stored there. I believe a better short-term solution is to store nuclear waste on-site at the reactors where it is produced, or at a designated facility in the state where it is produced, until we find a safe, long-term disposal solution that is based on sound science.
>
> In the meantime, I believe all spending on Yucca Mountain should be redirected to other uses, such as improving the safety and security of spent fuel at plant sites around the country and exploring other long-term disposal options.[61]

But if Yucca Mountain fails, it is not at all evident that a second program could be successfully put into place, as the NRC assumes. Besides the repeated delays, cost overruns, and technical problems that have plagued the Yucca Mountain program, there are other historical facts that need to be taken into account here. For instance, the DOE's Nuclear Waste Negotiator program, which aimed to find a community by consent, was eventually a failure. President George H.W. Bush appointed David H. Leroy as the Nuclear Waste Negotiator in 1990.[62]

Some attempts to locate a "temporary storage" facility at Native American reservations failed outright. The Private Fuel Storage proposed for Goshute reservation in Utah has also essentially failed, despite approval by the NRC, because of state opposition and opposition of people within the Goshute tribe to a tribal council decision to host it. A legal challenge remains.[63] It is highly unlikely that PFS will get to use the license that the NRC has granted it.

There is nothing in the history of the U.S. high-level waste program, from the first characterization program near the Lyons, Kansas, site in the 1960s to the Yucca Mountain site in 2009, that encourages the view that a repository would gain state approval. In its discussion of Finding 2, the NRC itself has acknowledged that "technical experience and confidence" are not enough to create a successful repository program:

> It is important to note, however, that broader institutional issues have emerged since 1990 that bear on the time it takes to implement geologic disposal. International developments have made clear that technical experience and confidence in geologic disposal, on their own, have not sufficed to bring about the broader societal and political acceptance needed to realize the authorization of a single national repository.[64]

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[61] Obama 2007

[62] Wald 1991

[63] Two agencies of the Department of the Interior have issued decisions effectively ending the proposed Private Fuel Storage facility. See BIA 2006 and BLM 2006. Discussion of the opposition to the PFS in Nevada can be found at http://deseretnews.com/article/content/mobile/1,5620,645199671,00.html?printView=true and at http://healutah.org/nuclearutah/waste/pfs, among other sources. Not all challenges have ended. In July 2007, Private Fuel Storage made a claim against the Department of the Interior, hoping to reverse the decision. See NRC 2008, p. 59566 (footnote 24) – the claim has not been settled.

[64] NRC 2008, p. 59559.

The entire history of the program, from Lyons Kansas, to the second round repository sites, to PFS, to the continuing legal, technical, and political challenges to Yucca Mountain, including now from the President of the United States, lends support to the view that both state and local consent are necessary (and consent of the people and governments of the tribes in the case of Native Americans) in the United States to the opening of a spent fuel repository.[65] With this history and with the strong U.S. tradition of state political prerogatives and rights, a statement that there is "reasonable assurance" that a repository would open in the foreseeable future without both state and local consent is unwarranted and unjustified. This conclusion would stand even if Yucca Mountain were a technically suitable site. And, as discussed above, there are many indications that Yucca Mountain is not a technically suitable site.

Yucca Mountain could not even accommodate spent fuel from existing reactors without new legislation, much less spent fuel from any new reactors that might be built. A second repository would also require new legislation and, as the proposed update acknowledges, it may require new NRC regulations.[66] There needs to be reasonable assurance that workable legislation would be passed before the NRC can conclude that there is "reasonable assurance" that a repository will be available in some general time frame. To fail to provide a basis for assuming that there would be such legislation is to fail to provide a satisfactory basis for the central claim in the proposed Finding 2.

The NRC stated in its Draft Waste Confidence rule that its revision of Finding 2 is based in part on "**predictions of the time needed** to bring about the necessary societal and political acceptance for a repository site."[67] But the NRC has not provided any political, historical, legislative, or social fact, much less an analysis, to support its prediction that that there will be sufficient political or societal support for a repository by 50 to 60 years after the license of any reactor has expired. Under the present circumstances, with opposition from the President of the United States and from the Majority Leader of the U.S. Senate, it is reasonable to conclude that the Yucca Mountain project will sputter along with inadequate funds or be ended entirely.

In the absence of action to lift the 70,000 metric ton cap, legislation to authorize a second repository is needed. Moreover, such legislation should be workable. The history of nuclear waste programs around the world indicates that state, local, and (when applicable) tribal consent is one essential ingredient of a successful program (though by no means the only one). Further, the federal government must be of one mind in pursuing the project over a long period of time. The history of the NWPA shows that not one of these societal and political conditions has been met. There is no indication in political reality that they will be met. The history of the second repository, which was abandoned in 1986, and the Nuclear Waste Negotiator program also points in the same direction.

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[65] This does not mean state and local support would be sufficient; it is just one necessary condition. Technical, legal, environmental and health criteria also needed to be satisfied.
[66] See footnote 3, NRC 2008, p. 59555.
[67] NRC 2008, p. 59561, emphasis added.

Even though it recognizes the important of social and political factors, the NRC proposes to find that there is reasonable assurance that there will be a repository any underlying legislative or political feasibility analysis. In effect, the NRC is assuming that the Executive Branch of government can confront the Legislative Branch with a *fait accompli* of granting license extensions to existing reactor licensees and licenses to new applicants. The implicit assumption is that Congress must then act to create a repository program that will accommodate all the waste and that new legislation will actually result in a repository.

The NRC apparently recognizes the weakness of its position regarding Finding 2 in that it explicitly solicits comment as to whether it should find instead that storage on site is safe "until a disposal facility can reasonably be expected to be available."[68] There is even less reasonableness in punting to the indefinite future, when the uncertainties and risks become greater. A large part of the very notion of spent fuel disposal is that it is far too risky to leave spent fuel lying around at dozens of sites for the indefinite future. This matter cannot be settled within the framework of dates or simply indefinite deferral of decisions. After repeatedly incorrect Waste Confidence Decisions regarding reasonable assurance of repository availability, the reasonable thing now is to do an Environmental Impact Statement that properly considers all the alternatives. This is necessary in any case, since a large part of the environmental impact evaluation done in the reactor licensing process is either obsolete or wrong or both (see below).

3. Financial considerations

There is also no fiscal or economic basis for concluding that there is a reasonable assurance that a repository will be available. The Nuclear Waste Policy Act requires nuclear utilities to collect 0.1 cents per kilowatt-hour from ratepayers and provide them to the federal government for spent fuel disposal in a repository. Annual nuclear electricity generation was about 787 billion kWh in 2006,[69] making that year's contribution to the Nuclear Waste Fund of about 787 million dollars. About 56,000 metric tons of spent fuel have already been generated as of April 2008. The figure is expected to rise to 119,000 metric tons by 2035.[70] However, reactor relicensing is continuing so this quantity is likely to increase, for instance, if nearly all operating reactors are relicensed.

In addition, the geologic repository must also accommodate Department of Energy reprocessing high-level waste disposal. As discussed above, it is highly unlikely that the 70,000 metric ton cap for the Yucca Mountain site will be lifted by Congress. The financial consequences of these facts must be taken into account in any waste confidence ruling dealing with both existing and new reactors.

The DOE's cost estimate for Yucca Mountain has escalated from about 57.5 billion dollars in 2001 to 96 billion dollars in 2008 for a variety of reasons, including more waste

[68] NRC 2008, p. 59561.
[69] Data from the U.S. Energy Information Administration (DOE EIA 2009)
[70] DOE OCRWM 2008.

and inflation.[71] This estimate is based on a smooth functioning of the program from here on out. This is highly unlikely given that program funds are highly likely to be cut, if it is not terminated altogether. It would be prudent and reasonable to assume that the costs of Yucca Mountain likely to be well over $100 billion, if it opens. At 0.1 cent per kWh, and 90 percent capacity factor for 60 years, the present U.S. reactor fleet will generate about $50 billion in revenue.[72] Moreover, this revenue is in current dollars, since the fee is not adjusted for inflation. But the costs are subject to inflation, one reason that they keep going up with every delay. Note that the cost estimate of $96 billion is in constant 2007 dollars. While there is some additional revenue from DOE defense high-level waste and some revenue from interest, this is unlikely to keep pace with rising costs.

It is not reasonable to assume that the present 0.1 cent per kWh fee will suffice to pay for the U.S. repository program. Further, given the political and legislative situation and the history of Nevada's opposition to Yucca Mountain, it is not reasonable to assume that the 70,000 metric ton cap will be lifted. Hence a second repository may well be necessary to accommodate spent fuel from existing reactors, and the problem will be worse if most or all of the reactors are relicensed. This would be true even if no new reactors are built.

There is at present no way to estimate the costs of a second repository, since the cost escalations for the first have been large and the program may fail altogether for one or more of a variety of reasons. In the interim, governmental liabilities for failing to meet its statutory deadline for beginning the process of taking ownership and disposing of the spent fuel are mounting. With no reasonable date for Yucca Mountain or a second repository in sight, the government's liabilities may become huge and must be taken into account in the overall cost of spent fuel storage and disposal. The penalty costs cannot at present be charged to ratepayers, since the government is in contractual default. The costs are nonetheless real to the people of the United States as a whole and much of the money is coming from ratepayers via federal taxes, and the rest from other taxpayers who are not now consuming nuclear electricity.

The NRC needs to address the financial uncertainties, legislative difficulties, and other political and social problems in making its estimate of the time in which a repository might become available. While political situations are subject to change, there is nothing in the past that encourages the view that it is becoming easier to find political acceptance for a repository in any part of the country.

In view of the above, the Institute for Energy and Environmental Research makes the following recommendations regarding the update of Finding 2. This finding should be change to explicitly state that:

1. It is far from assured that a second repository site can be successfully opened in the United States without the acceptance of the host state and local community.

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[71] DOE 2008b

[72] Some of this has already been generated, of course, since ratepayers have been paying into the fund for the past quarter of a century.

Such acceptance may or may not be forthcoming. The history of the U.S. repository program is not encouraging in this regard.

2. It is far from assured that the cap of 70,000 metric tons of heavy metal that is imposed by the Nuclear Waste Policy Act will be lifted.
3. In view of 1 and 2 above, commercial nuclear reactor licensees should make financial, security, and technical provisions for indefinite, secure, and hardened storage of spent fuel at reactor sites. These provisions should include infrastructure for transferring spent fuel bundles from one dry cask to another.
4. In view of 1, 2, and 3 above a generic EIS on spent fuel management and disposal including the alternatives mentioned above needs to be prepared, along with cost estimates and estimates of comparative security risks.

C. Requirements for a Generic Environmental Impact Statement on Spent Fuel Waste Confidence

The Waste Confidence Decision Update is being proposed in the context of NRC relicensing reactors in the existing fleet and of the applications for licenses for new reactors that it is considering. This update has major implications for safety and environmental impact. It will commit generations far into the future to potential harm if the NRC does not properly consider all relevant aspects of "safe disposal" and of environmental and health impacts of the wastes and radioactivity releases associated with reactor operations.

1. Need for a Generic EIS on Waste and Reactor-Related Emissions

As set forth in Section A above, the NRC has not presented a scientific analysis to support its claim that there is "reasonable assurance" that "safe disposal" of spent fuel in a geologic repository is "technically feasible" (Finding 1) or that it can be opened within the time frame set forth in the proposed revision of Finding 2. On the contrary, it far from assured that such safe disposal is technically feasible. It is important to note in this context that the prior Commission bases, on which its earlier findings were based, have been invalidated by experience, time, and new scientific understandings, many of which have been discussed above. Consider Yucca Mountain, which should provide the strongest case for a technical feasibility determination. Deadlines have repeatedly slipped. New data on corrosion have emerged. Some experts have deemed this site as inadequate and even "fatally flawed.' Most of the DOE dose estimates made since 1990 show exposures in excess of the current EPA standard of 100 millirem beyond 10,000 years. As a result, there is considerable scientific basis to doubt that Yucca Mountain is a suitable repository or that it should be licensed. We have discussed a critical problem with DOE's license application in that it sidestepped a key recommendation of the NWTRB by declaring it insignificant. There is also no real basis to estimate a future time, either as a date or in relation to expiry of reactor licenses, when there can be reasonable assurance that a repository can be opened.

The escalation of costs without an actual result in the form of a repository as well as the escalation of penalties for the government's failure to begin disposing of existing wastes

is causing waste management costs to escalate well beyond what was projected when the program was put into place. There is no clear current cost estimate of what it will cost to dispose of all the spent fuel currently scheduled to be produced from existing licenses and license extensions that have already been granted. This means that it is impossible to make a reasonable comparison with alternatives methods of electricity production that do no involve the creation of long-lived radioactive waste such as spent fuel and Greater Than Class C waste and depleted uranium.

In view of these facts, it is essential for the NRC to prepare a thorough generic environmental impact statement on spent fuel that would be generated by new reactors as well as from relicensing of existing reactors.

The NRC also needs a current and coherent analysis of the health impacts of the nuclear waste that will be created incident to the licensing of new nuclear plants and re-licensing of existing nuclear plants. The need for such a statement is further demonstrated by the fact that much of the basis for the assessment of the environmental impacts of reactor operation, which is part of the reactor licensing process, is obsolete and/or wrong. Specifically, Table S-3 at 10 CFR 51.51, is obsolete or incorrect in many respects, especially in regard to assumptions about the impacts of disposal of spent fuel, Greater than Class C Waste, Depleted Uranium as well as about other impacts (see below). Since the NRC is now engaged in a sweeping process, via relicensing existing reactors and considering new reactor licensees, to allow the creation of vast amounts of new waste, a generic EIS is needed.

Finally, the prior EIS on geologic disposal, prepared by the DOE is, like Table S-3, hopelessly out of date and also incorrect in essential parts about its estimates of environmental and health impacts.

No pre-existing EIS, already prepared by the NRC or the U.S. Department of Energy ("DOE"), is sufficient to support the Waste Confidence Decision. For instance, the EIS prepared by the DOE in 1980 is insufficient in scope and grossly out of date. As one example, the DOE EIS does not anticipate any releases from a properly constructed repository in the absence of extraordinary and rare events. In fact, it stated that:there was "every expectation that long-term radiological impacts will be nonexistent."[73] As discussed at length above, this is contrary to present understanding of any medium but salt, which the NRC itself now says is unsuitable for spent fuel disposal.

As another example, the DOE did not even examine a repository in tuff, which is the rock at Yucca Mountain and has been the only repository being characterized since 1987. It was written before there was an adequate understanding of the complexities of the three elements of the disposal system, discussed above in Section A, and the difficulties of estimating their joint performance. For instance, at the time, containers were expected to perform the role of a barrier for the early period of disposal, while the geologic system would take care of the long-term:

[73] DOE 1980, p. 5.72. The DOE only considered long-term radiological releases in case of improbable events such as meteorite impacts

> 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 millenia [sic] 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 1,000 years...[74]

It is clear that when DOE prepared this EIS in 1980, engineered barriers, including containers, were not expected to fulfill the main long-term function of containment for 10,000 years or more. But the NRC now only requires only an overall performance assessment which combines the performance of all elements together and does not put any sublimits on the performance of any particular element. As we have noted in Section A, in the case of Yucca Mountain, the essential performance burden in the sense of compliance with regulations rests with the containers. Indeed, the NRC's rules in this regard have also changed since the DOE's EIS was issued. The NRC's first rules corresponded more to the DOE's EIS concept that engineered barriers were to contain the waste in an initial period with the geology taking up the function after that. Those rules, which apply to geologic repositories to be licensed by the NRC, are at 10 CFR 60, but they Yucca Mountain was exempted from them, just as it was exempted from 40 CFR 191, Subpart B, which applies to all other repositories. 10 CFR 63, which requires only a combined performance assessment, was promulgated specially for Yucca Mountain.

Finally, a central part of licensing of new reactors and of the relicensing of existing reactors is as it concerns light water reactors (that is, all licensed power reactors in the United States) is the requirement that the license applicant prepare an Environmental Report that addresses:

> Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor.[75]

In the sections below we show that Table S-3 is obsolete and incorrect in a number of critical areas and needs revision, correction, and updating.[76] Since this is the main vehicle for assessing the environmental impacts of nuclear energy, a revision of this table and of the corresponding parts of 10 CFR 51, needs to be a part of the generic EIS on waste and the environmental impacts of nuclear energy.

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[74] DOE 1980, p. 5.1

[75] 10 CFR 51.51(e) 2008. [N.B.: formerly 51.20(e) 1984]

[76] The comments below on Table S-3 apply as well to Table S-3A, which is in WASH-1248 and provides more detail for Table S-3, when applicable.

2. Solid high-level waste and spent fuel disposal impacts

This requirement applies to "any applicant's environmental report submitted on September 4, 1979, or thereafter."[77] In regard to high-level waste or spent fuel, Table S-3 purports to provide environmental impacts that "are maximized to either of the two fuel cycles (uranium only and no recycle)."[78] While this purports to be the maximum impact from spent fuel disposal (either with or without reprocessing), the claim is either wrong, obsolete, or both.

First, the Nuclear Waste Policy Act envisions disposal of spent fuel. The reprocessing impact calculations are therefore irrelevant for present licensing and environmental impact considerations. Second, the Statements of Consideration associated with the promulgation of the final rule effective on September 4, 1979, explain the regulation note the following in regard to storage and disposal as follows:

> In determining the impacts associated with waste management and disposal, the [Nuclear Regulatory Commission] staff assumed that high-level waste (or reactor spent fuel treated as waste) would be stored in interim facilities (water basins and retrievable surface storage facilities) for about twenty years and then disposed of by burial in a bedded salt repository.[79]

In a footnote to this passage, the NRC noted that the original rulemaking had not extensively covered deep geologic disposal but subsequent work, published in NUREG-0116 has remedied that problem:

> ...NUREG-0116, Section 4.4, provides a 30-page quantitative discussion of disposal of long-lived wastes in a bedded salt repository, with citations to many relevant technical documents prepared since 1973. [80]

Thus, in 1979, the NRC had considered bedded salt as suitable for disposal either of reprocessed high-level waste or unreprocessed spent fuel. Yet, the draft waste confidence rule of 2008 states that salt formations are not being considered for spent fuel disposal for technical reasons (see quote above). Hence, Table S-3 is completely outdated and inappropriate according to current law, which requires spent fuel disposal, and the NRC's own understanding of salt repositories.

To wit, disposal in salt, which is the basis for estimating the environmental impact of high-level waste or spent fuel disposal, is only considered suitable for high-level waste resulting from reprocessing, but reprocessing is not the current policy. Rather, direct disposal of spent fuel, for which the NRC would not consider salt formation, is now the current policy.

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[77] 10 CFR 51.51(e) 2008.
[78] 10 CFR 51.51 2008, Table S-3, Footnote 1. Uranium only means a reprocessing cycle in which only the recovered uranium is reused as a fuel.
[79] NRC 1979
[80] NRC 1979, footnote 19

Moreover, Table S-3 assumes that there will be no releases whatsoever from solid high-level waste disposal.[81] According to WASH-1248, which is the underlying document developed for promulgating the rule:

> The most significant solid radiological waste consists of the fission products separated from the spent fuel of an annual fuel requirement in the reprocessing operation. These high level wastes will be stored onsite for a maximum of 10 yrs., and will ultimately be shipped, probably by rail, to a Retrievable Surface Storage Facility (RSSF). The RSSF will be established to store and manage high level solid wastes under constant surveillance for up to 100 years, or until such time as a more permanent Federal repository can be established. The facility will be designed to prevent the release of significant amounts of radioactive material to the environment under all credible environmental conditions and human actions. *Therefore, such waste will not be released as effluents to the environment.*[82]

The same assumption of essentially zero release and zero impact has evidently been applied to spent fuel as well. The NRC's 1981 background information on Table S-3 affirms this as well:

> It has been assumed that a geologic repository will be designed and operated so as to retain solid radioactive waste indefinitely.[83]

And again:

> The high-level radioactive waste from the once-through fuel cycle is the spent fuel assemblies, which will be packaged and disposed of in a geologic repository. The radioactive waste from the uranium-only recycle option consists of the fuel assembly hulls, the high-level and intermediate-level wastes from reprocessing, and the plutonium waste. These wastes will be disposed of in a geologic repository in the form of solids which will have chemical and physical properties that mitigate the release of radionuclides to the environs. It is assumed that *the geologic repository will be designed and operated so that the solid radioactive wastes are confined indefinitely.*[84]

Table S-3 does not show any releases from a deep geologic repository though ten million curies per reactor-year would be disposed of. Nor are any adverse health impacts estimated. Of course, these are implicitly zero as well, corresponding to the assumed zero release of radionuclides from the repository.

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[81] Table S-3 was revised in 1979 when 10 CFR 51 was promulgated. It has not been changed since. The references to Table S-3 are from 10 CFR 51 as it currently stands and to Table S-3A in so far as it is compatible with the present Table S-3.
[82] WASH-1248, p. S-23, italics added.
[83] NRC 1981
[84] NRC 1981, p. 13, italics added.

In 1983, the Supreme Court affirmed the reasonableness of the zero releases assumed in Table S-3 (BG&E v. NRDC, 462 U.S. 87). This decision was rendered in the context of the assumption of disposal of reprocessing high-level waste or spent fuel in a bedded salt repository. As noted above, the assumption of disposal of reprocessing waste from commercial spent fuel is obsolete; current law requires disposal of spent fuel. There is no commercial reprocessing facility in the United States. The assumption of disposal of spent fuel in salt has been is no longer scientifically supportable due to the thermo-mechanical properties of salt. The NRC itself has concluded that only reprocessing high-level waste is suitable for disposal in salt. Further, the assumption of zero release of radioactivity due to disposal of spent fuel is contrary to the established scientific understanding of the expected performance of all other geologic settings. For instance, all of the DOE documents cited above as well as the graphs shown in Attachment A to these comments show positive doses due to disposal of spent fuel in Yucca Mountain. Of course, positive doses can only be the result of positive releases of radionuclides into the human environment. As far back as 1983, the report on geologic isolation prepared for the DOE by the National Research Council concluded that radiation doses would be positive doses for spent fuel and high level reprocessing waste disposal in all settings other than salt that were evaluated – tuff, granite, and basalt.[85]

The Supreme Court's 1983 finding that an assumption of zero release from high-level waste or spent fuel disposal has therefore been rendered obsolete by the combination of following three considerations:

1. The Nuclear Waste Policy Act requires the disposal of waste from commercial nuclear power plants in the form of spent fuel rather than reprocessing waste.
2. Spent fuel cannot be safely disposed of in a salt repository, as acknowledged by the NRC (see above)
3. All other repository settings are now acknowledged to have some releases of radioactivity.

10 CFR 51 therefore is no longer valid and as the basis for determining the environmental performance of nuclear power plants so far as releases from spent fuel are concerned. As a result it does not provide a satisfactory basis for licensing new nuclear power plants or relicensing existing ones. It also does not provide the basis for confidence that a suitable repository will be available that will keep the environmental impacts within the limits assumed by Table S-3.

Instead of addressing the substantive issues that it faces in regard to waste confidence in the licensing of new reactors or the relicensing of existing reactors under the technical and legal conditions that exist today, the NRC has wrongly assumed the problem away in its draft waste confidence findings by implicitly assuming that Table S-3 is still valid. A new and valid estimate of the set of environmental impacts from high-level waste and

[85] NAS-NRC 1983, Chapter 9. Estimates of doses from spent fuel disposal are only presented for basalt along with the statement that the conclusions for basalt "will apply as well to the other repository media." p. 282.

spent fuel disposal is evidently needed as part of any waste confidence rule. A generic environmental impact statement is needed in order to establish the basis on which new reactors can be licensed or existing reactors can be relicensed.

We note here that there are other parts of Table S-3 that is obsolete or wrong or both that do not concern high-level waste or spent fuel, but relate to the impacts from other parts of the fuel cycle. These also needed to be covered in the new, generic environmental impact statement. Some additional requirements for revision of Table S-3 are discussed in below.

As noted above, Table S-3 is either incorrect or obsolete or both in regard to high-level waste and spent fuel disposal in a geologic repository. There are other ways in which these tables do not properly or adequately assess the impact of wastes and effluents associated with nuclear reactor operation. A thorough revision of these tables and the associated analysis is necessary to correct them and to assess the environmental impact from relicensing existing commercial reactors or licensing new reactors, both of which will result in the generation of large amounts of new waste and radioactivity. We will first cover the ways in which Table S-3 is deficient in matters other than high-level waste and spent nuclear fuel disposal. Then we will provide recommendations for the scope of the generic environmental impact statement that is needed to address those aspects of environmental and health impacts of reactor licensing and re-licensing.

3. Releases of volatile radionuclides from spent fuel

Volatile radionuclides are mainly released to the atmosphere from spent fuel when it is reprocessed if not captured.[86] For instance, iodine-129 would be released to the atmosphere in this way, if not captured. There are also liquid effluents as a result of reprocessing.

In constructing Table S-3, the NRC assumed that I-129 would be released to the atmosphere prior to spent fuel disposal in a repository even though, physically this would not occur. The NRC claimed that this was a "conservative" assumption:

> For spent fuel disposal the staff made the conservative assumption that fission-product gases in the spent fuel, including all tritium, krypton-85, carbon-14, and iodine-129, would be released during handling and emplacement of the waste prior to sealing of the repository. This assumption reflects the possibility that the spent fuel storage canisters and the fuel rod cladding will be corroded by the salt during the period the repository is open (roughly 6 to 20 years, and volatile materials in the fuel will escape to the environment. The staff assumed, however, that after the repository is sealed there would be no further release of radioactive materials to the environment.[87]

[86] The release of carbon-14 as carbon-14 dioxide gas is covered separately below.
[87] NRC 1979.

The NRC made this assumption in the context of disposal in a bedded salt repository, which, as noted, is obsolete for spent fuel. It is also not conservative for any other geologic setting, since iodine-129 releases into groundwater could cause much higher doses either via groundwater or where the groundwater is discharged into surface water.

For instance, the largest dose calculated by the French nuclear waste agency ANDRA, was due to I-129 in spent fuel. As noted in Section A, the whole body effective dose equivalent from I-129 in the event of seal failure was estimated to be 1,500 millirem, greatly in excess of both the French and current U.S. EPA performance requirements. Since the main organ that is irradiated is the thyroid, the implied dose to the thyroid is about 30,000 millirem.[88]

It is clear that under present circumstances, with present technical information, and under current law, Table S-3 is not conservative. On the contrary, by assuming that I-129 is dispersed into the atmosphere, the doses are implicitly assumed to be quite low. For instance, WASH-1248, the document underlying 10 CFR 51, estimates the thyroid dose due to the release of volatile radionuclides (mainly I-129) as only 6.3 millirem from one-reactor year of operation.

This dose appears to be well with compliance limits and hence the NRC can proceed to liecense reactors on this basis. However, if it is assumed that spent fuel will be disposed of in a geologic repository where groundwater could become contaminated, then the performance measure to be used is not longer that applying to one reactor for one eyar, but whther the geologic repository system is suitable for disposal of all the spent fuel that is created in the program as a whole. In the French case, the spent fuel disposed of is much less than will be required in the U.S., since the French have fewer reactors and they have reprocessing. It is plausible that the U.S. impacts from iodine disposal could therefore be far in excess of the limits set in 40 CFR 197 for geologic disposal.[89] Therefore the cumulative impact of licensing new reactors and re-licesing existing reactors would be far in excess of that estimated in Table S-3, which assumes zero releases into the environment from disposal of solid spent fuel.

Other parts of Table S-3 relating to volatile or gaseous radionuclides are also obsolete. For instance, Table S-3 assumes a release of 400,000 curies of krypton-85 into the atmosphere per reactor-year. While this may be conservative, it is greatly in excess of the EPA's maximum allowable release of krypton-85 from one-gigawatt-year[90] of operation as specified in 10 CFR 190.10(b):

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[88] Calculated using thyroid and committed dose equivalent dose conversion factors for ingestion of iodine-129 in EPA 1999 and 2002 suppl. The weighting factor used for the thyroid is 0.03, according to 40 CFR 191.

[89] The DOE's license application for Yucca Mountain estimates low doses only because it assumes near-total container integrity for very long periods of time and treats deliquescence-induced corrosion as insignificant.

[90] This is equal to one 1,000 megawatt reactor operating for one year at 100 percent capacity factor. Table S-3 assumes a "Reference Reactor Year" which is the same reactor operating at 80 percent capacity factor,

> (b) The total quantity of radioactive materials entering the general environment from the entire uranium fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, contains less than 50,000 curies of krypton-85, 5 millicuries of iodine-129, and 0.5 millicuries combined of plutonium-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year.[91]

Hence, the assumed release of Kr-85 in Table S-3 is far in excess of that allowed under current EPA rules, demonstrating yet another aspect of the obsolescence of Table S-3. We understand that these releases would occur mainly in the case of the reprocessing option being chosen and that reprocessing is not the current law for spent fuel management and disposal. But Table S-3 is designed to cover both the reprocessing and non-reprocessing cases. The releases it estimates, as an upper bound, are not in compliance with current regulations.

Table S-3's estimate of 1,300 millicuries (1.3 curies) of iodine -129, and 203 millicuries (0.203 curies) of fission products and transuranic radionuclides not otherwise specified are also not aligned with 40 CFR 190.10(b).

It is clear that some of the NRC assesses releases from reactor operations to be insignificant that are far in excess of those allowed by the EPA. The fact that these releases would be primarily from reprocessing operations and that reprocessing is no longer envisaged as the basis for disposal only highlights the obsolescence of Table S-3.

Further, it is possible that reprocessing may become the basis for spent fuel management for some or all of spent fuel. While we have concluded that such a course would create far more serious problems than it solves, it is nonetheless within the realm of possibility. For instance, it is part of a set of options being considered under the Global Nuclear Energy Partnership.[92]

As of April 2008, U.S. nuclear power plants had created 56,000 metric tons of spent fuel. The DOE anticipates that 119,000 metric tons of spent fuel will be created by existing reactors by 2035. There is some uncertainty about waste generation per reactor for new reactors, since it will depend on enrichment, burn-up etc. But 30 new reactors would likely generate in excess of 600 metric tons per year of spent fuel, or 24,000 metric tons over 40 years.

In sum, just considering spent fuel alone, there are a many ways in which Table S-3 is obsolete and/or incorrect. Hence revision of operational norms and release estimates in both the reprocessing and non-reprocessing cases is essential as is a reevaluation of the impacts and costs in a new generic EIS.

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see NUREG-0116, Table 3.2, p. 3-14. When translated into the same basis as the EPA regulation, the krypton-85 emissions would be 500,000 curies per gigawatt-year.

[91] 40 CFR 190.10(b) 2008

[92] GNEP PEIS draft 2008, see Section S.2.4 for a summary of options the DOE is considering. A Final EIS has not yet been prepared.

4. Greater than Class C (GTCC) waste and low-level waste

Table S-3 is severely outdated with respect to GTCC waste. It is also outdated with respect to Class A, B, and C low-level waste.

a. GTCC waste

There was no GTCC waste category when the 10 CFR § 51.51 and Table S-3 was revised in the late 1970's.[93] NRC regulations regarding GTCC waste were part of low-level waste regulations, which were not issued until 1982 and revised periodically after that.[94] The Part 61 low-level waste regulations generally require disposal of GTCC in a deep geologic repository and prohibit shallow land burial unless a specific exemption is obtained.[95] At present Table S-3 assumes all solid radioactive waste, except high-level waste, including what is now called GTCC waste, will be buried in a shallow land burial facility.[96] This is clearly incorrect. GTCC waste cannot be disposed of in shallow low-level waste facilities unless a specific exemption to do so is provided by the NRC. None has been provided; nor is there any application for such an exemption.

GTCC waste has a relatively high radioactivity per unit volume and many components of GTCC waste have long half-lives. The impacts in the absence of repository disposal could therefore be considerable – though the amounts would be site specific. Therefore, Table S-3, which was prepared prior to the understanding that led to the creation of a GTCC category, cannot be relied upon for estimating the environmental impact of GTCC disposal. We note here that Table S-3 has been republished in the same way since the late 1970s without change, including after the low-level waste regulations requiring deep geologic disposal of GTCC waste (unless specifically exempted). The current version of 10 CFR 51 also contains this same provision for disposal "on site."[97] The following is copied from the present Table S-3 at 10 CFR 51.51[98]:

Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci] comes from reactor decontamination and decommissioning--buried at land burial facilities. 600 Ci comes from mills--included in tailing returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.

Table S-3 is therefore legally wrong in its *a priori* assumption of shallow land burial (on site or at any site) of GTCC waste.

[93] NRC 1979. Table S-3 was first published in WASH-1248 and revised in the late 1970s, in which form it has been republished since that time.
[94] 10 CFR Part 61 2008
[95] See 10CFR 61.55(a)(2)(iv) 2008 and 10 CFR 61.55(a)(4)(iv) 2008.
[96] 10 CFR 51.51 2008. Table S-3 mentions onsite burial (i.e., "buried on site"). This would clearly not be allowed for any of the wastes discussed here.
[97] Disposal on site at reactors would not be permitted since none have a license do to so and no applications have been made. There are other issues as well in relation to low-level waste compacts see below.
[98] 10 CFR 51.51 2008.

The Department of Energy (DOE) is preparing an Environmental Impact Statement (EIS) regarding GTCC disposal.[99] This EIS is being prepared because the DOE considers the development of capability to dispose of GTCC waste as a "major Federal action."[100] A full evaluation of the impacts of options of GTCC disposal has never been done. The impacts of GTCC disposal as evaluated in this EIS need to be incorporated into a revised Table S-3. .

Table S-3 is also incorrect in another respect. As can be seen, above, it assumes that there will be "[n]o significant effluent to the environment" and no health impact is estimated. In other words, the assumption here is the same as that for high-level waste and spent fuel disposal – zero environmental impact.

The more stringent requirement for GTCC waste disposal is because the specific activity of the waste is higher than for the Class A, B, and C low-level waste categories as defined in 10 CFR 61.55. No difference in the types of radionuclides or their chemical composition is assumed to exist. The technical inference clearly is that shallow land burial would produce greater impacts than Class A, B, and C waste disposal. The radiation doses estimated by the NRC for these latter waste categories in its low-level waste EIS are greater than zero for all disposal cases, even those in conformity with the 10 CFR 61 regulations, over a period of 500 years.[101] *A forteriori*, the impacts associated with GTCC disposal in shallow land burial at the same reactor site or at some other site would likely be greater.

While the impacts of Disposal of GTCC waste disposal have not been evaluated in the United States, they are required to be disposed of in a deep repository in France. The French evaluation of Class B waste (corresponding approximately to GTCC waste) provides some interesting evidence. According to ANDRA's assessment, the dose from Class B waste disposal at the French Bure site could exceed allowable limits due to exposure to chlorine-36 in the scenario that assumes a failure of the repository seals.[102]

There is no explicit discussion of transuranic waste in Table S-3. Yet NUREG-0116, which supplements WASH-1248, and which is referred to in the notes to Table S-3 explicitly mentions that transuranic waste, mainly generated during reprocessing, should be disposed of in a deep geologic repository. Table S-3 does not even consider chlorine 36.

There will be a considerable amount of GTCC waste even if there is no reprocessing. The DOE estimated that a Boiling Water Reactor would generate 47 cubic meters and a

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[99] See DOE 2007 and DOE 2007b.
[100] According to the GTCC EIS website set up by Argonne National Laboratory for the GTCC EIS process, "The Secretary of Energy has determined that development of disposal capability for GTCC LLW is a major Federal action that may have a significant impact upon the environment within the meaning of the National Environmental Policy Act of 1969 (NEPA)." On the Web at http://www.gtcceis.anl.gov/eis/why/index.cfm.
[101] NRC 1982, v. 1, Table 4.6 (pp. 4-30 to 4-32).
[102] ANDRA 2001, p. 139.

Pressurized Water Reactor would generate 133 cubic meters upon decommissioning.[103] On this basis the existing reactor fleet would generate in excess of 10,000 cubic meters of GTCC waste upon decommissioning.

Again, it clear that Table S-3 is obsolete or incorrect in a number of respects in regard to GTCC waste. The impact of this needs to be assessed either by the NRC as part of the impacts associated with nuclear energy production.

b. Class A, B, and C low-level waste

10 CFR 61 allows disposal of Class A, B, and C low-level waste in shallow land disposal facilities. However, such facilities must be licensed and must meet the dose limits specified at 10 CFR 61 Subpart C. Table S-3 mentions "on site" disposal. WASH-1248, the underlying document supporting Table S-3 also mentions on site diposal. No current reactor sites have such licenses. No application for a new reactor contains provision for obtaining a license for on-site disposal of low-level waste. The table needs to revised and clarified in this regard.

Table S-3 also assumes that shallow land disposal of waste will have not environmental and health impact. This is incorrect. The low-level waste EIS recognizes that some impacts may occur. The standard computational model used for assessing the radiation dose impact of land contamination (and disposal of radioactive waste in shallow land burial facilities is a form of land contamination) generally produces non-zero radiation doses under any reasonable assumption of technical site parameters. This is especially so as 10 CFR 61 Subpart C contains no time limit for performance. That is, the dose limits specified there must be met for the durations that are multiples of the longest lived radionuclides disposed of at the facility. Hence Table S-3 is obsolete and wrong in its assumption of essentially zero release from shallow land burial of low-level waste as well. .

5. Depleted Uranium

Table S-3 makes no mention of the large amounts of depleted uranium that will be generated in the course of enrichment of uranium to produce fuel for the proposed nuclear reactors. Large amounts of DU from uranium enrichment plants were not regarded as a waste when Table S-3 was created. But the Nuclear Regulatory Commission has declared depleted uranium as a low-level waste. However, the classification of large amounts of DU from enrichment plants within the low-level waste scheme (Class A, B, C or GTCC) has yet to be decided. The NRC as asked its staff to conduct a generic proceeding to determine such a classification.[104]

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[103] DOE data as cited in Makhijani and Saleska 1992, Table 6.

[104] "...the Commission directs the NRC staff, outside of this adjudication, to consider whether the quantities of depleted uranium at issue in the waste stream from uranium enrichment facilities warrant amending section 61.55(a)(6) or the section 61.55(a) waste classification tables." (NRC 2005).

The NRC staff has recently begun that assessment. It has determined that 10 CFR 61 does not automatically apply to DU in large amounts such as those created by enrichment plants. In fact, it has decided that DU from enrichment plants differs essentially from other low-level wastes in some respects in that it has a much higher level of specific activity, the radionuclides are exceptionally long-lived, and there is in-growth of thorium-230 and radium-226 (which emits radon-222) over hundreds of thousands of years.[105]

DU has radiological characteristics similar to Greater than Class C low-level waste, containing long-lived, alpha-emitting transuranic radionuclides at concentrations greater than 100 nanocuries per gram. Shallow land disposal of over 10,000 metric tons of DU would cause substantial health and environmental impacts in the long run. An assessment done by the Institute for Energy and Environmental Research in the context of evaluating the disposal of 133,000 metric tons of DU from an enrichment plant proposed for New Mexico, concluded that peak doses from the disposal would be in the hundreds of rem per year to the maximally exposed individual under a variety of shallow land disposal conditions, including disposal in dry or wet areas.[106] In contrast, the maximum allowable dose from low-level radioactive waste disposal is only 0.025 rem per year.[107] This means that DU from enrichment plants, over the life of the plant, if disposed of in shallow land burial, would produce doses thousands of times greater than the allowable limit at the time of peak dose.

The NRC staff paper has itself estimated that the disposal of DU in shallow land burial will cause non-zero radiation doses.[108]

Table S-3 does not take any of these realities into account. Indeed, at the time it was published in its present form, in the late 1970s, DU was not even considered a waste. However, the NRC now requires it to be considered as waste in the context of the licensing of uranium enrichment plants.[109] Hence Table S-3 is obsolete in not explicitly considering the impacts of DU.

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[105] Borchardt 2008 Enclosure 1.
[106] Makhijani and Smith 2004, Table 5 (p. 24). "Version for Public Release Redacted March 20, 2007."
[107] 10 CFR 61.41 2008
[108] Borchardt 2008, See Enclosure 1. Note that we do not agree with the results of the NRC staff's calculations. For instance, the NRC staff has assumed that "there will not be significant releases of waste to the environment from fluvial or aeolian erosion." This is completely unrealistic and in general scientifically incorrect for the time periods evaluated – well over 1,000 years and up to one million years. As a result, the quantitative impacts assessed by the NRC for arid sites are serious underestimates (since erosion is the main pathway for long-term dose, which is external dose, in arid areas). See Makhijani and Smith 2004. The NRC's conclusion that that some shallow land burial sites may be suitable for DU disposal is based on the incorrect assumption of zero erosion rates, is therefore also incorrect. There has been no scientifically credible demonstration that there would be essentially zero impact from erosion at shallow burial sites, even if these are more than three meters deep, given the time scales involved.
[109] NRC 2005

The 56,000 metric tons of spent fuel that have been created so far correspond to more than 300,000 metric tons of DU.[110] There will be hundreds of thousands of metric tons of additional DU due to future fuel production for the existing reactor fleet. Relicensing the rest of existing reactors and licensing new reactors will commit to production of further large amounts.[111]

DU cannot be buried at the reactor site or the enrichment plant site without an appropriate license. Under the current path, DU from an enrichment plant or even more than one enrichment plant may be disposed of at a single facility.

The impacts of DU management and disposal and whether such safe disposal of DU – that is disposal of DU in conformity with low-level waste disposal standards at 10 CFR 61 Subpart C – is possible needs evaluated in the generic EIS on waste that would include a revision of Table S-3. The costs of disposal that would conform to 10 CRF 61 Subpart C also need to be estimated.[112]

6. Radon

The matter of doses from radon-222 due to emissions from mill tailings had not been included in Table S-3. On March 20, 2008, the NRC denied a petition by the New England Coalition on Nuclear Pollution, which had requested that a value for the impact of radon-222 be included in Table S-3. In denying the petition, the NRC concluded that "the radiological impacts of the uranium fuel cycle, including those from radon-222 emissions, on individuals off-site will remain at or below the Commission's regulatory limits, and as such, are of small significance."[113] The NRC referred to Chapter 6 of NUREG-1437 for technical details about the denial.

Limiting radon-222 emissions from uranium mill sites requires the maintenance of the mill tailings site. This includes maintenance of a cover to prevent radon emissions:

> The design and implementation of the radon cover and erosion protection features are the primary reliance for maintaining radon emissions within the [10 CFR] Part 40 limits; significant failure of the covers is considered highly unlikely. However, the indefinite licensed long-term custody and care provide additional assurances.[114]

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[110] This is an approximate figure. It is much greater than the amount used in the illustrative calculation in the paragraph before. The exact figure attributable to commercial nuclear power plants is difficult to estimate, since the U.S. has had dual use enrichment plants for its civilian and military enrichment requirements and because in recent years the U.S. has also imported enrichment services from Russia in the form of Russian highly enriched uranium that was downblended into low enriched reactor fuel.

[111] The exact amounts are difficult to estimate since some depleted uranium tails may be used as enrichment feedstocks and the assay of U-235 in the tails may vary as uranium prices change.

[112] See for instance Makhijani and Smith 2004.

[113] NRC 2008c. The quote is on p. 14947

[114] NRC 1996, Vol. 1, pp. 6-9 and 6-10.

This assumption that there will be custody and maintenance for the indefinite future in NUREG-1437 is patently absurd. While the decay of radium-226, which has a half-life of 1,600 years, is the proximate source of radon-222 emissions from mill tailings, radium-226 itself is the decay product of thorium-230.

So long as there is thorium-230 in the tailings, the amount of radium-226 will be about the same (excepting that part accounted for by differential environmental mobilization). Thorium-230 has a half-life of over 75,000 years. Hence, there will be significant amounts of radium-226 in the tailings ponds for about ten half-lives or about three quarter of a million years. No human institution has lasted even one percent of this time. The United States, which has had a long political continuity, is not even 300 years old, and it has had a Civil War less than a hundred years after its creation. While the Atomic Energy Act may require institutional control and maintenance of mill tailings, an environmental impact assessment is a technical matter. That assessment cannot rely on a legal requirement that is patently out of touch with any reasonable expectation or technical judgment. For instance, the National Research Council has advised that long-term institutional control should not be assumed in waste disposal or matters relating to the use of contaminated sites:

> *The committee believes that the working assumption of DOE planners must be that many contamination isolation barriers and stewardship measures at sites where wastes are left in place will eventually fail, and that much of our current knowledge of the long-term behavior of wastes in environmental media may eventually be proven wrong. Planning and implementation at these sites must proceed in ways that are cognizant of this potential fallibility and uncertainty.*[115]

The NRC has done exactly the opposite of the recommendation of the National Research Council. Instead of being "cognizant of this potential fallibility and uncertainty" arising from the failure of stewardship and the possibility of incorrect assumptions, it has simply reckoned that all of its essential assumptions and all the necessary institutions and finances will be in place for three quarters of a million years. While this time frame is not specified in NUREG-1437, it is implicit in it because radon-222 emissions ultimately originate in the thorium-230 present in the mill tailings. Indeed, over the long periods considered, the potential for high population doses due to erosion and airborne radioactive particles from the mill tailings should be explicitly considered.

Further, radon releases will also occur from DU disposal, which was not considered in Table S-3. DU disposal is now acknowledged by the NRC to create risks for a million years or more.[116] Since U-238 decay will create radium-226 buildup over time, radon-222 risks from DU disposal will persist for the indefinite future.

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[115] NAS-NRC 2000, p. 5. Italics in the original.

[116] Borchardt 2008. See for instance Figure 7. While this Figure stops at one million years, it is evident from the charts that non-zero doses continue after that time.

Finally, it should also be noted that EPA's Federal Guidance Report 13, which provides dose conversion and risk factors for persons by age does not provide any data for radon-222. In updating Table S-3 the NRC will need to consider whether children or women get a higher dose than men under specified environmental conditions.

7. Carbon-14

While Table S-3 makes an estimate of 24 curies of carbon-14 releases as gaseous effluents from one reactor year of operation, WASH-1248 does not provide an analysis of the dosimetric consequences. Carbon-14 is oxidized either during reprocessing or in an unsaturated oxidizing environment like Yucca Mountain. While the individual doses from C-14 releases can be expected to be very small, the population doses integrated over time would be very large. This is because carbon-14 has a very long half-life (5,730 years); it will continually be recycled through the biosphere along with non-radioactive carbon. Over ten thousand years, the population doses could be very high in an oxidizing environment. The SAB report cites a population dose of 14 million person rem over 10,000 years assuming that half the carbon-14 is released. This corresponds to 4,000 cancer fatalities over 10,000 years.[117] The total amount of spent fuel considered in this calculation was 70,000 metric tons of heavy metal, the present legal limit for repository disposal. The corresponding estimate per reactor-year, assuming 20 metric tons per reactor-year, would be 1.14 cancer fatalities over 10,000 years. This amounts to 45 fatal cancers due to carbon-14 releases from spent fuel generated over a 40-year operating life and twice that if the license is extended by another 40 years.

Such consequences would be estimated only for unsaturated oxidizing repositories, which is the description that fits the Yucca Mountain site as presently designed and characterized. They would also be estimated in reprocessing scenarios. Hence, the estimates of C-14 fatalities and corresponding estimates of cancer incidence need to be included in a revised Table S-3. We note here that the dose conversion factors have been updated since the EPA carbon-14 report, cited above, was published. Doses and cancer risks need to be calculated on an age-specific, gender-specific basis in the generic waste EIS.

8. Conclusions regarding aspects of Table S-3 other than Spent Fuel and High-Level Waste

Table S-3 is obsolete and/or wrong in its legal, technical, environmental and health assumptions and estimates in regard to spent fuel, gaseous releases from spent fuel, GTCC waste, Class A, B, and C low-level waste, DU, radon-222, and carbon-14. In light or more rigorous requirements for waste management and the fact that repository costs have escalated without a repository having been commissioned as previously envisaged, a thorough revision of the cost basis of nuclear power in regard to its waste aspects is also

[117] Loehr, Nygaard, and Watson 1993, p. 21

needed. This is essential because without such estimates, the costs of nuclear energy with alternative options cannot be fairly made.

A generic environmental impact statement must compare the environmental impacts and costs of the present course with the following alternatives in regard to spent fuel:

1. At reactor storage for the indefinite future, including periodic replacement of storage containers and inter-container transfer.
2. Consolidated monitored storage in one or more locations for the indefinite future, including replacement and transfer as in Item 1 above.
3. Yucca Mountain at 70,000 metric tons with no second repository.
4. Yucca Mountain at a higher capacity than 70,000 metric tons.
5. Yucca Mountain with a second repository.
6. Yucca Mountain fails as a program and one or more other sites in a new program to accommodate all spent fuel.
7. Reprocessing of spent fuel with fast reactor reuse of plutonium and uranium, plus a waste repository for high-level waste and Greater Than Class C waste.
8. Reprocessing with light water reactor re-use of plutonium (including costs of reactor modification), with a repository as in Item 7 above.
9. Reprocessing of spent fuel without fast reactor reuse of plutonium and uranium, with a repository as in Item 7 above.
10. Uranium only fuel recycle, with a repository as in Item 7 above.
11. Partial reprocessing, with repository disposal of uranium and mixed uranium-plutonium oxide spent fuel, uranium spent fuel, high-level waste and Greater Than Class C waste.

The risk of terrorist attacks and proliferation risks must be included in the generic EIS. These risks are different for the various options and those differentials need to be factored into the process of choosing a preferred alternative in the EIS process.

It must also consider the various options for GTCC disposal and DU disposal that would conform with existing low level waste dose limits specified at 10 CFR 61 Subpart C.

A waste confidence rule as well as a generic EIS on spent fuel must consider the above alternatives and provide cost estimates for them. These costs must be added to reactor costs for new reactors in the licensing process and in the re-licensing process of existing reactors. The costs must be added to nuclear power costs when evaluating alternatives when preparing environmental impact statements for new reactors. Without a realistic estimate of costs and a generic waste confidence EIS, the EIS process for new reactor licenses and the adjudicatory process for re-licensing reactors will remain fundamentally deficient. If the costs of repository alternatives cannot be realistically estimated based on present U.S. data and history (including technical, legal, regulatory, political, social, and fiscal aspects), then the waste confidence finding must be that there is no reasonable assurance that a repository for spent fuel can be opened in the United States at any time in the foreseeable future. Specifically, if a well-founded upper bound cannot be attributed to waste management and disposal costs, then there is no basis on which to

compare the total costs of nuclear with various combinations of renewable energy, storage, combined heat and power, and efficiency alternatives as a part of the EIS process of licensing new reactors.

D. Conclusions

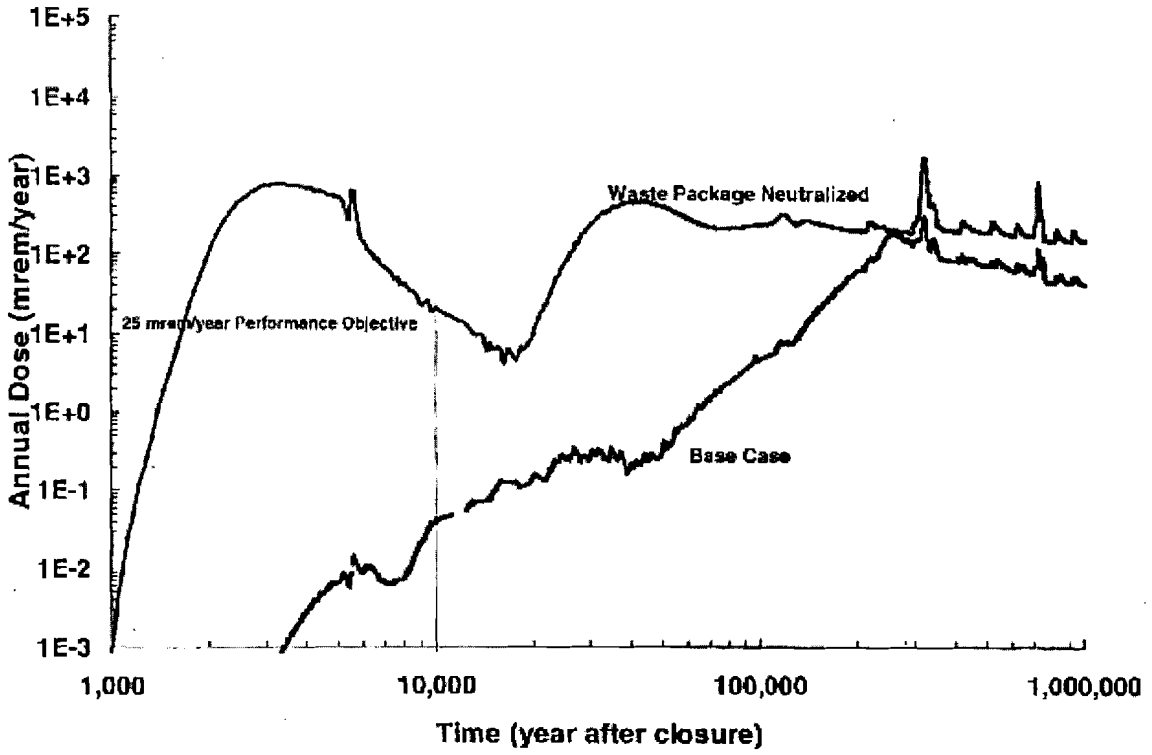
The NRC has not provided a sound scientific, technical, legal, political, social financial, or fiscal basis for its conclusions that (i) a geologic repository for disposal of spent fuel is technically feasible, (ii) it can state with reasonable assurance that a geologic repository to accommodate the required waste volumes can be opened within 50 to 60 years after the license expiry of any U.S. nuclear power plant, including new plants.

Further, Tables S-3 is either obsolete or wrong needs to be fundamentally revised to take into account new scientific and legal realities. We have concluded that at present there is no reasonable assurance that a repository in the United States can be opened within the time frame specified in the revised Finding 2 or indeed at any time. A generic EIS on nuclear spent fuel management, including a revision of Tables S-3, is required before new reactors can be licensed or existing reactors can be relicensed.

This generic EIS should include consideration of the impacts of the various options described above. It should include consideration of costs of the various options. Compliance with regulations limiting public exposure should be the fundamental basis for assessing whether the impact is small or not. Note that compliance with annual dose limits needs to be estimated for the most exposed individual, who may be a male or female, infant, or a male or female of any other age, using dose conversion factors that are specific to that age and gender. Population doses should also be estimated as this is important for understanding the full extent of the health risks over time. Other aspects of waste management and disposal to be considered as part of the process of licensing new reactors or relicensing existing reactors are discussed below.

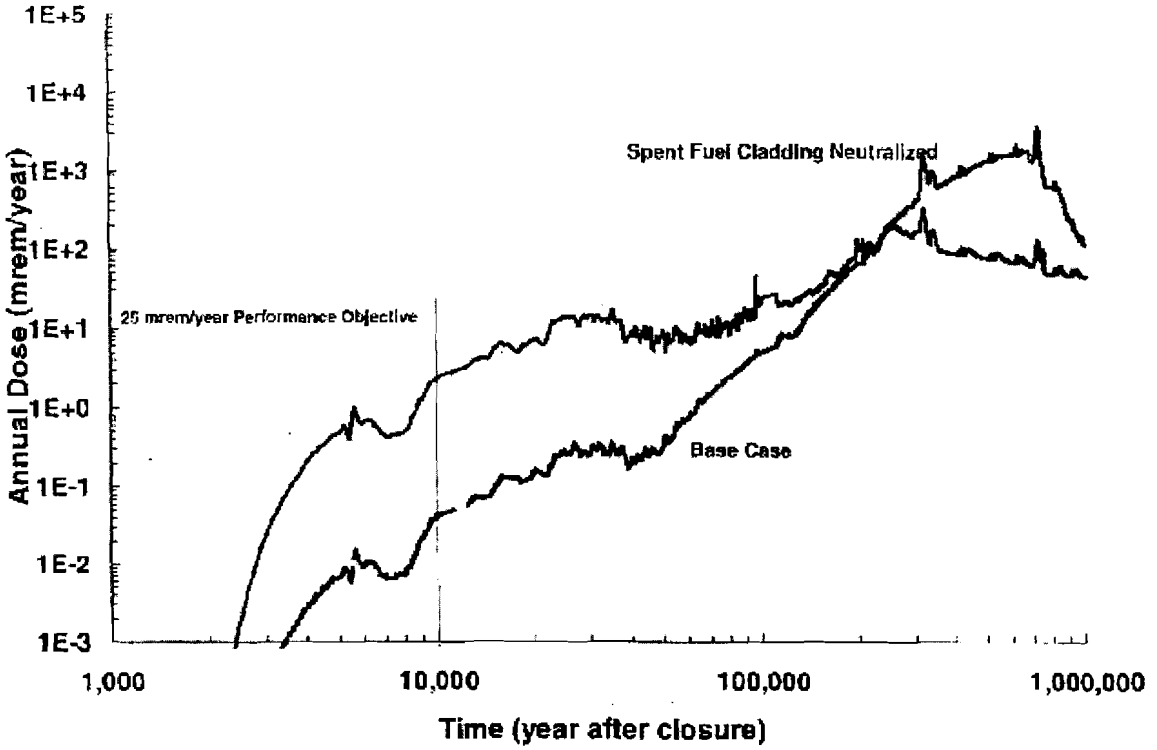
Attachment A[118]

Graph A: Neutralize Waste Package

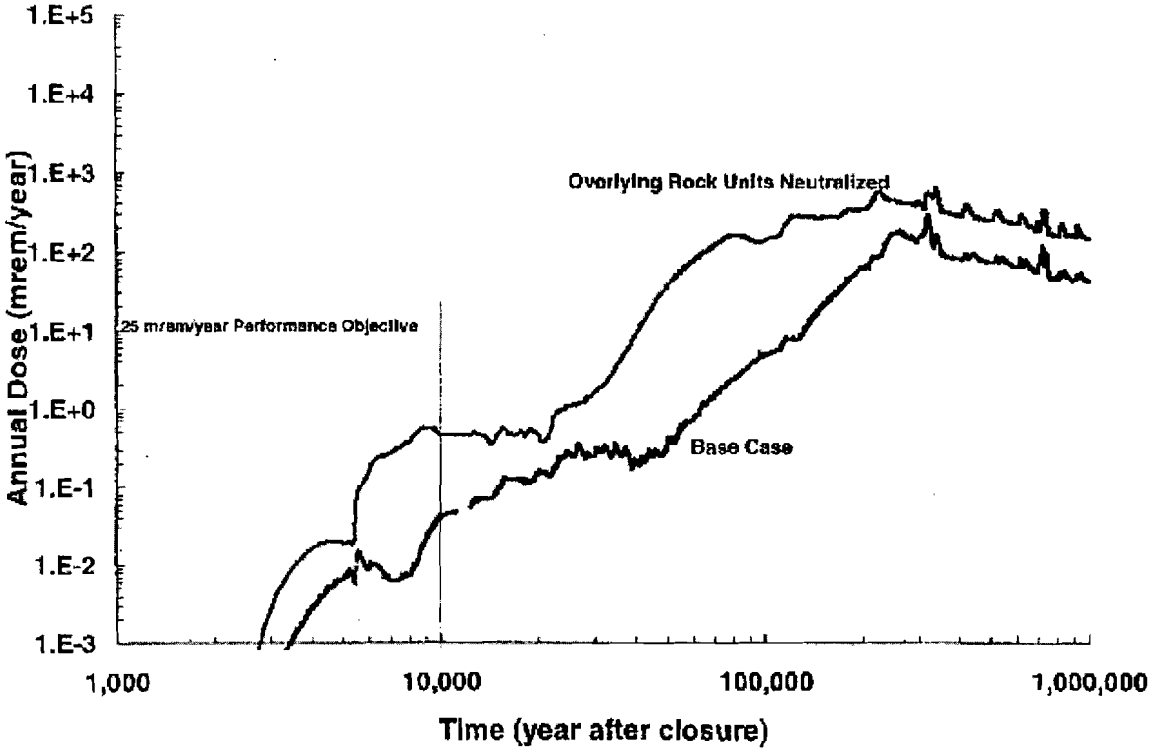


[118] Source for all graphs: DOE OCRWM 1999.

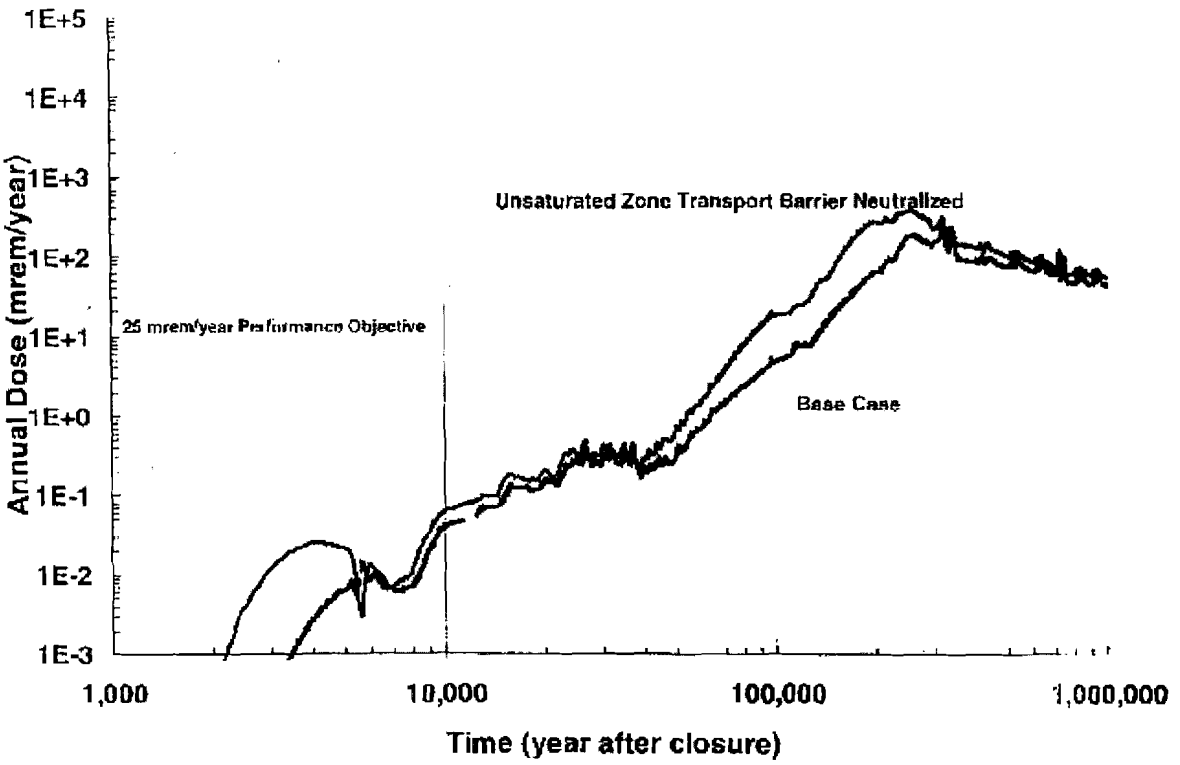
Graph B: Neutralize Spent Fuel Cladding



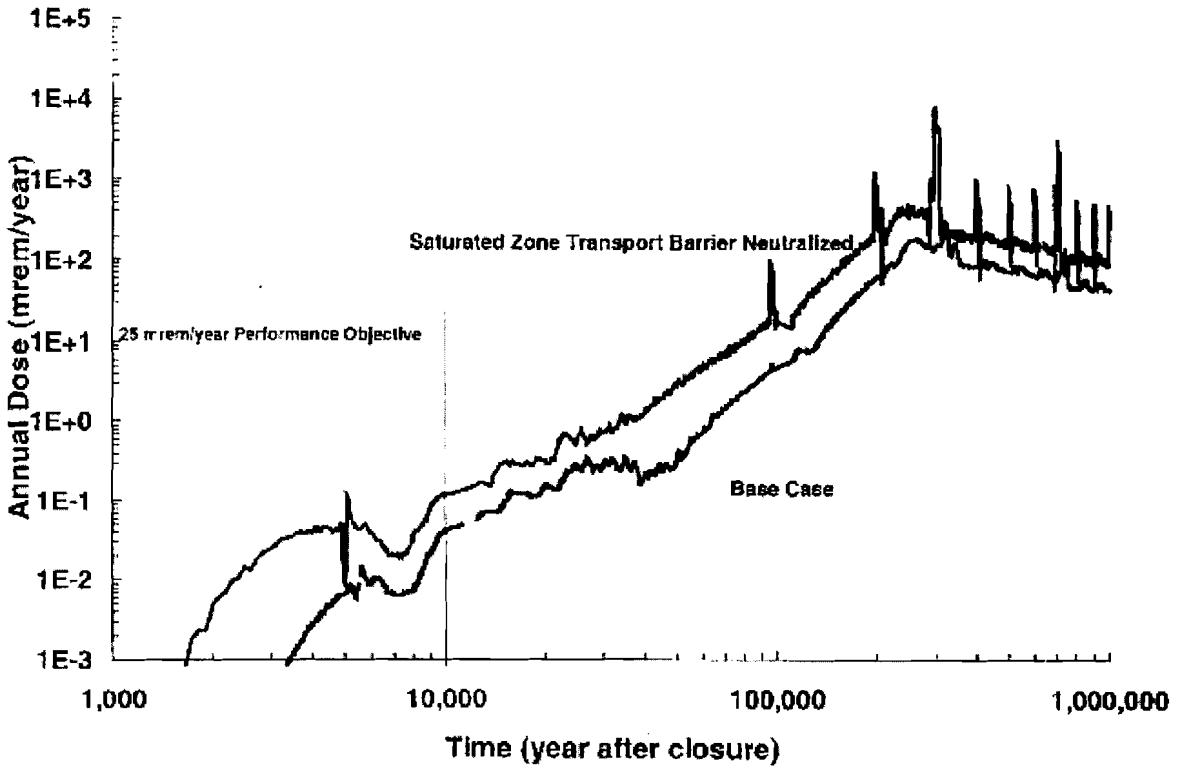
Graph C: Neutralize Overlying Flow Barriers



Graph D: Neutralize Unsaturated Zone Transport Barrier



Graph E: Neutralize Saturated Zone Transport Barrier



Source for all graphs: U.S. DOE Office of Civilian Radioactive Waste Management, "NWTRB Repository Panel meeting: Postclosure Defense in Depth in the Design Selection Process," presentation for the Nuclear Waste Technical Review Board Panel for the Repository, January 25, 1999. Presented by Dennis C. Richardson. Online at http://www.nwtrb.gov/meetings/1999/jan/richardson.pdf.

Attachment B

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Curriculum Vitae

des membres de l'équipe IEER et un relecteur

présent à l'IEER 29-30 novembre 2004

Examen critique du programme de recherche de l'ANDRA pour déterminer l'aptitude du site de Bure au confinement géologique des déchets à haute activité et à vie longue

RAPPORT FINAL

préparé par
l'Institut pour la recherche sur l'énergie et l'environnement (IEER)

pour
Le Comité Local d'Information et de Suivi

Directeur du Projet
Arjun Makhijani, Ph.D.

Coordinatrice du projet
Annie Makhijani

27 décembre 2004
avec corrections 11 janvier 2005

Arjun Makhijani, Ph.D.
Annie Makhijani
Prof. Jaak Daemen, Ph.D.
Prof. George Danko, Ph.D.
Prof. Rod Ewing, Ph.D.
Detlef Appel, Ph.D.
Yuri Dublyansky, Ph.D.
Prof. Gerhard Jentzch, Ph.D.
Mike Thorne, Ph.D., relecteur

Les différents membres de l'équipe ont eu la responsabilité des disciplines scientifiques suivantes et ont rédigé les chapitres correspondants :

Chapitre 1: Principes de confinement géologique - Arjun Makhijani. Yuri Dublyansky a contribué à la section sur la paléoclimatologie
Chapitre 2: Mécanique des roches - Jaak Daemen
Chapitre 3: Aspects thermiques de la conception et de la construction du site de stockage - George Danko
Chapitre 4: Programme de recherches sur le terme source et le champ proche - Rod Ewing
Chapitre 5: Hydrogéologie - Detlef Appel
Chapitre 6:Aspect minéralogiques et géochimiques dans la formation hôte - Yuri Dublyansky
Chapitre 7: Sismologie et déformation - Gerhard Jentzsch et Horst Letz

Traduction: Annie Makhijani
Relecture de traduction: Annike et Jean-Luc Thierry
Appui scientifique: Annie Makhijani
Documentaliste: Lois Chalmers

Curriculum Vita of
Arjun Makhijani

Education:

Ph.D. University of California, Berkeley, 1972, from the Department of Electrical Engineering. Area of specialization: plasma physics as applied to controlled nuclear fusion. Dissertation topic: multiple mirror confinement of plasmas.

M.S. (Electrical Engineering) Washington State University, Pullman, Washington, 1967. Thesis topic: electromagnetic wave propagation in the ionosphere.

Bachelor of Engineering (Electrical), University of Bombay, Bombay, India, 1965.

Current Employment:

1987-present: President and Senior Engineer, Institute for Energy and Environmental Research, Takoma Park, Maryland. (part-time in 1987).

February 3, 2004-present, Associate, SC&A, Inc., one of the principal investigators in the audit of the reconstruction of worker radiation doses under the Energy Employees Occupational Illness Compensation Program Act under contract to the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Professional Societies:

Institute of Electrical and Electronics Engineers and its Power Engineering Society
American Physical Society
Health Physics Society
American Association for the Advancement of Science

Official positions

Subcommittee on carbon-14 emissions from Yucca Mountain of the Radiation Advisory Committee, U.S. Environmental Protection Agency, 1992-1993
Radiation Advisory Committee, U.S. Environmental Protection Agency, 1992-1994
Technical Advisory Panel, Hanford high level waste tanks, early 1990s (ex-officio)
Consultant to the Office of Technology Assessment of the U.S. Congress

Consulting Experience, 1975-1987

Consultant on a wide variety of issues to various organizations including:

Tennessee Valley Authority
Lower Colorado River Authority
Federation of Rocky Mountain States
Environmental Policy Institute
Lawrence Berkeley Laboratory
Food and Agriculture Organization of the United Nations
International Labour Office of the United Nations
United Nations Environment Programme

United Nations Center on Transnational Corporations
The Ford Foundation
Economic and Social Commission for Asia and the Pacific
United Nations Development Programme

Some publications relevant to nuclear waste and radioprotection

Makhijani, A., K.M. Tucker, with Appendix by D. White, *Heat, High Water, and Rock Instability at Hanford*, Health and Energy Institute, Washington, D.C., 1985.

Makhijani, A., R. Alvarez, and B. Blackwelder, *Deadly Crop in the Tank Farm: An Assessment of Management of High-Level Radioactive Wastes in the Savannah River Plant Tank Farm,* Environmental Policy Institute, Washington, D.C., 1986.

Makhijani, A., *Release Estimates of Radioactive and Non-Radioactive Materials to the Environment by the Feed Materials Production Center, 1951-85*, Institute for Energy and Environmental Research, Takoma Park, 1988.

Makhijani, A., and B. Franke, *Addendum to Release Estimates of Radioactive and Non-Radioactive Materials to the Environment by the Feed Materials Production Center, 1951-85*, Institute for Energy and Environmental Research, Takoma Park, 1989.

Makhijani, A. and S. Saleska, *High Level Dollars Low-Level Sense: A Critique of Present Policy for the Management of Long-Lived Radioactive Waste and Discussion of an Alternative Approach*, Apex Press, New York, 1992.

Makhijani, A. and Annie Makhijani, *Fissile Materials in a Glass, Darkly: Technical and Policy Aspects of the Disposition of Plutonium and Highly Enriched Uranium,* IEER Press, Takoma Park, 1995.

Makhijani, A., H. Hu, K. Yih, eds., *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and the Health and Environmental Effects*, MIT Press, Cambridge, MA, 1995.

Fioravanti, M. and A. Makhijani, *Containing the Cold War Mess: Restructuring the Environmental Management of the U.S. Nuclear Weapons Complex,* Institute for Energy and Environmental Research, Takoma Park, October 1997.

Makhijani, A., Bernd Franke, and Hisham Zerriffi, *Preliminary Partial Dose Estimates from the Processing of Nuclear Materials at Three Plants during the 1940s and 1950s*, Institute for Energy and Environmental Research, Takoma Park, September 2000. (Prepared under contract to the newspaper *USA Today*.)

Makhijani, A. and Bernd Franke, *Final Report of the Institute for Energy and Environmental Research on the Second Clean Air Act Audit of Los Alamos National Laboratory by the Independent Technical Audit Team*, Institute for Energy and Environmental Research, Takoma Park, December 13, 2000.

Makhijani, Arjun, Hisham Zerriffi, and Annie Makhijani, "Magical Thinking: Another Go at Transmutation," *Bulletin of the Atomic Scientists,* March/April 2001.

Makhijani, A. and Michele Boyd, *Poison in the Vadose Zone: An examination of the threats to the Snake River Plain aquifer from the Idaho National Engineering and*

Environmental Laboratory Institute for Energy and Environmental Research, Takoma Park, October 2001.

Makhijani, A. and Sriram Gopal, *Setting Cleanup Standards to Protect Future Generations: The Scientific Basis of Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels (RSALs) for Rocky Flats*, Institute for Energy and Environmental Research, Takoma Park, December 2001.

Makhijani, A. and Michele Boyd, *Nuclear Dumps by the Riverside: Threats to the Savannah River from Radioactive Contamination at the Savannah River Site*, Institute for Energy and Environmental Research, Takoma Park, Maryland, forthcoming, March 2004.

Annie Makhijani

Education:
M.S. (Chemistry, with emphasis on Physical Chemistry) University of Maryland, College Park, Maryland, 1994. Research topic: the physical properties of nanostructures.
Bachelor of Science (Chemistry) University of Maryland, College Park, 1985.
Studied Hindi at the Institut des Langues Orientales in Paris (1980).
Bachelor of Arts (Psychology) Université de Tours, France (1972)

Employment:
- 1994-present: Project Scientist, Institute for Energy and Environmental Research, Takoma Park, Maryland.
- Staff Scientist, Institute for Energy and Environmental Research, Takoma Park, Maryland.
- Consultant for the White House Council on Environmental Quality (1979).
- French teacher, Alliance Française, Bombay, India (1977-1979)

Publications:
- Makhijani, Arjun and Annie Makhijani, *Fissile Materials in a Glass Darkly:* Technical *and Policy Aspects of the Disposition of Plutonium and Highly Enriched Uranium,* IEER Press, Takoma Park, 1995.
- Hisham Zerriffi and Annie Makhijani, *An Assessment of Transmutation as a Nuclear Waste Management Strategy,* Institute for Energy and Environmental Research, Takoma Park, 2000.

Some accomplishments
- Did research on the management of depleted uranium for the proposed Claiborne uranium enrichment plant in Louisiana (1996).
- Did research on the decommissioning or the Sequoyah uranium conversion plant in Oklahoma.
- Was responsible for some of the background research for the Institute for Energy and Environmental Research technical report: *Radiation Exposures in the Vicinity of the Uranium Facility in Apollo, Pennsylvania* (1998).

RESUME
JAAK J.K. DAEMEN

Education: Ph.D. Geo_Engineering, University of Minnesota, June 1975
Mining Engineer (Honors), University of Leuven, Belgium, July 1967

Registration: State of Arizona: Registered P.E. Civil Engineering (AZ 12158) and Mining Engineering (AZ 12980)

Professional:
American Institute of Mining Engineers, American Society of Civil Engineers, International Society for Soil Mechanics and Foundation Engineering, American Society for Engineering Education, International Society for Rock Mechanics, Royal Flemish Engineering Association, Royal Belgian Society of Engineers and Industrialists, American Geophysical Union, American Rock Mechanics Association.

Past Member, National Tunneling Committee, U.S. National Rock Mechanics Committee and Committee on Geological and Geotechnical Engineering of the National Research Council of the National Academy of Sciences; Reviewer for National Science Foundation, Geotechnical Engineering Program; U.S. Geological Survey; Mining Engineering, Society of Mining Engineers of AIME; International Journal of Rock Mechanics and Mining Sciences; Water Resources Research; Canadian Geotechnical Journal

Employment Record:

October 2001 - Present Professor, Mining Engineering, Mackay School of Mines, University of Nevada, Reno.

July 1990 - Sept.2001 Professor and Chair, Mining Engineering, Mackay School of Mines, University of Nevada, Reno.

September 1976 _ June 1990 Assistant and Associate Professor, University of Arizona, Department of Mining and Geological Engineering.

Summer 1980, 1981 Visiting Associate Research Engineer, Research Associate, University of California, Berkeley.

Summer 1977 Occidental Research Corporation. Investigations of roof control problems, Island Creek Coal Company.

April 1975 - September 1976 Research Engineer, E. I du Pont de Nemours & Co., Potomac

River Development Laboratory, Martinsburg, West Virginia 2504.

Sept. 1967 - March 1975 Research Assistant, Teaching Assistant, Teaching Associate, Research Fellow and Post_Doctoral Research Associate, Univ. of Minn, Minneapolis, Department of Civil & Mineral Engineering.

Sponsored Research:
Mechanics of Fully Grouted Bolts in Bedded Mine Rook (United Engineering Foundation); Rock Mass Sealing (U.S. Nuclear Regulatory Commission); Numerical Analysis of the influence of Bench Stiffness on Rock Fragmentation in Surface Blasting (AZ MMRRI); Ground and Air Vibrations Induced by Large Surface Blasts (Office of Surface Mining; U.S. Bureau of Mines); Mechanical Characterization of Welded Tuff (Center of Nuclear Waste Regulatory Analyses); Permeability-Strain Measurements in Rock Salt (Sandia National Laboratories); Sealing Studies for WIPP (SNL); Sealing Studies for Yucca Mountain, (SNL), Rock
Movement Induced by Blasting (Placer Dome); Long Term Drift Sability (DOE).

Courses Taught:
University of Arizona: Rock Excavation Practice; Tunneling and Underground Construction; Surface Mining; Coal Mining; Geomechanics; Applied Geomechanics: Underground Construction; Advanced Geomechanics; Design of Underground Structures; Rock Fracture and Flow; Subsidence Engineering; Rock Dynamics: Drilling, Blasting; Key Block Theory; Boundary Element Analysis.
University of Nevada, Reno: MINE 210 Mining Methods; MINE 301 Coal Mining; MINE 380 Quarry Engineering; MINE 445 Rock Excavation; MINE 448 Rock Mechanics; MINE 658 Rock Mechanics for Underground Mining and Construction.

Consulting: Morrison_Knudsen, Inc.; Sandia National Laboratories; Anaconda Minerals Company; Golder Associates; E.I. du Pont de Nemours & Co.; Fluor Mining & Metals; Cia Minera Las Cuevas, San Luis Potosi; Engineers International, Inc.; Itasca Consulting Group, Inc.; Nuclear Waste Management Consultants, Inc.; GRC Consultants, Inc; Hargis and Associates, Inc.; Southwest Research Institute; Asarco Mining Co., Inc.; Getchell Gold , Inc.; Petroplug, Inc.; U.S. DOE, J.S. Redpath.

CURRICULUM VITAE OF DR. GEORGE DANKO

EDUCATION:

Ph.D.	(Candidacy Degree in Technical Sciences), 1985, Hungarian Academy of Sciences. Thesis: Measurement and Model-building for the Convective Heat Transfer Examinations.
Dr. Tech.	(Doctor's Degree in Fluid Dynamics), 1976, Department of Fluid Dynamics, University of Technology, Budapest. Thesis: Matrix Analysis of Hydraulic Transients in Pipeline Flow.
M.S.	Applied Math, 1975, Eotvos University of Sciences, Budapest
M.S.	Mechanical Engineering, 1968, University of Technology, Budapest

EMPLOYMENT HISTORY:

7/95-present	Professor, Mining Engineering Department, Mackay School of Mines, University of Nevada, Reno.
8/90-6/95	Associate Professor, Mining Engineering Department, Mackay School of Mines, University of Nevada, Reno.
09/87-8/90	Lecturer in Mechanical Engineering, College of Engineering, University of Nevada, Reno.
11/86-8/90	Research Associate, Mining Engineering Department, Mackay School of Mines, University of Nevada, Reno.
1/79-11/86	Associate Professor, Institute of Thermal Energy and Systems Engineering, University of Technology, Budapest.
8/78-1/79	Visiting Postdoctoral Associate, Department of Mechanical Engineering, University of Minnesota.
9/75-8/78	Fellow of Hungarian Academy of Sciences.
8/68-9/75	Assistant Professor, Department of Mechanical Engineering, University of Technology, Budapest.

Selected recent publications relevant to nuclear waste disposal:

Danko, G., (1999), "In Situ REKA Probe Measurements at Yucca Mountain," Proceedings, International Bureau of Mining Thermophysiscs, St. Petersburg, pp 1-12.

Danko, G., (2000), "Coupled Convection-Diffusion Modeling with MULTIFLUX," Proceedings of the International Symposium on Hydrogeology and the Environment, Wuhan, China, pp 26-31.

G. Danko, D. Bahrami, (2001), "Ventilation Analysis of a Cold Conceptual Repository using MULTIFLUX with NUFT," Proceedings, 9th International high-Level Radioactive Waste Management Conference , April 29th-May 3rd.

G. Danko, D. Bahrami, and A. Adu-Acheampong, (2001), "In Situ Thermophysical Properties Measurements Under Hydrothermal Disturbances at DST," Proceedings, 9th International high-Level Radioactive Waste Management Conference , April 29th-May 3rd.

G. Danko and D. Bahrami, (2002), "The Application of CFD to Ventilation Calculations at Yucca Mountain", Proceedings, WM 02' Conference, February 24-28, 2002, Tucson, AZ, Session 39B, Paper 12, Abs. 243, pp. 1-11.

Danko, G., Shah, N., and Bahrami, D., (2002). "Evaluation of Lithophysal Conductivity, Diffusivity, and Porosity Measurements using the REKA Method," Proceedings, WM' 02 Conference, February 24-28, Tucson, AZ. pp. 1-13.

Danko, G., Jain, A., (2002). "Parameter Identification of a Numerical Transport Code," Proceedings, WM' 02 Conference, February 24-28, Tucson, AZ. pp.1-7.

Danko, G., and Bahrami, D., (2003). " Sensitivity Analysis of Ventilation Parameters and Site Input Properties," Proceedings, 10th Int. High-Level Radioactive Waste Management Conference, pp.1-8.

Danko, G., and Bahrami, D., (2003). "Natural Ventilation of a Deep Geologic Nuclear Waste Storage Facility," Proceedings, 10th Int. High-Level Radioactive Waste Management Conference, pp.1-8.

Danko, G., Shah, N., and Bahrami, D., (2003). "Monte Carlo Analysis of In Situ Lithophysal Properties Identification," Proceedings, 10th Int. High-Level Radioactive Waste Management Conference, pp.1-10.

Danko, G., Shah, N., and Bahrami, D., (2003). "In Situ Thermophysical Properties Variation at DST, Yucca Mountain," Proceedings, 10th Int. High-Level Radioactive Waste Management Conference, pp.1-8.

Danko, G., Bahrami, D., Leister, P., and Croise, J., (2003). "Temperature and Humidity Control for Underground Spent Fuel Storage," Proceedings, 10th Int. High-Level Radioactive Waste Management Conference, pp.1-8.

RODNEY C. EWING

Rod Ewing is a professor in the Department of Nuclear Engineering and Radiological Sciences at the University of Michigan, responsible for the program in radiation effects and nuclear waste management. He also holds appointments in Geological Sciences and Materials Science & Engineering and is an Emeritus Regents' Professor at the University of New Mexico in the Department of Earth and Planetary Sciences, where he was a member of the faculty from 1974 to 1997 and chair of the department from 1979 to 1984. He is also an *Adjungeret Professor* at the University of Aarhus in Denmark.

Ewing received a B.S. degree in geology from Texas Christian University (1968, summa cum laude) and M.S. (1972) and Ph.D. (1974, with distinction) degrees in mineralogy from Stanford University where he held an NSF Fellowship. His graduate studies focused on an esoteric group of minerals, metamict Nb-Ta-Ti oxides that are unusual because they have become amorphous due to radiation damage caused by the presence of radioactive elements (U and Th) and radionuclides in their decay series. This radiation-induced phase transformation from a crystalline to amorphous (periodic-to-aperiodic) structure can have significant effects on the properties of materials, such as the decreased durability of radioactive waste forms. Over the past twenty years, the early study of these unusual minerals has blossomed into a broadly based research program on radiation effects in complex ceramic materials. Such studies have lead to the development of techniques to predict and confirm the very long-term behavior of materials, such as those used in radioactive waste disposal. The key to such studies has been the use of natural phases of great age in designing highly durable nuclear waste forms. Present research includes: radiation effects caused by heavy-particle interactions with crystalline materials (e.g., ion-beam modification of ceramics and minerals); the structure and crystal chemistry of complex Nb-Ta-Ti oxides; the crystal chemistry of actinide and fission product elements, the application of "natural analogues" to the evaluation of the long-term durability of radioactive waste forms and the release and transport of radionuclides; the low-temperature corrosion of silicate glasses; the neutronics and geochemistry of the natural nuclear reactors in Gabon, Africa. The research has utilized a wide variety of solid-state characterization techniques, such as x-ray diffraction, x-ray absorption spectroscopy and high-resolution electron microscopy. The work of the research group has been supported not only by U.S. funding agencies but also from sources abroad (Sweden, Germany, Australia and Japan, as well as by the European Union and NATO). Ewing is the author or co-author of approximately 400 research publications and the editor or co-editor of seven monographs, proceedings volumes or special issues of journals. He was recently granted a patent for the development of a highly durable material for the immobilization of excess weapons plutonium. He received a Guggenheim Fellowship in 2002.

Ewing is a fellow of the Geological Society of America and the Mineralogical Society of America and has served the Materials Research Society as a Councilor (1983-1985; 1987-1989) and Secretary (1985-1986). He was president of the Mineralogical Society of America (2002) International Union of Materials Research Societies (1997-1998) and the New Mexico Geological Society (1981). He was a member of the Board of Directors of the Caswell Silver Foundation (1980-1984) and Energy, Exploration,

Education, Inc. (1979-1984). He has served as a guest scientist or faculty member at Battelle Pacific Northwest Laboratories, Oak Ridge National Laboratory, the Hahn-Meitner-Institut in Berlin, the Department of Nuclear Engineering in the Technion University at Haifa, the Centre D'Etudes Nucléaires de Fontenay-Aux-Roses, Commissariat A L'Énergie Atomique in France, Charles University in Prague, the Japan Atomic Energy Research Institute, the Institut für Nukleare Entsorgungstechnik of the Kernforschungszentrum Karlsruhe, Aarhus University in Denmark, Mineralogical Institute of Tokyo University and the Khlopin Radium Institute in St. Petersburg, Russia.

The involvement in issues related to nuclear waste disposal has proceeded in parallel with the basic research program most notably in association with the activities of the Materials Research Society where he has been a member of the program committee and the editor or associate editor for the proceedings volumes for the symposia on the "Scientific Basis for Nuclear Waste Management" held in Berlin-82, Boston-84, Stockholm-85, Berlin-88, Strasbourg-91, Kyoto-1994, Boston-1998 and Sydney-2000. He is co-editor of and a contributing author of *Radioactive Waste Forms for the Future* (published by North-Holland Physics, Amsterdam, 1988). Professor Ewing has served on National Research Council committees for the National Academy of Sciences that have reviewed the Waste Isolation Pilot Plant in New Mexico (1984 to 1996), the Remediation of Buried and Tank Wastes at Hanford, Washington and INEEL, Idaho (1992 to 1995), and the INEEL High-Level Waste Alternative Treatments (1998-1999), as well as a subcommittee on WIPP for the Environmental Protection Agency's National Advisory Council on Environmental Policy and Technology (1992 to 1998). He has served as an invited expert to the Advisory Committee on Nuclear Waste of the Nuclear Regulatory Commission and a consultant to the Nuclear Waste Technology Review Board. He is presently a member of the Board of Radioactive Waste Management of the National Research Council.

Dr. Detlef Appel

Professional background
Born 1943

1965-1971
study of geology at the University of Hannover, Lower Saxony, Germany, and the University of Vienna, Austria - diploma thesis on tectonical aspects of the Asse salt-structure in Lower Saxony (test site for radioactive waste disposal in West-Germany).
1971-1983
scientific employee: Institute of Geology and Paleontology of the University of Hannover - doctoral thesis on sedimentological questions of Upper Triassic sandstone formation in Lower Saxony.

Since 1983

freelancing consultant

Numerous expert opinions / publications in applied (hydro)geology and methodology (mostly in cooperation with other authors):

- selection, assessment and licensing of sites for final disposal of "conventional" and radioactive waste,
- risk assessment of (abandoned industrial) contaminated sites,
- site-specific and conceptual groundwater and soil protection in environmental impact assessment, water and soil management and planning,

Main clients: state authorities, regional/local water and environmental authorities, environmental NGOs (Greenpeace) and local environmental organizations.
Advisory activity

for German federal and state governments, environmental NGOs and local citizen action groups:

- Advisory Board on "Questions of Nuclear Power Phase-Out" of the Lower Saxony Ministry of the Environment (1992-1998),
- Committee on Site Selection Procedure of the Federal Ministry of the Environment, Nature Protection and Reactor-Safety (1999-2002),
- Working Group Fuel and Waste Management of the German Commission on Reactor-Safety,
- Radiation Protection Commission of BUND - Friends of the Earth,
- Scientific Advisory Board of the Konrad Mine Working Group.

International activities and cooperation

- Swiss Expert Group on Disposal Concepts for Radioactive Waste,

- Cantonal Working Group Wellenberg (Advisory Board of the Canton Nidwalden on safety aspects of the formerly planned LWA/MAW repository, Switzerland; until September 2002),
- Forum on Stakeholder Confidence (OECD/NEA),
- EC-Project COWAM (Community Waste Management),

Membership of scientific / professional associations

- German Geological Society,
- Society of Environmental Geosciences,
- Engineering-Technical Association on Contaminated Sites,
- Professional Society of German Geoscientists.

YURI V. DUBLYANSKY

EDUCATION	University of Perm, Russia: PhD (Candidate of Sciences) in Geosciences, 1987 University of Odessa, Ukraine: M.S. in Geological Engineering and Hydrogeology, 1982
WORK PLACE	Fluid Inclusion Lab. Institute of Mineralogy and Petrography, Russian Academy of Sciences, Siberian Branch, since 1985 to present
POSITION	Senior Scientist
WORK ADDRESS	Russia, 630090, Novosibirsk, 3, Koptyuga Ave. IM&P SB RAS Phone: +8-913-920-5263 (cel); FAX: +7-3832-332792 e-mail: kyoto_yuri@hotmail.com
SPECIALIZATION AND FIELD OF INTEREST	Geological disposal of nuclear waste; low temperature hydrothermal processes; fluid inclusions, isotope geochemistry. Analysis of the scientific and regulatory issues related to the geological disposal of the high-level nuclear waste.
LANGUAGES	English (fluent) and French (somewhat rusty)

PROFESSIONAL EXPERIENCE

2002	By request of the State of Nevada Attorney General Office, with the group of co-authors from USA, UK and Russia, writing a scientific monograph, providing independent evaluation of the suitability of the U.S. proposed site for geological disposal of the high-level nuclear waste at Yucca Mountain, Nevada. Monograph will be used by the State of Nevada as part of legal deposition in the forthcoming litigations, court hearings and licensing proceedings related to the Yucca Mountain high-level nuclear waste disposal site.
1999-2001	Official representative of the State of Nevada in the three-lateral (U.S. Department of Energy, State of Nevada and University of Nevada) research project on the paleo-hydrology of the proposed geological disposal site for the high-level nuclear waste at Yucca Mountain, Nevada. In this capacity testified before the presidential Nuclear Waste Technical Review Board and before the Advisory Committee on Nuclear Waste of the U.S. Nuclear Regulatory Commission. Scientific leader and manager of the research project commissioned by the Government of the State of Nevada studying critical issues of the geological suitability of the proposed high-level nuclear waste site in Nevada.
1997 - 1998	Served as an expert to TACIS (a EC program), assessing geological issues of the nuclear waste disposal in the Northwest Russia. Performed critical evaluation of the concept of the nuclear waste disposal in permafrost on the Novaya Zemlia archipelago.
1994 - 1998	Consulting the State of Nevada's Nuclear Waste Project Office and the Attorney General Office on the issues of the geological suitability of the high-level nuclear waste repository at Yucca Mountain. Submitted 19 technical reports.
1993 - 1994	International Scientific Fellowship Award from NSERC, Canada, taken up at McMaster University, Hamilton, Ontario, Canada. Fluid inclusion and stable isotope geochemistry research.

1992 - 1993 Consulting the Hungarian National Authority for Nature Conservation on fossil hydrothermal systems and caves in Budapest and the Transdanubian Range.

RECENT PROFESSIONAL PUBLICATIONS PERTINENT TO THE NUCLEAR WASTE DISPOSAL

1. Dublyansky Y.V., Smirnov, S.Z., and Pashenko S.E. 2003 Identification of the deep-seated component in paleo fluids circulated through a potential nuclear waste disposal site: Yucca Mountain, Nevada, USA. *Journal of Geochemical Exploration*, **4013**, pp. 1-5. (*In press*)
2. Dublyansky, Y., Ford, D., and Reutski, V. 2001 Traces of epigenetic hydrothermal activity at Yucca Mountain, Nevada: preliminary data on the fluid inclusion and stable isotope evidence. *Chemical Geology*. **173**, pp. 125-149.
3. Dublyansky, Y. 2001 Paleohydrogeology of Yucca Mountain by Fluid Inclusions and Stable Isotopes. Proc. Int. Con., Amer. Nucl. Soc. "High-Level Radioactive Waste Management". La Grande Park, Illinois. CD ROM
4. Dublyansky, Y., Szymanski, J., Chepizhko, A., Lapin, B., and Reutski, V. 1999 Paleohydrogeology of Yucca Mountain (Nevada, USA): Key to the Site Suitability Assessment for Planed Nuclear Waste Repository. *Geoecology*. **1**, pp. 77-87. (In Russian)
5. Dublyansky, Y., Szymanski, J., Chepizhko, A., Lapin, B. and Reutski, V. 1998 Geological History of Yucca Mountain (Nevada) and the Problem of a High-Level Nuclear Waste Repository. *Defence Nuclear Waste Disposal in Russia*. NATO Series. Kluwer Academic Publishers, The Netherlands. pp. 279-292.
6. **Hill, C., Dublyansky, Y., Harmon, R., and Schluter, C. 1995 Overview of calcite/opal deposits at or near the proposed high-level nuclear waste site, Yucca Mountain, Nevada: pedogenic, hypogene, or both? *Environmental Geology*, 26(1), pp. 69-88.**

Prof. Dr. Gerhard Jentzsch Institute for Geosciences, University of Jena

Born in 1946 in Taucha near Leipzig, Germany

Education:

Habilitation for Geophysics, Free University of Berlin, 1985, Institute for Geophysical Sciences, Free University of Berlin.

Doctoral examination, Technical University of Clausthal, Germany, 1976, from Faculty for Geosciences, Institute for Geophysics.

Exam (Diploma) in Geophysics, 1972, same institute.

Current Employment:

1996-present: Full Professor for Applied Geophysics at the Institute for Geosciences of the University of Jena

Professional Societies:

German Geophysical Society (currently President of this society), Geologische Vereinigung, European Geophysical Union, American Geophysical Union

Employment history:

1990 - 1996: Professor for General Geophysics at the Institute for Geophysics, Technical University of Clausthal.

1987 – 1990: Professor for Applied Geophysics (Angewandte Geophysik) at the Geological Institute of the University of Bonn.

1977 – 1987: Assistant at the Institute for Geophysical Sciences, Free University of Berlin, Assistence Professor (Hochschulassistent)

1972 – 1977: scientific co-worker of Prof. Dr. O. Rosenbach, Institute for Geophysics

Consulting Experience, 1990 – present:

Seismic hazard assessment for the sites of different nuclear power plants and nuclear industry in Germany, in the form of:

- check of reports
- own calculations
- member of advisory board

1999 – 2002 Member of the German siting committee to develop a procedure for the search for a site of the German nuclear repository (appointed by the German Federal Ministry of the Environment)

1993 – 1998 Member Advisory Board for the Termination of Nuclear Energy Use (Provincial Ministry for the Environment of Lower Saxony)

Additional information:

Research Interests: deformation and seismology (Earth tides, global dynamics, seismological network in East-Thuringia, Geodynamic Observatory Moxa), seismic hazard assessment, physical volcanology

Publications: more than 40 papers during the past 5 years; 15 of them in reviewed journals

National and international activities:

Chairman of working groups (IAG), convenor of special sessions (EGS Meetings, Earthtide Symposium, national meetings), reviewer for the German Research Soc. and different scientific journals

Currently: President of the German Geophysical Society

Publications relating to seismicity / deformation and nuclear waste repository:

1. **Nuclear waste repositories:**

AKEnd: Arbeitskreis Auswahlverfahren Endlagerstandorte des BMU, 2000. 1. Zwischenbericht, Stand: Juni 2000. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), Referat RS III 4 (A), 54 S. First intermediate report.

Bräuer, V. und G. Jentzsch, 2001. Abgrenzung von Gebieten mit offensichtlich ungünstigen geologischen Verhältnissen. Bericht an den AkEnd. Separation of areas with obvious unfavourable geological conditions.

Jentzsch, G., 2001. Vulkanische Gefährdung in Deutschland. Bericht an den AkEnd. Volcanic hazard in Germany.

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Curriculum Vita of Mike Thorne

Qualifications PhD FSRP

KEY SKILLS

- Radiological protection
- Assessing the radiological safety of disposal of radioactive wastes
- Distribution and transport of radionuclides in the environment
- Expert elicitation procedures
- Probabilistic safety studies
- Development of safety criteria
- Pharmacodynamics

CAREER HISTORY

2001- **Mike Thorne and Associates Limited**

Review Studies for the Proposed Australian National Radioactive Waste Repository

Client – RWE NUKEM

Reviews of reports on animal transfer factors and of the potential effects of climate change on the repository plus development of a model for the biokinetics of the ^{226}Ra decay chain in grazing animals.

Support for development of the Drigg Post-closure Radiological Safety Assessment

Client - BNFL

Support in the areas of FEP analysis, biosphere characterisation, human intrusion assessment and the effects of natural disruptive events. In addition, provision of advice of future research initiatives that should be pursued by BNFL.

Co-ordination of biosphere research and participation in BIOCLIM

Client – UK Nirex Ltd

Review of Parameter Values: Review of biosphere parameter values for use in the ANDRA assessment model AQUABIOS.

Effects of Radiation on Organisms Other Than Man

Client: Study for ANDRA to identify appropriate indicator organisms and develop appropriate dosimetry and effects models for those organisms.

Evaluation of Unusual Pathways for Radionuclide Transport from Nuclear Installations
Client – Environment Agency

Review of literature and conduct of formal elicitation meetings to determine potential pathways and evaluate their radiological significance.

Support Studies on the Drigg Post-closure Performance Assessment
Client - BNFL
Biosphere Research Co-ordination and Assessment Studies
Client - United Kingdom Nirex Ltd

Continuation of a programme of work originally undertaken at Electrowatt Engineering (UK) Ltd

Site Investigation and Risk Assessment - Hilsea Lines
Client - Portsmouth City Council
Radiological assessment of a radium-contaminated site.

PROFESSIONAL ACTIVITIES AND MEMBERSHIP

- Fellow of the Society for Radiological Protection and Immediate Past President
- Member of the Eco-ethics International Union
- Visiting Fellow at the Climatic Research Unit, University of East Anglia

SELECTION OF PUBLICATIONS

The biosphere in post-closure radiological safety assessments of solid radioactive waste disposal, M C Thorne, Interdisciplinary Science Reviews, Vol. 23, 258-268, 1998.

Modelling radionuclide distribution and transport in the environment, K M Thiessen, M C Thorne, P R Maul, G Prohl and H S Wheater, Environmental Pollution, 100, 151-177, 1999.

Validation of a physically based catchment model for application in post-closure radiological safety assessments of deep geological repositories for solid radioactive wastes, M C Thorne, P Degnan, J Ewen and G Parkin, Journal of Radiological Protection, 20(4), 403-421, 2000.

Development of a solution method for the differential equations arising in the biosphere module of the BNFL suite of codes MONDRIAN, M M R Williams, M C Thorne, J G Thomson and A Paulley, Annals of Nuclear Energy, 29, 1019-1039, 2002.

Modelling sequential BIOsphere Systems under CLIMate change for radioactive waste disposal. Project BIOCLIM, D Texier, P Degnan, M F Loutre, D Paillard and M Thorne, Proceedings of the 10th International High-level Radioactive Waste Management Conference (IHLRWM), March 30th – April 2nd, Las Vegas, Nevada.

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40 CFR 190 2008 U.S. Environmental Protection Agency. *Code of Federal Regulations. Title 40 – Protection of Environment. Chapter I Environmental Protection Agency. Part 190 – Environmental Radiation Protection Standards For Nuclear Power Operations.* 7-1-08 Edition. Washington, DC: Office of the Federal Register, National Archives and Records Administration; U.S. Government Printing Office, 2008. On the Web at http://www.access.gpo.gov/nara/cfr/waisidx_08/40cfr190_08.html.

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Potential Impacts of Indian Point Relicensing with Delayed Site Reclamation

Summary of finding

If the "no action" option of ceasing operations at IP2 in 2013 and IP3 in 2015 permits more rapid site reclamation and restoration, while the option of relicensing operations to run through 2035 is associated with a delayed process of site restoration, there are significant additional burdens imposed on off-site property values if license renewal is approved. If the diminution in current property values is approximately $500 million, then the burden caused by the additional delay in restoration due to the period of extended plant operation plus the longer period required for site reclamation is reasonably estimated as between $300 and $340 million.

Introduction

In my initial report submitted on November 29, 2007, I reviewed a variety of studies that had appeared in peer-reviewed journals concerning the potential impacts on off-site land use and property values resulting from continued operation of Indian Point 2 and Indian Point 3 nuclear power plants in the Village of Buchanan in Westchester County. Making use of census data and estimated impacts of large power plants on off-site property values I demonstrated that the effects resulting from relicensing could be over $500 million, with a more exact measurement requiring detailed data from the local property markets. In that analysis I assumed that if license renewal were approved, the additional wastes generated by license renewal would be gone from the site and the site would be fully restored no later than 30 years after the renewed license expired - i.e. by 2065. However, as discussed below, I have now been advised that it is possible the wastes generated by license renewal may remain on the site for much longer and perhaps indefinitely. This substantial additional delay in restoring the site to unrestricted use will have a substantial additional impact on off-site land values.

Diminution of off-site property value can be expected to be associated with important and visible changes in land use, including delayed development of land, lower density of development on land that is developed, and deferred maintenance on affected parcels.

A full analysis of the impacts naturally depends on the dynamic structure of the nuisance. In particular, I have been told to assume that the "no action" option (denying the request to relicense IP2 and IP3) involves operating the power plant at present levels until 2015, and then commencing a process of site reclamation so that by 2025 the site can be developed to its most efficient use, and the nuisance impact on off-site properties resulting from proximity to the power plant would be removed.

In comparison with this "no action" option I am asked to consider the impact resulting from relicensed operation of IP2 and IP3 until 2035. Following this period will commence a period of undetermined length during which of the nuclear waste products produced at the plant during extended license operation will continue to be stored at the site. The site would no longer be a significant source of employment and would possibly be a reduced source of property tax revenue for the community. The implication is that the relicensing option is likely to continue to impose a nuisance burden on off-site property values with a combined magnitude equal or greater to the magnitude imposed on property values at present. This impact is expected to continue for at least a period of 60 years (until 2095) and potentially much longer. What impact does the extended delay in full site reclamation associated with IP2 and IP3 have on the off-site costs?

Analysis

To answer the question posed at the end of the previous section with precision requires an estimate of the total impact on off-site property values. In order to illustrate the impact of delayed site reclamation and illustrate the range of possible impacts, I assume a present market impact of $500 million on property values. To the extent that more detailed evaluation of these impacts suggests an amount more or less than this, the results discussed below would increase or decrease.

All options under consideration allow the continued operation of IP2 and IP3 until 2015. Following this, the "no action" option imposes a continued cost of $500 million in reduced wealth on local property owners for a period of 10 years until site reclamation is complete. The relicensing option imposes this cost on local property owners through the period of continued operation (until 2035) followed by possibly larger costs imposed for an indefinite amount of time. For this example I assume the costs continue at the level of $500 million, but a detailed evaluation may well suggest a substantial increase.

The difference between the two options depends critically on four variables:

1. The total diminution in off-site property values
2. The real rate of increase in local property values
3. The appropriate discount rate chosen to evaluate the dynamic flow of costs
4. The time required for complete site reclamation following the relicensed operation of IP2 and IP3

As indicated above, for this report I will assume that the diminution in values caused by the current plant operation is $500 million, and that this lost value could be recovered in 2025 if relicensing were not allowed. I will also make the conservative assumption that there is no real increase in local property values (meaning that property values increase or decrease at exactly the same rate as the general price level).

The impact of the discount rate is shown below in Figure 1. This figure assumes a delay in site reclamation until 2105 (70 years after the plants cease operations). A range of possible discount rates is shown along the horizontal axis, and the additional burden on off-site property values arising from relicensing and delayed reclamation is shown on the vertical axis. As indicate, the impact ranges from about $240 million to $310 million, depending on the discount rate chosen.

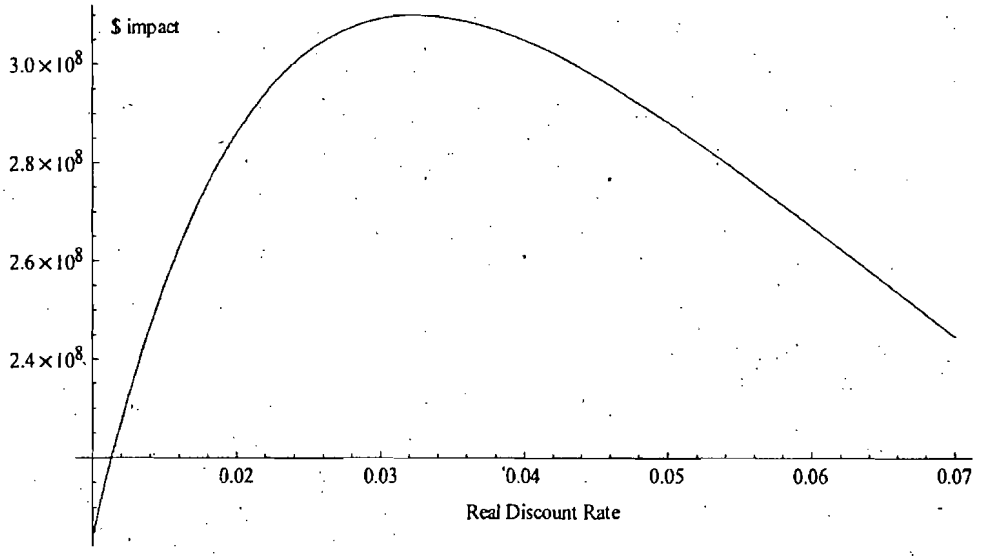

Figure 1: Burden on off-site properties at various discount rates

While there can be debate about the appropriate discount rate to use for analysis, a reasonable starting point would be the real mortgage interest rate, or the mortgage interest rate less the rate of inflation. This would

suggest a discount rate of between 3 and 4 percent (.03 to .04). Figure 1 shows that over this range the burden on off-site property values from relicensing and delayed reclamation would be between $300 and $310 million.

What about the duration of the delay in site reclamation and restoration? It is clear that increasing the delay imposes greater burdens on off-site properties, because the penalty of reduced values and reduced wealth is being imposed for a longer time period. The exact magnitude depends on the discount rate used, but a range of possible impacts is shown in Figure 2 below. Figure 2 shows the burden on off-site property values at various durations of delay, assuming a discount rate of .0325, or 3.25 percent. As one might expect, the burden is increasing as the delay increases. The impact is particularly severe as we increase the delay from 60 or 70 years of delay (where the burden imposed is $300 to $310 million) to 140 years of delay (where the burden rises to $350 million). Beyond that the additional delay imposes only modest increases in the cost to off-site property owners because the remedy (removal of the nuisance) is so far in the future as to be of little or no market value.

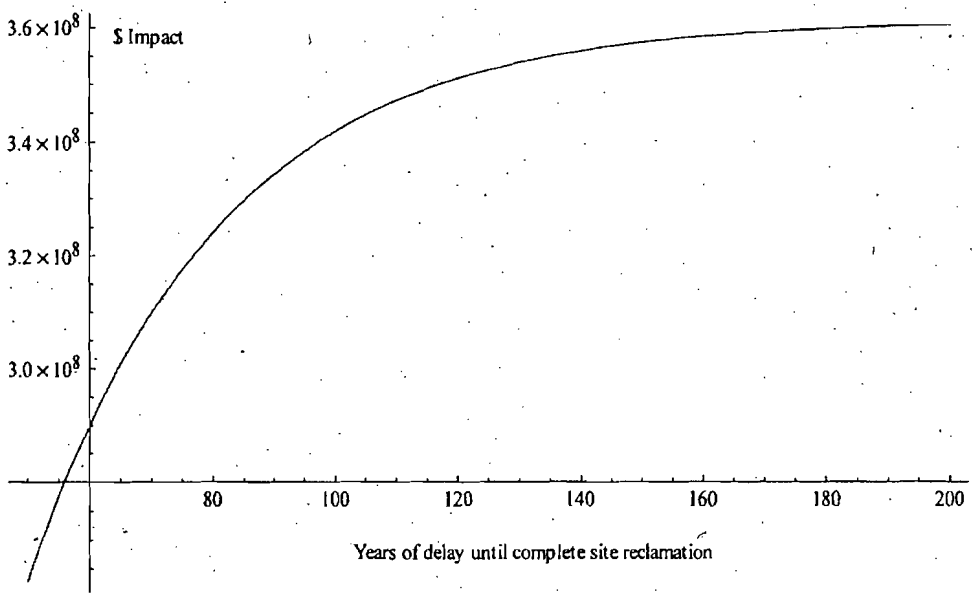

Figure 2: Burden on off-site properties at various years of delay

It should be noted that the calculations in Figure 2 are sensitive to the assumption of zero increase in real property values.

Conclusion

If the "no action" option permits complete site reclamation and restoration within ten years after the end of operations, while relicensing delays site reclamation by not only the additional time period of plant operations but also a significant delay during which nuclear waste is stored on site, there are important additional burdens imposed on off-site properties. Making reasonable assumptions about this delay, and using the potential property value impacts identified in my earlier report, the option that provides for relicensing of IP2 and IP3 would impose additional burdens of $300 to $340 million on these properties. This is not only a burden on the individuals involved but could have significant land use and development impacts.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:	
Waste Confidence Decision Update	**RIN 3150-AI47**
and	**NRC-2008-0482**
Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation	**NRC-2008-0404**

SUPPLEMENTAL COMMENTS BY THE OFFICE OF THE ATTORNEY GENERAL OF THE STATE OF NEW YORK CONCERNING THE NUCLEAR REGULATORY COMMISSION'S PROPOSED WASTE CONFIDENCE DECISION UPDATE AND CONSIDERATION OF ENVIRONMENTAL IMPACTS OF TEMPORARY STORAGE OF SPENT FUEL AFTER CESSATION OF REACTOR OPERATION

This rulemaking proceeding concerns NRC's review of its previous "waste confidence" determinations. In October 2008, NRC invited public comment on this issue, and a number of States provided written statements. Since those public comments were submitted a year ago, various events have occurred that are relevant to these ongoing rulemaking proceedings. These recent events confirm the State of New York's concern about the continued storage of radioactive waste at the Indian Point reactors, which are located in Westchester County just 24 miles north of New York City. Accordingly, the State of New York respectfully submits the following comments to supplement its previous statement.

I. Introduction and Summary of Comments

It is undisputed that questions involving the storage and disposal of nuclear waste pose significant health and environment concerns that require analysis under the National Environmental Policy Act (NEPA) and the Atomic Energy Act (AEA). In a 1979 case involving placement of additional nuclear waste in the spent fuel pools at Vermont Yankee and Prairie Island, the Court of Appeals for the District of Columbia Circuit instructed NRC to determine whether there was reasonable assurance that an off-site storage solution will be available by 2007-2009. *Minnesota v. NRC*, 602 F.2d 412, 418, 420 (D.C. Cir. 1979). Following that court

order, NRC embarked on a NEPA rulemaking process to determine whether or not NRC had confidence to predict that a permanent disposal facility would be available by 2007. The result was the "waste confidence" determination in which NRC predicted a permanent national waste disposal facility would be permitted and operational by a specific date. However, each of NRC's predictive dates has come to naught, and thirty years later, the high-level radioactive waste at Indian Point is no closer to a final disposal site. During the same time, the "leak tight" spent fuel pools at Indian Point released radionuclides into the environment.

Because of markedly changed circumstances that have occurred during the past year and have been acknowledged by NRC, the Commission should now address the issue of nuclear waste disposal in a different manner than its past decisions. For the first time since the initial promulgation of the waste confidence rule (10 C.F.R. § 51.23(a) & (b)) several key facts have been revealed and accepted, directly or indirectly, by the Commission:

1. As evidenced by the September 2009 Notation Votes, a majority of the Commissioners have acknowledged that they are not able to predict a date certain by which a permanent nuclear waste mined geologic repository or solution will be in place.

2. Thus, spent fuel generated from this point forward, and particularly spent fuel generated during the term of any extended operating license, will likely have to remain at the reactor site indefinitely following shutdown of the reactor.

3. The Commission has not made a generic determination regarding environmental and safety issues presented by indefinite storage of spent fuel at the site of nuclear reactors following shutdown.

4. Recent actions by the Commission, particularly since 2001, have demonstrated that a significant number of substantial environmental and safety issues related to indefinite storage of spent fuel at the site of shutdown nuclear reactors are specific to the particular reactor and site and cannot be addressed on a generic basis.

These facts demonstrate that NRC, in order to comply with its obligations under the National Environmental Policy Act and the Atomic Energy Act, as well as the mandates of the United States Court of Appeals in *Minnesota v. NRC*, 602 F.2d 412 (D.C. Cir. 1979), and *Potomac Alliance v. NRC*, 682 F.2d 1030 (D.C. Cir. 1982), will have to reformulate its approach to the issues raised in the pending waste confidence rule making. In particular, the Commission should now recognize as

result of the prospect of indefinite storage of spent fuel at reactor sites after the plants have been shut down, that there are issues – such as what site-specific measures are required to make spent fuel pools safe from fires, seismic hazards, or leaks – that must be resolved on a plant-by-plant basis and these issues, if properly raised in a license renewal proceeding, are appropriate for resolution by an Atomic Safety and License Board.

In its February 6, 2009 comments on the proposed modifications to the waste confidence findings, the State of New York, along with the State of Vermont and the Commonwealth of Massachusetts, provided extensive evidence that:

1. Past and current events have substantially undermined all the bases upon which the Commission had previously concluded that a permanent, off-site spent fuel waste disposal site would exist by a date certain (*see* States' February 6, 2009 Waste Confidence Comments at 11-28);

2. Recent actions and studies, including a wide-ranging NRC Staff report on spent fuel storage in pools demonstrated that there is no longer any basis to conclude, on a generic basis, that spent fuel can be stored in pools at reactor sites without any substantial adverse environmental or safety concerns arising from routine plant operations and that site-specific analyses would be required to determine, in light of site-specific characteristics, including geology, seismology, demography, spent fuel pool design, configuration of the spent fuel in the pool, and vulnerability to malevolent acts, whether mitigation measures proposed to address these conditions at each site are adequate (*see, e.g.,* NUREG-1738, SECY-01-0100, Sandia Letter Report, Revision 2 (Nov. 2006), February 2002 Interim Compensatory Measure Order (or "ICM or B.5.b Order"), Alvarez, et al., *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States,* 11 Science and Global Security, 1-51 (2003));

3. Past events, including a report by the National Academy of Sciences, demonstrate that intentional acts by malevolent persons or groups pose a credible threat to spent fuel stored at certain reactor sites (*see* National Research Council of the National Academies of Science, *Safety and Security of Commercial Spent Nuclear Fuel Storage,* Public Report (2005));

4. Past events, including a report by scientists at the Lamont Doherty Earth Observatory of Columbia University, identified the existence of a new seismic fault line that could increase the probability of an earthquake in the New York metropolitan area (*see* Lynn R. Sykes, John G. Armbruster, Won-Young Kim, and Leonardo Seeber, *Observations and Tectonic Setting*

of Historic and Instrumentally Located Earthquakes in the Greater New York City-Philadelphia Area, Bulletin of the Seismological Society of America, Vol. 98, No. 4., pp. 1696-1719 (Aug. 2008)). The report also found that the Indian Point facilities and their spent fuel pools sit at the previously-unidentified intersection of seismic fault lines. *Id.* Such seismic features could contribute to accidental or external events, outside the control of the plant operator, which could create a previously-unexamined risk to spent fuel stored at the site.

The States of Connecticut and California made similar points in their rulemaking comments.

These well-documented factual conclusions are, in and of themselves, sufficient basis for the Commission to abandon its proposal to make new generic findings regarding the safety and environmental acceptability of indefinite storage of spent fuel at reactor sites. To these conclusions, the State now adds the following:

1. Subsequent to 2001, the Commission has abandoned any attempt to treat safety and environmental issues associated with spent fuel storage at reactor sites on a generic basis. Rather, the Commission, operating through its regulatory staff, has ordered implementation of site-specific mitigation measures for each reactor to address concerns with spent fuel storage. NRC has acknowledged that there are differences in spent fuel pool designs and capabilities. NRC has also required the implementation of site-specific mitigation measures in response to Congressional directives to NRC to develop site-specific analyses and measures for each spent fuel pool. Moreover, while these mitigation measures have been the subject of extensive discussion between NRC and industry, their details have not been disclosed to the States, and there has not been any opportunity for public input regarding the adequacy of the measures being taken or even whether measures are being taken to address all the potential environmental and safety issues associated with spent fuel storage at reactor sites or whether more effective alternatives are available;

2. Previous indications that the Yucca Mountain waste repository proposal would never come to fruition have now become more certain as the funding for the program has been removed from the proposed federal budget and DOE staff have publicly stated that the project will not go forward. *See Terminations, Reductions, and Savings: Budget of the U.S. Government, Fiscal Year 2010*, p. 68 (*quoted in* SECY-09-0900); *see also* U.S. Dep't of Energy, Motion to Stay the Proceeding, filed in *In re U.S. Department of Energy (High-Level Waste Repository)*, Docket No. 63-001 (Feb. 1, 2010); *Terminations, Reductions, and Savings: Budget of the U.S. Government, Fiscal Year 2011*, p. 62.

These new factual conclusions provided substantial additional support for the positions taken in the initial comments filed by the State of New York, the State of Vermont, and the Commonwealth of Massachusetts. Thus, the State again urges the Commission to accept the positions stated in the State's original comments, to abandon: (1) reliance on the now-discredited waste confidence findings and schedule; (2) generic environmental and safety findings regarding spent fuel storage at reactor sites, including the expected duration of that storage; and (3) the generic findings on long-term waste disposal imbedded in Table S-3. Instead, the State urges NRC to require and perform a site-specific evaluation of environmental impacts of spent fuel pool storage at each reactor location, taking into account environmental factors including surrounding population density, water resources, seismicity, subsurface geology, and topography along with the design, construction, and operating experience of the spent fuel pool in question and the layout of the fuel assemblies in that pool.

These new factual conclusions also provide compelling evidence to support, at a minimum, modification of the now obsolete and superseded 10 C.F.R. § 51.23(a) & (b) to allow for consideration in relicensing proceedings, such as the ongoing proceeding for the Indian Point power reactors, of any properly presented environmental and safety contention focused on the adequacy of mitigation measures taken or to be taken at that site to address the safety and environmental impacts flowing from the 20 additional years of spent fuel storage at the reactor site, the increased volume of spent fuel created during those 20 years, and the indefinite storage at that reactor site of all the waste generated by that reactor.

As currently written, the Commission's regulations segment the issues of the environmental and safety implications of spent fuel storage at reactor sites into several separate "bins" or proceedings, with varying levels of public participation (or exclusion). First, issues related to storage of spent fuel at the reactor during power

reactor operations may be considered during an operating license proceeding under 10 C.F.R. § 51.23(c). Second, issues related to spent fuel storage at reactor sites for the first 30 years following the end of reactor operations at the site are foreclosed under 10 C.F.R. § 51.23(b). Third, issues related to spent fuel storage at reactor sites for any period beyond 30 years following the end of reactor operations at the site, including indefinite storage at the site, is not addressed in any regulation because it has been assumed, erroneously, that all spent fuel would be gone from the reactor site within 30 years after operations cease. Not only is this assumption no longer valid for plants currently seeking license extensions, it is invalid for those plants that were shutdown decades ago and at which sites no reactor operations continue.

There is not, and cannot be, a rational explanation for the regulatory distinctions that provide different levels of public participation (in some cases, no participation is allowed) for consideration of the environmental and safety issues related to spent fuel storage depending on whether the storage takes place during the 20 years of extended reactor operation, the 30 years after cessation of reactor operations, or the infinite number of years beyond that 30-year "out of bounds" period. Equally inexplicable is the distinction between spent fuel stored at the site of a reactor which has ceased operations but where other reactors continue to operate (such as Indian Point Unit 1, whose operations ceased in 1974 and whose spent fuel remained in the Unit 1 spent fuel pool until December 2008 when long-running leaks of radionuclides from that pool forced its closure) and sites where no further reactor operations are continuing (such as: Zion Units 1 & 2 whose operations ceased in 1998 and whose spent fuel remains in its spent fuel storage pools; Rancho Seco whose operations ceased in 1989 and whose spent fuel has been transferred to an on-site dry cask storage facility; and Humboldt Bay whose operations ceased in 1976 and whose spent fuel has remained in a spent fuel pool more than 30 years after reactor operations ceased and is now proposing a unique form of dry cask storage to address seismic concerns at the site). *See generally* http://www.nrc.gov/info-finder/decommissioning/; *see also* Hydrogeologic Site Investigation Report for the Indian Point Energy Center, GZA GeoEnvironmental, Inc., Figures 9.4, 9.3, 9.2, 9.1 (Jan. 7, 2008) (depicting subsurface radionuclide plumes flowing from Indian Point's spent fuel pools).

It is apparent that the central issues which need to be addressed at the time of consideration of authorization of the right to create spent fuel, are whether measures are being taken, or will be taken, to (1) provide adequate protection for public health and safety and (2) eliminate the environmental impact from the likely indefinite storage of the spent fuel at the reactor site. As discussed in more detail below and in the February 6, 2009 submittal, there are numerous issues which are specific to certain sites and certain nuclear facilities that make it impossible to

resolve these issues on a generic basis for all reactors and all sites.

The Commission should create a new paradigm for addressing the issue of indefinite storage of spent fuel at Indian Point and other sites. It should acknowledge to host communities and States that NRC accepts the proposition that radioactive waste will remain at reactor sites after reactors cease commercial operations. It should adopt a regulatory scheme that allows the site and facility-specific issues related to indefinite storage of spent fuel to be resolved in a licensing proceeding at the time of deciding whether to authorize the creation of spent fuel. The time has come for the Commission to provide a meaningful role for stakeholders that have been previously excluded from the process – the States, their localities, and their citizens.

II. Some Spent Fuel Storage Safety and Environmental Issues Are Site- and Facility-Specific And Cannot Be Generically Resolved

Since 2001 NRC, based on guidance from various reports and based on its own considerations, has begun the process to implement site-specific measures to mitigate the consequences of accidental or intentional events that impact spent fuel storage at nuclear reactor sites. The reports demonstrate clearly that those doing the analysis not only saw substantial safety and environmental issues associated with spent fuel storage at reactor sites but also that many of the measures needed to address those issues were inherently site-specific. The following NRC or federal documents confirm that such concerns implicate site-specific analyses:

1. NUREG-1738, Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants (January 2001)("Fuel assembly geometry and rack configuration are plant specific" * * * "Heat removal is very sensitive to . . . fuel assembly geometry . . . [and] rack configuration . . . [and is] subject to unpredictable changes after an earthquake or cask drop that drains the pool * * * [I]t was not feasible, without numerous constraints, to establish a generic decay heat level (and therefore a decay time) beyond which a zirconium fire is physically impossible * * * [S]ince a non-negligible decay heat source lasts many years and since configurations ensuring sufficient air flow for cooling cannot be assured, the possibility of reaching the zirconium ignition temperature cannot be precluded on a generic basis");

2. SECY-01-0100, *Policy Issue Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools* (WITS 200000126) and attachments (June 2001) (discussing NUREG-1738);

3. National Academy of Sciences Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, *Safety and Security of Commercial Spent Nuclear Fuel Storage*: Public Report (2005)(recognizing that there are a "variety of designs" of spent fuel pools and "The potential vulnerabilities of spent fuel pools to terrorist attacks are plant-design specific. Therefore, specific vulnerabilities can be understood only by examining the characteristics of spent fuel storage at each plant"); and

4. Sandia National Laboratories, Letter Report, Rev. 2, *Mitigation of Spent Fuel Loss of Coolant Inventory Accident and Extension of Reference Plant Analyses to Other Spent Fuel Pools* (November 2006) (identifying site-specific mitigation options and alternatives and confirming that many plant-specific variables are at play such as the density or dispersion of the fuel rods in the pool, the decay heat level, fuel burn up rate, power production rate, time since discharge, assembly inlet temperature, convective and conductive heat removal rates, and heat transfer rate to and from adjacent assemblies).

In an effort to implement the recommendations of these and other reports and to address the concerns raised, NRC Staff proceeded to develop a series of mitigation measures that were tailored to each reactor site. Staff described these steps in a Safety Evaluation Report appended to a letter sent to the licensee for Indian Point Units 2 & 3 (Entergy), on July 7, 2007, in which it gave approval to site-specific mitigation measures proposed to be taken, or already taken, by Entergy at the Indian Point site to address concerns raised by NRC Staff:

> The February 25, 2002, ICM Order that imposed interim compensatory measures on power reactor licensees required in Section B.5.b, Mitigative Measures, the development of "specific guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities using existing or readily

available resources (equipment and personnel) that can be effectively implemented under the circumstances associated with loss of large areas of plant due to explosions or fire." These actions were to be implemented by the end of August 2002. Inspections of the implementation of the Section B.5.b requirements were conducted in 2002 and 2003 (Temporary Instruction (TI) 2515/148). *The inspections identified large variabilities in scope and depth of the enhancements made by licensees.* As a result, the NRC determined that additional guidance and clarification was needed for nuclear power plant licensees.

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Section B.5.b of the ICM Order required licensees *to develop specific guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities* using existing or readily-available resources (equipment and personnel) that can be effectively implemented under the circumstances associated with loss of large areas of the plant due to explosions or fire. Determination of the specific strategies required to satisfy the Order, elaborated on in the Phase 1 guidance document, was termed Phase 1.

In order to assure adequate protection of public health and safety and common defense and security, the NRC determined that differences in plant design and configuration warranted independent assessments to verify that the likelihood of damage to the reactor core, containment, and spent fuel pools and the release of radioactivity is low at each nuclear power plant. The Commission directed the NRC staff to conduct site-specific security and safety assessments to further identify enhanced mitigation capabilities. Site-specific assessments of spent fuel pools was deemed Phase 2 and site-specific assessments of reactor core and containments was deemed Phase 3.

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During 2005, the NRC staff performed inspections (TI 2515/164) to determine licensees' compliance with Section B.5.b of the ICM Order (Phase 1). Subsequent meetings were held with licensees to resolve identified open issues.

> Confirmatory B.5.b Phase 1 inspections (TI 2515/168) were conducted during the period of June to December 2006. *The NRC staff conducted site visits as part of the Phase 2 assessments during 2005. In 2006, the NRC staff observed licensee Phase 3 studies and conducted independent Phase 3 assessments.*
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> The industry proposed high level functional mitigating strategies for a spectrum of potential scenarios involving spent fuel pools. In a letter to all Holders of Licenses for Operating Power Reactors dated June 21, 2006 (ADAMS Accession No. ML061670146), the NRC accepted the Phase 2 proposal *pending review of site-specific details of its application and implementation.*
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>
> The implementing details of mitigation strategies included in the proposal, including those that utilize beyond-readily available resources, will be treated as commitments, which will become part of the licensing basis of the plant. Additional strategies identified during site-specific assessments which licensees deem acceptable and valuable to promote diversification and survivability, will be incorporated into licensees' Severe Accident Management Guidelines, Extreme Damage Mitigation Guidelines, or appended to other site implementation guidance. *To verify compliance, the NRC staff evaluated the site-specific implementation and documentation of the proposed Phases 2 and 3 mitigating strategies for each U.S. nuclear power plant.*
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> As part of the NRC staff's Phase 2 assessment, it was determined that *mitigating strategies for the Indian Point Nuclear Generating Unit No. 2 spent fuel were not required due to being screened out.* Therefore, the license condition for Unit 2 does not include Item b.7, "Spent fuel pool mitigation measures."

Safety Evaluation by The Office of Nuclear Reactor Regulation Related to Order No. Ea-02-026 Entergy Nuclear Operations, Inc. Indian Point Nuclear Generating Unit Nos. 2 and 3 Docket Nos. 50-247 and 50-286 (July 7, 2007) at pp. 1-4 (emphasis added) appended to a letter from NRC Staff to Entergy of the same date (ML071920020). It is indisputable that the measures proposed and taken were

specific to individual sites, like Indian Point, even though the details of the actions taken have not been released and the public has not been allowed to provide comments on, much less raise contentions in a licensing hearing to challenge, the adequacy of measures adopted by NRC Staff.[1]

There is considerable evidence from well-respected experts that substantial mitigation measures are required to address issues raised by the presence of spent fuel at nuclear reactor sites for extended periods of time:

Dr. Gordon Thompson. Already part of the record in this rulemaking is the Report by Dr. Gordon Thompson entitled Environmental Impacts of Storing Spent Nuclear Fuel and High-Level Waste from Commercial Nuclear Reactors: A Critique of NRC's Waste Confidence Decision and Environmental Impact Determination (Feb. 6, 2009) along with Dr. Thompson's CV establishing his distinguished qualifications in the field of spent fuel storage safety and environmental concerns. Dr. Thompson provides examples of site-specific mitigation measures that are needed to fully address the environmental and safety risks created by long term storage of spent nuclear fuel at reactor sites. *See, e.g.*, Report at Table 8-2 identifying a number of mitigation measures that would have to be configured and implemented on a site-by-site basis to reduce the risk of spent fuel fires.[2]

Dr. Richard T. Lahey. In addition, the State calls the Commissioners' attention to the Declaration prepared by Dr. Richard T. Lahey, Jr. in support of the State of New York's Notice of Intention to Participate and Petition to Intervene in *In re: License Renewal Application Submitted by Entergy Nuclear Operations, Inc.* (Indian Point Units 2 & 3) Docket Nos. 50-247-LR and 50-286-LR dated November

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[1] NRC Staff developed these new mitigation measures in close cooperation with a trade group, the Nuclear Energy Institute (NEI), whose website describes its mission as the promotion of nuclear power (www.NEI.org).

[2] The Commission has also acknowledged, in responding to a Congressional directive to address the threat of air-based sabotage directed at a nuclear facility, that the measures being proposed are directed at the individual sites and involve measures that are to be taken *after* the attack has occurred, not as a means to prevent the attack. As a spokesman for NRC clarified to Congress, mitigation measures to address terrorist threats "will be at the back end once the attack occurs." Homeland Security: Monitoring Nuclear Power Plant Security: Hearing Before the Subcomm. on Natl. Security, Emerging Threats and Int'l Relations, House Comm. on Govt Reform, 108th Cong. 61 (2004) (testimony of Luis Reyes, Executive Dir. of Operations, NRC), *available at*: http://frwebgate.access.gpo.gov /cgibin /getdo~.cgi?dbname=10-8house-hearings&docid=f:98358.pdf.

30, 2007 ("Lahey Declaration"). The Lahey Declaration is contained within NRC ADAMS Accession No. ML073400193.

Dr. Lahey is the *Edward E. Hood Professor Emeritus of Engineering* at Rensselaer Polytechnic Institute (RPI). He has served as the Dean of Engineering and Chairman of the Department of Nuclear Engineering & Science at RPI. He belongs to and has actively participated in a number of professional organizations including the American Nuclear Society, the American Society of Mechanical Engineers, the American Institute of Chemical Engineering and the American Society of Engineering Educators. He was the editor of the *Journal of Nuclear Engineering & Design.* He has served on numerous panels and committees for the NRC, Idaho National Engineering Laboratory, Oak Ridge National Laboratory, the Electric Power Research Institute and the National Research Council of the National Academies. Dr. Lahey was a member of the Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage which co-authored the National Research Council Report *Safety and Security of Commercial Spent Nuclear Fuel Storage* (Public Report 2006).[3] *See* Lahey Declaration at ¶ 33.

In his November 2007 Declaration, Dr. Lahey identifies site-specific mitigation measures, recommended in the *Safety and Security of Commercial Spent Nuclear Fuel Storage* Report that should be, but have not been, adopted for the Indian Point spent fuel pools to mitigate against the consequences of an external attack on the spent fuel pools. *See* Lahey Declaration at ¶ 36. Dr. Lahey also notes the existence of unique characteristics of the Indian Point plant configuration and location that require special measures to mitigate against the consequences of an external attack on the Indian Point spent fuel pools. *Id.*, at ¶¶ 32, 34, 35, 37 & 38.

Dr. Stephen Sheppard. The State also calls the Commissioners' attention to the declarations and reports prepared by Dr. Stephen Sheppard. Dr. Sheppard is a Professor of Economics at Williams College and conducts research on environmental and natural resources economics. Dr. Sheppard's statements are contained within NRC ADAMS Accession Nos. ML073400193 and ML090690303.

Dr. Sheppard has identified site-specific environmental issues which are relevant to the indefinite storage of spent fuel at reactor sites. In reports prepared by him in support of the New York State Notice of Intention to Participate and Petition to Intervene in *In re: License Renewal Application Submitted by Entergy Nuclear Operations, Inc.* (Indian Point Units 2 & 3) Docket Nos. 50-247-LR and 50-286-LR dated November 30, 2007 and New York State's Contentions Concerning NRC Staff's Draft Supplemental Environmental Impact Statement dated February

[3] Dr. Lahey's full curriculum vitae is available at http://www.rpi.edu/~laheyr/.

27, 2009, Dr. Sheppard identified substantial impacts on the land use and land values surrounding the Indian Point site in the event that license renewal is not allowed and the plant is promptly decommissioned and the spent fuel removed to a waste disposal site by 2025 (land values will increase) and in the event that spent fuel is stored indefinitely at the site (land values will remain depressed for the indefinite future).

The fact that addressing the issue of the integrity of spent fuel pools from external events, facility accidents, or external malevolent acts requires site-specific mitigation measures and evaluations should be no surprise. As early as 1983 then-Commissioner Victor Gilinsky filed a separate statement of dissent when the Commission proposed adoption of what is now the Waste Confidence Rule in which he observed "[w]hile I agree that there is no obstacle in principle to extended on-site storage, I think it is clear that each power reactor site will have to be examined in detail." 48 Fed. Reg. 22730, 22733 (May 20, 1983). The Commission itself recognized at that time the site-specific nature of the measures needed to deal with spent fuel storage following reactor shutdown by proposing, what is now 10 C.F.R. § 50.54(bb), a provision that requires each licensee to submit, no later than 5 years before expiration of the operating license, a site-specific plan for how the spent fuel will be managed on the site following reactor shutdown and until such time as the fuel is sent for reprocessing or off-site disposal. *Id.* at 22732.

The State's comments identify a group of additional site-specific factors that will impact on the nature of the risks to which stored spent fuel is subjected and the mitigation measures needed to address those risks including site-specific seismic dangers such as those which are now requiring the Humboldt Bay reactor to implement special procedures for dry cask storage.

III. Recent Events Confirm that No Reasonable Assurance Now Exists to Conclude That A Permanent Waste Disposal Facility Will Be Available By Any Specific Future Date

The majority of Commissioners have now recognized that certain underpinnings supporting the waste confidence findings no longer exist – namely, when a central disposal repository will accept spent fuel or even if such a repository will ever be constructed. As fully developed in the States' initial comments, evidence has been growing for years that the Commission's efforts to set a date by which time a permanent waste disposal facility will be available to receive the wastes from nuclear power plants have been a failure. NRC has missed every deadline it has predicted regarding the achievement of that goal by a date certain. Meanwhile, at Indian Point, high-level radioactive spent fuel remains on site and it has leaked into the soil and bedrock under the facilities and the Hudson River.

On June 15, 2009, NRC General Counsel Burns stated that:

> Although the licensing proceeding for the Yucca Mountain repository is ongoing, DOE and the Administration have made it clear that they do not support construction of Yucca Mountain. The President's 2010 budget proposal states that the "Administration proposes to eliminate the Yucca Mountain repository program." *Terminations, Reductions, and Savings: Budget of the U.S. Government, Fiscal Year 2010*, p. 68.

SECY 09-0900, Final Update of the Commission's Waste Confidence Decision (June 15, 2009) at 3. General Counsel Burns also suggested the Commission might defer action on the draft final update and draft final rule to incorporate "more precise information on near-term federal actions relevant to the development of the federal [High Level Waste] disposal program." *Id.* at 4.

The September 2009 Notation Votes reflect that the Commissioners rejected the General Counsel's recommendation to approve an amended Waste Confidence Rule that included a new date certain for a permanent repository.[4] Commissioner Svinicki separated the issue of whether a technologically feasible permanent waste disposal solution exists and whether, if it does exist, it can be reasonably expected to be available in the future, from the entirely different question of whether a date by which that solution will be implemented can be predicted. *See* Commissioner Svinicki Notation Vote at pp. 1-2. The latter she considers to be impossible in the current environment, concluding that "this is a particularly difficult time to be in the prediction business." *Id.* at 2.

In his Notation Vote, Commissioner Klein, like Commissioner Svinicki, recognized that there will not be a waste disposal facility at Yucca Mountain -- the administration has announced that the Yucca project will be cancelled -- and recognizes that the current record available to the Commission is insufficient to determine a specific date by which a permanent facility will be available. *See* Commissioner Klein Notation Vote at 1 (recognizing "the Administration's proposed budget plan to eliminate the Yucca Mountain project"). Commissioner Klein

[4] The Notation Vote Response Sheets reflect the views of the three sitting commissioners: Chairman Jaczko (dated Sept. 17, 2009), Commissioner Klein (dated September 16, 2009), and Commissioner Svinicki (dated Sept. 24, 2009). The Notation Votes are available at http://www.nrc.gov/reading-rm/doc-collections/commission/cvr/2009/.

emphasizes that new waste disposal options, other than a mined repository, are now possible and urges the Commission to broaden any statement about the future to include more than just mined repositories (*id.* at 2), thus making prediction of when a permanent repository will be available even less possible.

Chairman Jaczko's Notation Vote acknowledged the termination of the Yucca project referenced in the Staff's SECY paper. Based on his view of the administrative record before the Commission in the rulemaking proceeding, he proposed additional revisions that deleted reliance on the existence of "one mined geologic repository" and "repository" in Finding 2 and Finding 3. While he suggested that some high-level waste disposal "capacity" might be available in 50 years or perhaps 60 years beyond the licensed life a reactor, he also stated that he would support the extending the public comment period to solicit additional public input on this issue.

Thus, the formal Notation Votes reveal that a majority of the current Commissioners do not now have a basis to make a finding of "reasonable assurance" that a mined repository for the permanent disposal of high-level radioactive waste will be available to receive waste from Indian Point or other reactors at a specific future date. Nonetheless, like a ghost ship long since abandoned by its crew, the Waste Confidence Rule sails on, without heed to the interests of States, the right to public participation and review, concerns of communities being told to host the waste, and the credibility of the NRC licensing process.

Black's Law Dictionary describes a "legal fiction" as an "assumption that something is true even though it may be untrue," or "a device by which a legal rule or institution is diverted from its original purpose to accomplish indirectly some other object."[5] For the last 45 years, NRC has sought to preclude inquiry into the consequences of continued on-site storage of spent nuclear fuel at Indian Point after cessation of reactor operations because it has assumed the waste would be removed from the site. The passage of time has demonstrated that the initial assumption, which then became promulgated regulatory confidence in 1984 with the appearance of § 51.23, was mistaken. Early on, West Valley did not re-process Indian Point's waste. Nor did a mined geologic repository accept Indian Point's waste in 2007 (the 1984 assumption). And now it is clear that a mined geologic repository will not take Indian Point's waste by 2025 (the 1990 and 1999 assumption). Indian Point's experience over the last 48 years shows that the retention of obsolete, discredited, and superseded § 51.23 continues a legal fiction.

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[5] Black's Law Dictionary 913 (8th ed.2004); *see also* Merriam-Webster's Collegiate Dictionary 465 (11th ed.2006) (defining "fiction," in sense of "legal fiction" as: "an assumption of a possibility as a fact irrespective of the question of its truth").

Whatever the basis for the assertion in the past, the declaration today that all spent fuel will be removed from reactors within 30 years after operations cease and that, on a generic basis, it can be determined that there will be no significant environmental or safety issues as a result of spent fuel storage on site during that 30-year period is a fiction. It is a fiction that is perpetuated by the continued presence of the obsolete and superseded 10 C.F.R. § 51.23 in its current form. That language has been used by NRC Staff and licensees as a basis to prohibit public participation and meaningful dialogue regarding the adequacy of site-specific mitigation measures being proposed and/or taken at nuclear reactor facilities to address environmental and safety concerns associated with the on-site storage of spent fuel. Various states, local governments, and citizens groups sought to raise these concerns in the Indian Point license renewal proceeding. In response to these proffered contentions, NRC Staff opposed any consideration of the safety and environmental problems associated with storage of spent fuel at Indian Point by pointing to language in 10 C.F.R. §§ 51.23(a) and (b) that asserts that the wastes will be gone from those sites within 30 years after operations cease and because NRC previously decreed that during those 30 years there can be no significant safety or environmental problems.

As the previous comments make clear, the measures now being proposed and implemented to address the issues of safety and environmental concerns associated with spent fuel storage at reactor sites are anything but generic. In addition, although the actual measures being taken to mitigate the consequences of damage to the spent fuel storage facility have not been revealed, it is evident from the previously cited Sandia Report and from the statements by Dr. Lahey and Dr. Thompson that alternative measures could to be taken at each reactor site to mitigate spent fuel safety and environmental impacts. However, despite the existence of such alternative site-specific mitigation measures, NRC continues to resist allowing these issues to be fully aired in a context in which the active participants, with full access to the decision-making process, include anyone other than NRC Staff, nuclear reactor licensees, and their trade association, the Nuclear Energy Institute.[6]

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[6] While a number of the mitigation measures may be security sensitive (there is no evidence that all the mitigation measures are security sensitive) that is no barrier to public participation on, and hearing board evaluation of, the adequacy those measures. The provisions of 10 C.F.R. Part 2, Subpart I provide the procedures to be used to permit consideration of such matters in a licensing hearing. The purpose of Subpart I is "to provide such procedures in proceedings subject to this part as will effectively safeguard and prevent disclosure of Restricted Data and National Security Information to unauthorized persons, with minimum

IV. An Alternative Approach: Permitting States to Raise Site-Specific Concerns Is Consistent With and Required By NEPA and CEQ Regulations.

The State's previous comments present the legal basis for its conclusion that the Commission by continuing to prevent public participation on environmental and safety issues associated with indefinite storage of spent fuel at reactor sites is in violation of the NEPA, AEA, and CEQ regulations. As the previous discussion and the States' prior comments make clear, there are a number of issues that are not appropriate for generic resolution and must be resolved on a site-by-site basis. Of course, even those issues, may not end up in a licensing proceeding since the public participant will be required to overcome the considerable barriers imposed by 10 C.F.R. Part 2 in order to present an admissible contention. Nonetheless, some issues will have to be reviewed in Part 2 proceedings and/or facility-specific environmental impact statements and, rather than run from that consequence, the Commission should embrace it. There is considerable evidence that public participation in a licensing proceeding improves the final outcome on both environmental and safety issues.[7] For public participants there is no conflicting economic self-interest that may compromise an effort to provide full and adequate

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impairment of procedural rights." 10 C.F.R. § 2.900. States and their governmental officials should readily qualify under this provision. Given that State and local governments may have to deal with the consequences of a spent fuel pool fire or other incidents involving off-site releases, and given that many States are part of NRC's "Agreement State" program, they should be allowed to request a hearing on this important issue pursuant to Part 2.

[7] NRC Hearing Panels, which are composed of impartial administrative judges who are closely involved with the AEA hearing process, have confirmed the important role played by public participants. *See, e.g., In the Matter of Gulf States Utilities Company* (River Bend Station, Units 1 and 2), ALAB-183, Docket Nos. 50-458 and 50-459, 7 A.E.C. 222, 227-28 (Mar. 12, 1974); *In the Matter of Shaw Areva Mox Services* (Mixed Oxide Fuel Fabrication Facility), LB-08-11, Docket No. 70-3098-MLA, at 49 (June 27, 2008) (Farrar, J., concurring). NRC Commissioners have also recognized the useful role the public can play in NRC proceedings. *See, e.g.,* Dale E. Klein, Chairman, U.S. Nuclear Regulatory Comm'n, Presentation to the Convention on Nuclear Safety: The U.S. National Report, at Slides 3 and 11 (Apr. 15, 2008), http://www.nrc.gov/ reading-rm/doc-collections /commission/; Gregory B. Jaczko, Comm'r, U.S. Nuclear Regulatory Comm'n, Remarks to the OECD's Nuclear Energy Agency Workshop on the Transparency of Nuclear Regulatory Activities: Openness and Transparency-The Road to Public Confidence (May 22, 2007), http://www.nrc.gov/readingrm/doc-collections/commission/.

safety and environmental protection and develop a comprehensive analysis of the environmental impacts and their alternatives. Such a review of site-specific impacts and alternatives is entirely consistent with, and indeed required by, NEPA, AEA, and CEQ regulations.

V. Conclusion

The time has come for the Commission to formally abandon the outdated, discredited, and superseded portions of the Waste Confidence Rule and to reestablish the public's right to participate in those site-specific safety and environmental issues related to the indefinite storage of spent fuel at reactor sites in their neighborhoods. The promise that nuclear waste would be gone when the reactors shut down or shortly thereafter, or even by a time certain after shutdown, cannot be kept. That realization has profound implications for the safety and environmental protection of the community where the nuclear reactors are located. The Commission should immediately cancel the portions of 10 C.F.R. § 51.23 that prohibit consideration of properly presented site-specific contentions related to the adequacy of measures to mitigate the safety and environmental consequences of indefinite storage of spent fuel at reactor sites following shutdown of the reactors. The Commission's actions should apply to pending proceedings, such as the Indian Point license renewal proceeding, where parties sought to raise concerns about indefinite spent fuel storage at the reactor site. The parties should be given a reasonable time, not less than 60 days, to formulate new proposed contentions that are site-specific and address the environmental and safety consequences of indefinite storage of spent fuel at the site and the adequacy of mitigation measures to address those consequences.

Dated: February 9, 2010

Respectfully submitted

s/

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POLICY ISSUE
INFORMATION

February 28, 2011 SECY-11-0029

FOR: The Commissioners

FROM: Catherine Haney, Director
Office of Nuclear Material Safety
and Safeguards

SUBJECT: PLAN FOR THE LONG-TERM UPDATE TO THE WASTE CONFIDENCE RULE AND INTEGRATION WITH THE EXTENDED STORAGE AND TRANSPORTATION INITIATIVE

PURPOSE:

The purpose of this paper is to (1) provide the plan to develop a long-term waste confidence (WC) rule, including an environmental impact statement (EIS) and updated WC decision, for the handling and extended storage of spent nuclear fuel (SNF) for more than 60 years after a reactor's licensed life, and (2) describe the integration of WC activities with the extended storage and transportation (EST) project plan activities. This paper responds to staff requirements memorandum (SRM-) SECY-09-0090, "Final Update of the Commission's Waste Confidence Decision," dated September 15, 2010, and SRM-COMSECY-10-0007, "Project Plan for Regulatory Program Review to Support Extended Storage and Transportation of Spent Nuclear Fuel," dated December 6, 2010.

SUMMARY:

In 2010, the Commission issued an updated WC rule and decision, and separately directed the staff to develop a longer term WC update to consider the storage of SNF and high-level waste (HLW) for more than 60 years after the licensed life for operation of any commercial power reactor. The WC update will consist of an EIS, a WC Decision (which includes updated safety findings), and the 10 CFR Part 51 rule update. The EIS will provide the basis for the generic environmental determination made in the updated rule. Much of the work to develop the supporting technical bases and environmental impact analyses will be similar to the work described in COMSECY 10-0007, dated June 15, 2010 (ADAMS No. ML101390216).

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SECY NOTE: THIS SECY PAPER (WITH THE EXCEPTION OF ENCLOSURE 3) WILL BE RELEASED TO THE PUBLIC IN 10 WORKING DAYS.

The staff will integrate activities into an EST Regulatory Program with two main goals: (1) update the WC decision and rule and (2) enhance the technical and regulatory basis of the existing regulatory framework for the regulation of SNF for extended periods. The staff will engage stakeholders through public meetings and workshops, as well as the National Environmental Policy Act (NEPA) scoping process, EIS development, and the Administrative Procedure Act notice-and-comment rulemaking processes.

The staff considers a timeframe of up to 300 years of storage to be appropriate for characterization and prediction of aging effects and aging management issues for EST. The staff may adjust this analytical period based on the expanded gap assessment results, expected in 2012, which will identify technical and regulatory needs to support the development of an EST framework and WC update.

The staff plans to complete a WC update in fiscal year (FY) 2016. The schedule depends, in part, on the results of technical analyses that the U.S. Nuclear Regulatory Commission (NRC) develops and applicable data collected during the same time by external organizations such as the U.S. Department of Energy (DOE). The Agency's proposed resources for this activity will need to be significantly augmented in FY 2012 and FY 2013 to conduct research and necessary analyses to support this schedule. In lieu of providing annual information papers to the Commission as directed by SRM-COMSECY-10-0007, the staff will inform the Commission of significant progress and any significant changes in plans, as appropriate.

BACKGROUND:

On June 15, 2010, the staff provided its detailed project plan in COMSECY-10-0007, which identified research needs and potential enhancements to the EST regulatory basis over a projected 7-year timeframe. The project plan would also make other near-term improvements to the storage and transportation regulatory framework.

The Commission issued SRM-SECY-09-0090 on September 15, 2010, which directed the staff to update Title 10 of the *Code of Federal Regulations* (10 CFR) 51.23, "Temporary Storage of Spent Fuel after Cessation of Reactor Operation—Generic Determination of No Significant Environmental Impact," and revise Findings 2 and 4 of the WC decision. On December 23, 2010, the NRC published the updated rule and decision in the *Federal Register* (75 FR 81032 and 81037). The SRM directed the staff to develop a plan for a long-term rulemaking effort to go beyond the updated WC rule to account for storage at onsite facilities, offsite facilities, or both, and address the impacts of storage beyond a 120-year timeframe. The SRM also directed the staff to recommend an appropriate timeframe for the technical analysis beyond 120 years and to prepare an EIS to serve as the environmental analysis to support this rulemaking effort. The SRM stated that the plans and resources for this longer-term rulemaking should be integrated and realigned, to the extent possible, with the staff's current efforts to examine EST of SNF in accordance with COMSECY-10-0007.

On December 6, 2010, the Commission issued SRM-COMSECY-10-0007, which approved the EST project plan in part and provided additional direction to the staff. Specifically, the Commission directed the staff to integrate WC update and EST activities, to reflect the resources available in the FY 2012 budget, to include a prioritization of the main elements of

the EST project plan, to provide general resource estimates for the years beyond FY 2012, and to discuss the impacts of the WC activities on EST activities (e.g., EST activities that may be deferred).

DISCUSSION:

Based on Commission direction, the staff is integrating the current EST project plan activities and long-term WC update activities into an EST Regulatory Program with two main goals: (1) update the WC decision and rule to ensure the continued long-term stability of the generic safety and environmental findings in the rule by developing a NEPA analysis (in this case an EIS) that continues to be informed by current circumstances and scientific knowledge, and (2) enhance the technical and regulatory basis of the existing regulatory framework (i.e., 10 CFR Parts 71, 72, and 73) to identify and resolve technical, environmental, and regulatory issues associated with regulation of SNF for extended periods. While the two goals share common elements, they have different timing, scope, depth, and analysis of some key research activities.

Enhancement of the EST regulatory framework is focused on ensuring that the NRC is able to regulate extended storage facilities and extended aging management programs, if necessary. The research and analyses will address important aging phenomena and aging management issues (including maintenance, monitoring, and mitigation) associated with the regulatory oversight of EST operations. For the WC update, the research and analyses will highlight the impacts of aging effects and aging management needs on the affected environment (e.g., human health, natural resources, socio-economic, etc.), and will examine important environmental characteristics for longer periods of time. The EST Regulatory Program will supersede the current EST project plan and is under development. It will integrate the scope and timing of activities to efficiently and effectively support both goals to the extent practical. Enclosure 2 describes the strategy for developing the technical basis for WC and integrating ongoing EST project plan activities with WC update activities.

In 2010, the staff began an assessment, referred to as a gap assessment, to identify technical and regulatory needs to expand the basis for regulating EST. The staff plans to issue the draft gap assessment in November 2011 for comment and finalize it in April 2012. The staff has already identified three key areas that will need to be assessed and is adjusting ongoing research plans to address these areas. These areas include long-term canister shell and weld integrity, metallic seal and lid bolt integrity, and concrete overpack integrity in various external environmental conditions. These key areas provide fundamental confinement of SNF and protection against normal environmental conditions and accident events. Understanding the integrity of SNF cladding for extended periods of wet and dry storage and long-term cask monitoring capabilities are also high priority areas. One significant outcome of the various research studies may be the identification of failure modes and storage times that require significant mitigation (e.g., replacement of major cask components or fuel repackaging) to ensure continued safe storage and transportability. However, the staff has not yet identified the need for significant mitigation.

By April 2012, the staff will identify any additional needs to specifically develop the WC EIS (e.g., future HLW waste forms and storage effects on the surrounding environment). DOE Office

of Nuclear Energy is concurrently identifying and prioritizing technical gaps for the EST of SNF. Separately, the Blue Ribbon Commission on America's Nuclear Future (BRC) intends to issue draft and final recommendations on national spent fuel management issues in July 2011 and January 2012, respectively. To the extent practical, the staff will consider the results of those assessments and BRC recommendations.

The staff will continue to define and integrate its research activities, perform environmental scoping assessments, prioritize research, and begin the formal NEPA scoping process in April 2012 to support the WC rule. Upon publication of the final WC rule in FY 2016, the staff may need to continue research activities and complete any appropriate EST regulatory framework rulemakings for an additional two years.

Plan for Developing the Waste Confidence Update and EST Activities

Enclosure 1 describes the plan for completing the WC update by FY 2016, including the preliminary scope of the EIS. The plan for developing the WC update consists of three key activities: (1) developing the technical information needed to understand the significant safety issues and environmental impacts of EST, (2) developing an EIS and updated WC decision for long-term storage and handling of SNF, and (3) revising the WC rule, as appropriate. Because the WC rule is a generic environmental determination, the regulatory basis for the rule (the EIS, WC decision, and relevant EST technical analyses) will take the most time and resources to complete. Once the basis is in place, the rulemaking process itself will rely on the EIS (with appended WC decision) to provide the regulatory basis for the WC rule.

The following table shows the schedule for major activities leading to the WC update and EST rulemaking, if needed.

Schedule of Major Activities

Activity	Start	Complete
Expanded EST & WC Gap Assessment	Ongoing	April 2012
Supporting Research and Analyses (WC & EST)	Ongoing	2015
Scoping and draft EIS Development	April 2012	2014
Final EIS and WC Rule	2014	**2016**
Additional EST Framework Research	2014	2015
EST Regulatory Basis and Guidance	2014	2016
EST Rulemaking (if needed)	2016	2018

Preliminary Scope of the Environmental Impact Statement and Long-Term Update of the Waste Confidence Rule

The EIS will provide the regulatory basis for the update to the WC rule. The staff will comply with the NRC regulations for implementing NEPA in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," and will follow NRC NEPA guidance, as appropriate. The staff considers periods of up to 300 years to be appropriate for the technical analyses of cask system performance considering the current knowledge of potential aging phenomena and the cumulative increase of uncertainties over long

timeframes. The EIS will initially consider the impacts of SNF and HLW handling, storage, and associated transportation from approximately the years 2050 to 2250. This timeframe is based on the greater uncertainties that accompany environmental characteristics and environmental impacts for longer periodsand considerations for the 300 years of cask aging analyzed in the technical analysis for EST. The staff selected 2050 as the starting point for the NEPA analysis to approximate the minimum storage periods contemplated in the current Waste Confidence rule ("at least" 60 years after the expiration of licensed life) and an end-date of 2250 to approximate the time when this fuel could approach 300 years of total storage time (in a combination of wet and dry storage). The timeframe could be shortened if uncertainties are greater than expected. Alternatively, the timeframe could be expanded if the uncertainties of impacts for longer periods are not significant. The staff will be conducting pre-EIS scoping assessments of the 2050–2250 timeframe and intends to solicit stakeholder feedback on this timeframe.

The staff is also considering the use of segmented periods of time for the environmental analysis (e.g., 2050–2150 and 2150–2250). The analyses may show that some environmental impacts can be more easily characterized or graded by different time periods. When updating the rule, the staff will correlate the EIS analyses of impacts to generic safety and environmental findings for some period of storage after reactor licensed life (e.g., 100 or 200 years after reactor licensed life instead of the current 60 years). The EIS will consider the range of impacts typically included in NRC environmental analyses, as appropriate. These may include impacts on human health, natural and cultural resources, land use, socioeconomic conditions, and an analysis of cumulative impacts. The Appendix to Enclosure 1 describes the preliminary scenarios and initial scoping assumptions that will be considered in development of the EIS.

Near-Term Regulatory Improvements

The staff is implementing near-term licensing, inspection, and enforcement program improvements as described in COMSECY-10-0007. These activities include a comprehensive review of the current regulations, guidance, and standards to identify and implement near-term efficiency and effectiveness enhancements within the current regulatory technical bases. The ongoing reviews, which are budgeted separately from EST and WC, will address current challenges with dual-purpose cask certification and will enhance the effectiveness of the licensing, inspection and enforcement programs in an integrated manner. As directed in SRM-COMSECY-10-0007, the staff will develop performance measures to track efficiency and effectiveness gains from near-term improvements. Progress on these regulatory activities is not integral to addressing the technical and environmental challenges of the WC update and enhancing the EST regulatory framework. As a result, the staff will implement and track separately from the new EST Regulatory Program the licensing, inspection, and enforcement regulatory program improvements defined in the EST project plan.

Stakeholder Interaction

The staff has engaged some stakeholders through industry meetings, workshops, public meetings, and conferences related to EST and will continue to engage various stakeholder groups, such as the public, State, local, and tribal governments, industry, and international

counterparts. For example, the staff has interacted on EST issues at the Nuclear Energy Institute dry cask storage forum, NRC Storage and Transportation Licensing Workshop, Electric Power Research Institute Extended Storage Collaboration Program meetings, DOE used nuclear fuel program technical meetings, Council of State Governments and National Conference of State Legislators meetings, and several national and international conferences. The staff has also participated with stakeholders in BRC meetings to provide regulatory perspectives on the safety and security of storage and transportation. The staff has used the information from these meetings to identify regulatory and technical issues and high-priority research activities for the EST project plan. Enclosure 2 provides additional description of EST activities of external stakeholders and NRC coordination efforts.

The staff will continue to interact with stakeholders and share information to develop the technical basis for the WC update and EST regulatory framework. The staff plans to hold a public workshop in the summer of 2011 to solicit input on technical and regulatory issues. The staff will publish for public comment its draft gap assessment results and the preliminary scope of the EIS. The staff will hold public meetings as part of the NEPA public scoping process and after the draft EIS is published. As the WC update progresses, the staff will seek more opportunities to engage stakeholders.

Future Adjustments to Plan for WC Update and EST Regulatory Program

As the staff develops its scoping assessments over the coming year, it will consider the data and analyses that the NRC can either develop itself or leverage from external organizations within the schedule established for the WC update. The uncertainties in aging phenomena, cask performance, and environmental impacts may increase over longer fuel aging periods, and the resulting limitations in the technical analyses will influence the final scope of the WC update. However, by April 2012, the staff will have an improved understanding of the scope of the technical analyses that should be developed, the research plans of external parties that can be effectively leveraged, and potential changes that are needed in the scope and schedule of the EIS. By this time, the staff will have received stakeholder feedback and developed insights from the final gap assessments, the BRC will have completed its final recommendations, and DOE's Office of Nuclear Energy will likely have completed its gap assessments and started developing research plans to address EST.

The staff may also need to update the EST Regulatory Program at that time and consider changes in the scope or completion times for the WC update, as appropriate. In lieu of providing annual information papers to the Commission as directed by SRM-COMSECY-10-0007, the staff would inform the Commission of any significant changes in the scope of these projects or schedules, as appropriate.

RESOURCES:

Enclosure 3 describes resource needs for a FY 2016 completion of the WC update and the potential impacts on scope and schedule if sufficient resources cannot be provided, including delayed completion dates for the WC update (e.g., 2018 and 2020).

The staff considered the feasibility of completing an update before FY 2016, should additional resources be made available. However, the minimum amount of time needed to plan and complete limited research, adequately engage stakeholders, and develop a comprehensive EIS precludes a shorter timeframe.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objection. The required funding in future years will be addressed during the Planning, Budgeting and Performance Management process at the agency level.

The staff requests that this paper, with the exception of Enclosure 3, be made publicly available to facilitate future dialogue with stakeholders on WC activities.

Catherine Haney, Director /RA/
Office of Nuclear Material Safety
and Safeguards

Enclosures:
1. Plan for the Long-Term Update of the Waste Confidence Rule
2. Strategy for Integrating Extended Storage and Transportation Project Plan and Waste Confidence Rule Update Activities
3. Projected Resource Needs for the Extended Storage and Transportation Regulatory Program

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U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Fact Sheet on Dry Cask Storage of Spent Nuclear Fuel

Printable Version

Background

For years, nuclear power plants have temporarily stored used fuel, known as "spent fuel," in water pools at the reactor site. Periodically, about one-third of the nuclear fuel in an operating reactor needs to be unloaded and replaced with fresh fuel. Designers of nuclear power plants anticipated that the spent fuel would be reprocessed, with usable portions of the fuel to be recycled and the rest to be disposed as waste. However, commercial reprocessing was never successfully developed in the United States, and a permanent waste repository has not yet been developed. As a result, many of the spent fuel pools at commercial nuclear power plants are nearing capacity.

In the early 1980s, utilities began looking at options for increasing spent fuel storage capacity. Current regulations permit re-racking (placing fuel rod assemblies closer together in spent fuel pools) and fuel rod consolidation, subject to NRC review and approval, to increase the amount of spent fuel that can be stored in the pool. Both of these methods are constrained by the size of the pool.

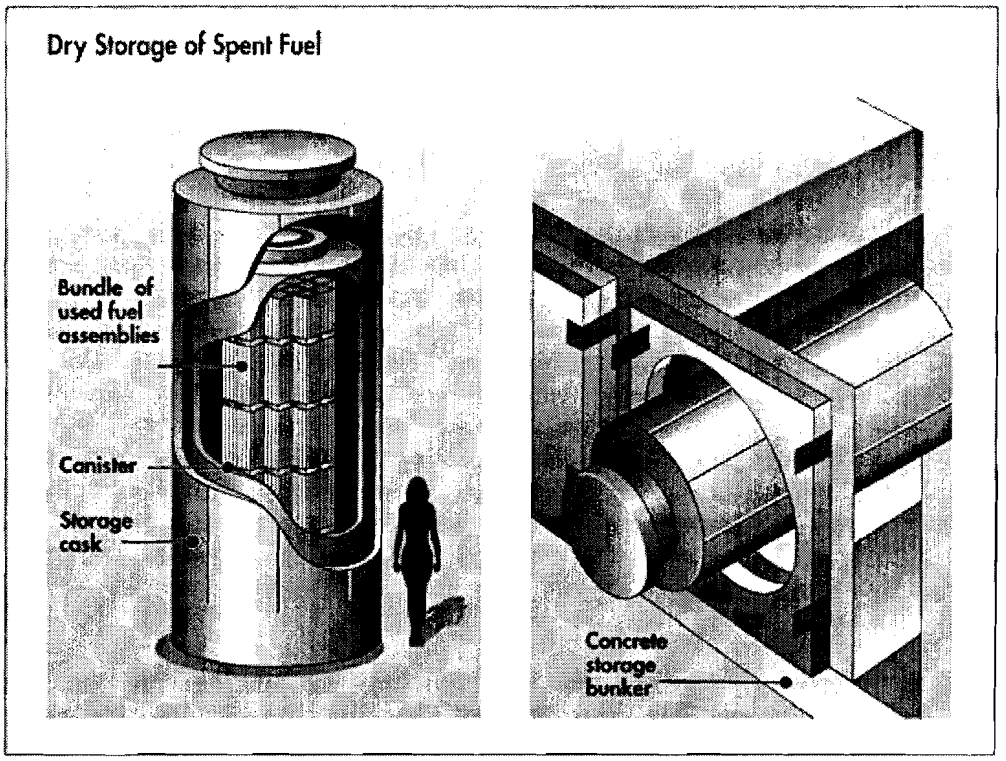
Another option for increasing capacity is storage in an independent spent fuel storage installation (ISFSI). Such storage may be either at the reactor site or elsewhere. The spent fuel may be stored in wet or dry ISFSIs. On-site storage of spent fuel in dry casks has become increasingly popular among licensees needing additional capacity for storing spent fuel. Fuel that has been stored for at least five years in water has cooled sufficiently, and its radioactivity decreased enough, for it to be removed from the spent fuel pool and loaded into casks. This frees up additional space in the pool for storing spent fuel newly removed from the reactor.

Congress is considering options to create additional storage capacity on federal lands to store commercial spent fuel until a repository or new reprocessing technologies can be developed.

There are two ways an ISFSI may be licensed. A "site-specific license" authorizes operation of a storage facility at a nuclear power plant or elsewhere, subject to the NRC's standard licensing requirements. The license specifies the type of storage system to be used. Alternatively, nuclear power plant operators may operate an ISFSI under a "general license" using NRC-approved dry storage casks. The general license option allows plants to avoid repeating certain evaluations – such as environmental impact or seismic reviews – that were already conducted for the plant's operating license.

Discussion

Dry casks typically consist of a sealed metal cylinder containing the spent fuel enclosed within a metal or concrete outer shell. In some designs, casks are placed horizontally; in others, they are set vertically on a concrete pad. The NRC reviews and approves the designs for spent fuel dry storage systems. The NRC's regulations for review are developed through a public process and provide a sound basis for determining whether use of a proposed storage system will protect public health and safety and the environment.



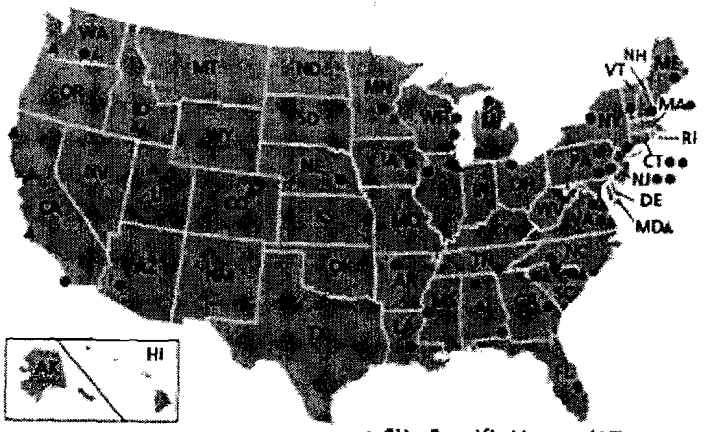
The NRC periodically inspects the design, fabrication, and the use of dry casks, to ensure licensees and vendors are performing activities in accordance with radiation safety and security requirements, and licensing and quality assurance program commitments.

Dry spent fuel storage in casks is considered to be safe and environmentally sound. Over the last 20 years, there have been no radiation releases which have affected the public, no radioactive contamination, and no known or suspected attempts to sabotage spent fuel casks or ISFSIs. For approval of cask designs, the NRC conducts a technical review to ensure the design would be safe and secure for use at a broad range of nuclear power plant site characteristics, consistent with the requirements for a general license. Additional information is available at http://www.nrc.gov/waste/spent-fuel-storage.html.

Dry cask storage systems are designed to resist floods, tornadoes, projectiles, temperature extremes, and other unusual scenarios. NRC requires the spent fuel to be cooled in the spent fuel pool for at least five years before being transferred to dry casks. Typically, the maximum heat generated from 24 fuel assemblies stored in a cask is less than that given off by a typical home heating system in an hour. As the fuel cools further, the heat generated will decrease over time.

Spent fuel is currently in dry storage at ISFSIs located at 40 sites with general licenses and 15 sites with site-specific licenses. The map shows the current ISFSIs.

Licensed/Operating Independent
Spent Fuel Storage Installations by State



33 States have at least one ISFSI

▲ Site-Specific License (15)
● General License (40)

ALABAMA
● Browns Ferry
● Farley

ARIZONA
● Palo Verde

ARKANSAS
● Arkansas Nuclear

CALIFORNIA
▲ Diablo Canyon
▲ Rancho Seco
● San Onofre
▲ Humboldt Bay

COLORADO
▲ Fort St. Vrain

CONNECTICUT
● Haddam Neck
● Millstone

FLORIDA
● St. Lucie

GEORGIA
● Hatch

IDAHO
▲ DOE: TMI-2 (Fuel Debris)
▲ Idaho Spent Fuel Facility

ILLINOIS
▲ GE Morris (Wet)
● Dresden
● Quad Cities

IOWA
● Duane Arnold

LOUISIANA
● River Bend

MAINE
● Maine Yankee

MARYLAND
▲ Calvert Cliffs

MASSACHUSETTS
● Yankee Rowe

MICHIGAN
● Big Rock Point
● Palisades

MINNESOTA
● Monticello
▲ Prairie Island

MISSISSIPPI
● Grand Gulf

NEBRASKA
● Ft. Calhoun

NEW HAMPSHIRE
● Seabrook

NEW JERSEY
● Hope Creek/Salem
● Oyster Creek

NEW YORK
● Indian Point
● FitzPatrick

NORTH CAROLINA
● McGuire

OHIO
● Davis-Besse

OREGON
▲ Trojan

PENNSYLVANIA
● Limerick
● Susquehanna
● Peach Bottom

SOUTH CAROLINA
● ▲ Oconee
● ▲ Robinson
● Catawba

TENNESSEE
● Sequoyah

UTAH
▲ Private Fuel Storage

VERMONT
● Vermont Yankee

VIRGINIA
● ▲ Surry
● ▲ North Anna

WASHINGTON
● Columbia

WISCONSIN
● Point Beach
● Kewaunee

March 2011

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Home > Radioactive Waste > Spent Fuel Storage > FAQ

Spent Fuel Storage in Pools and Dry Casks Key Points and Questions & Answers

Key Points:

All U.S. nuclear power plants store spent nuclear fuel in "spent fuel pools." These pools are robust constructions made of reinforced concrete several feet thick, with steel liners. The water is typically about 40 feet deep, and serves both to shield the radiation and cool the rods.

As the pools near capacity, utilities move some of the older spent fuel into "dry cask" storage. Fuel is typically cooled at least 5 years in the pool before transfer to cask. NRC has authorized transfer as early as 3 years; the industry norm is about 10 years.

The NRC believes spent fuel pools and dry casks both provide adequate protection of the public health and safety and the environment. Therefore there is no pressing safety or security reason to mandate earlier transfer of fuel from pool to cask.

After the September 11, 2001, terrorist attacks, the NRC issued orders to plant operators requiring several measures aimed at mitigating the effects of a large fire, explosion, or accident that damages a spent fuel pool. These were meant to deal with the aftermath of a terrorist attack or plane crash; however, they would also be effective in responding to natural phenomena such as tornadoes, earthquakes or tsunami. These mitigating measures include:

Controlling the configuration of fuel assemblies in the pool to enhance the ability to keep the fuel cool and recover from damage to the pool.
Establishing emergency spent fuel cooling capability.
Staging emergency response equipment nearby so it can be deployed quickly
According to the Congressional Research Service (using NEI data), there were 62,683 metric tons of commercial spent fuel accumulated in the United States as of the end of 2009.

Of that total, 48,818 metric tons – or about 78 percent – were in pools.
13,856 metric tons – or about 22 percent – were stored in dry casks.
The total increases by 2,000 to 2,400 tons annually.
On this page:

- What do you look at when you license a fuel storage facility? How do I know it can withstand a natural disaster?
- How do you know the fuel pools are safe? Does the NRC inspect these facilities, or just the reactor itself?
- What would happen to a spent fuel pool during an earthquake? How can I be sure the pool wouldn't be damaged?
- Can spent fuel pools leak?
- How would you know about a leak in such a large pool of water?
- How can operators get water back in the pool if there is a leak or a failure?
- Do U.S. nuclear power plants store their fuel above grade? Why is this considered safe?
- How are spent fuel pools kept cool? What happens if the cooling system fails?
- What keeps spent fuel from re-starting a nuclear chain reaction in the pool?

- Questions and Answers – ISFSIs
  - What is dry cask storage?
  - What is an "ISFSI"?
  - What kind of license is required for an ISFSI?

- Questions and Answers – Dry Cask Safety
  - How do you know the dry casks are safe? Does the NRC inspect these facilities, or just the reactor and spent fuel pool?
  - What keeps fuel cool in dry casks?

- Questions and Answers – Waste Confidence & Future Plans
  - How long is spent fuel allowed to be stored in a pool or cask?
  - The most recent waste confidence findings say that fuel can be stored safely for 60 years beyond the reactor's licensed life. Does this mean fuel will be unsafe starting in 2059 [60 years after Dresden 1's original license ended]? What if the spent fuel pool runs out of room even before the end of a reactor license? What is the NRC going to do about this?
  - Does the waste confidence decision mean that a particular cask is safe?
  - The waste-confidence revision seems like a long-term effort. What is the NRC doing to improve safety of spent fuel storage now?
  - The NRC is reviewing applications for new nuclear power plants. What is the environmental impact of all that extra fuel?

- Questions and Answers – Security
  - What about security? How do you know terrorists won't use all of this waste against us?

- Questions and Answers – Emergency Planning
  - What emergency plans are required for spent fuel storage facilities at nuclear power plants undergoing decommissioning or sites that have completed decommissioning?

Index to all Frequently Asked Question Pages

TOP

Questions and Answers – General

What is spent nuclear fuel?

"Spent nuclear fuel" refers to fuel elements that have been used at commercial nuclear reactors, but that are no longer capable of economically sustaining a nuclear reaction. Periodically, about one-third of the nuclear fuel in

an operating reactor needs to be unloaded and replaced with fresh fuel.

TOP

Why does spent fuel need to be cooled?

Spent fuel continues to generate heat because of radioactive decay of the elements inside the fuel. After the fission reaction is stopped and the reactor is shut down, the products left over from the fuel's time in the reactor are still radioactive and emit heat as they decay into more stable elements. Although the heat production drops rapidly at first, heat is still generated many years after shutdown. Therefore, the NRC sets requirements on the handling and storage of this fuel to ensure protection of the public and the environment.

TOP

Questions and Answers – Spent Fuel Inventories

Why doesn't the NRC have up-to-date figures on how much spent fuel is stored at U.S. nuclear plants?

The NRC and Department of Energy (NNSA) operate the Nuclear Material Management and Safeguards System (NMMSS), a database that tracks Special Nuclear Material (enriched uranium and plutonium). This database does not distinguish between fresh and irradiated material, and the information is withheld from the public for security reasons. That's why figures on spent fuel inventory come from the industry.

TOP

How much fuel is currently in dry cask storage?

As of November 2010, there were 63 "independent spent fuel storage installations" (or ISFSIs) licensed to operate at 57 sites in 33 states. These locations are shown on a map on the NRC website at: http://www.nrc.gov /waste/spent-fuel-storage/locations.pdf. Over 1400 casks are stored in these independent facilities.

TOP

How much fuel is stored at decommissioned reactors? Is it in pools or casks?

There are currently 10 decommissioned nuclear power reactors at 9 sites with no other nuclear operations. According to a 2008 Department of Energy report to Congress, approximately 2800 metric tons of spent fuel is stored at these nine sites. As of the writing of that report, seven of the sites had independent spent fuel storage installations, or ISFSIs. Two additional sites had approximately 1000 metric tons of spent fuel remaining in pool storage.

TOP

Questions and Answers – Spent Fuel Pool Safety

What do you look at when you license a fuel storage facility? How do I know it can withstand a natural disaster?

The NRC's requirements for both wet and dry storage can be found in Title 10 of the Code of Federal Regulations (10 CFR), including the general design criteria in Appendix A to Part 50 and the spent-fuel storage requirements in Part 72. The staff uses these rules to determine that the fuel will remain safe under anticipated operating and accident conditions. There are requirements on topics such as radiation shielding, heat removal, and criticality. In addition, the staff reviews fuel storage designs for protection against:

- natural phenomena, such as seismic events, tornados, and flooding
- dynamic effects, such as flying debris or drops from fuel handling equipment and drops of fuel storage and

handling equipment
- hazards to the storage site from nearby activities

TOP

How do you know the fuel pools are safe? Does the NRC inspect these facilities, or just the reactor itself?

NRC inspectors are responsible for verifying that spent fuel pools and related operations are consistent with a plant's license. For example, our staff inspects spent fuel pool operations during each refueling outage. We also performed specialized inspections to verify that new spent fuel cooling capabilities and operating practices were being implemented properly.

TOP

What would happen to a spent fuel pool during an earthquake? How can I be sure the pool wouldn't be damaged?

All spent fuel pools are designed to seismic standards consistent with other important safety-related structures on the site. The pool and its supporting systems are located within structures that protect against natural phenomena and flying debris. The pools' thick walls and floors provide structural integrity and further protection of the fuel from natural phenomena and debris. In addition, the deep water above the stored fuel (typically more than 20 feet above the top of the spent fuel rods) would absorb the energy of debris that could fall into the pool. Finally, the racks that support the fuel are designed to keep the fuel in its designed configuration after a seismic event.

TOP

Can spent fuel pools leak?

Spent fuel pools lined with stainless steel are designed to protect against a substantial loss of the water that cools the fuel. Pipes typically enter the pool above the level of the stored fuel, so that the fuel would stay covered even if there were a problem with one of the pipes. The only exceptions are small leakage-detection lines and, at two pressurized water reactor (PWR) sites, robust fuel transfer tubes that enter the spent fuel pool directly. The liner normally prevents water from being lost through the leak detection lines, and isolation valves or plugs are available if the liner experiences a large leak or tear.

TOP

How would you know about a leak in such a large pool of water?

The spent fuel pools associated with all but one operating reactor have liner leakage collection to allow detection of very small leaks. In addition, the spent fuel pool and fuel storage area have diverse instruments to alert operators to possible large losses of water, which could be indicated by low water level, high water temperature, or high radiation levels.

TOP

How can operators get water back in the pool if there is a leak or a failure?

All plants have systems available to replace water that could evaporate or leak from a spent fuel pool. Most plants have at least one system designed to be available following a design basis earthquake. In addition, the industry's experience indicates that systems not specifically designed to meet seismic criteria are likely to survive a design basis earthquake and be available to replenish water to the spent fuel pools. Furthermore, plant

operators can use emergency and accident procedures that identify temporary systems to provide water to the spent fuel pool if normal systems are unavailable. In some cases, operators would need to connect hoses or install short pipes between systems. The fuel is unlikely to become uncovered rapidly because of the large water volume in the pool, the robust design of the pool structure, and the limited paths for loss of water from the pool.

TOP

Do U.S. nuclear power plants store their fuel above grade? Why is this considered safe?

For boiling water reactor (BWR) Mark I and II designs, the spent fuel pool structures are located in the reactor building at an elevation several stories above the ground (about 50 to 60 feet above ground for the Mark I reactors). The spent fuel pools at other operating reactors in the U.S. are typically located with the bottom of the pool at or below plant grade level. Regardless of the location of the pool, its robust construction provides the potential for the structure to withstand events well beyond those considered in the original design. In addition, there are multiple means of restoring water to the spent fuel pools in the unlikely event that any is lost.

TOP

How are spent fuel pools kept cool? What happens if the cooling system fails?

The spent fuel pool is cooled by an attached cooling system. The system keeps fuel temperatures low enough that, even if cooling were lost, operators would have substantial time to recover cooling before boiling could occur in the spent fuel pool. Licensees also have backup ways to cool the spent fuel pool, using temporary equipment that would be available even after fires, explosions, or other unlikely events that could damage large portions of the facility and prevent operation of normal cooling systems. Operators have been trained to use this backup equipment, and it has been evaluated to provide adequate cooling even if the pool structure loses its water-tight integrity.

TOP

What keeps spent fuel from re-starting a nuclear chain reaction in the pool?

Spent fuel pools are designed with appropriate space between fuel assemblies and neutron-absorbing plates attached to the storage rack between each fuel assembly. Under normal conditions, these design features mean that there is substantial margin to prevent criticality (i.e., a condition where nuclear fission would become self-sustaining). Calculations demonstrate that some margin to criticality is maintained for a variety of abnormal conditions, including fuel handling accidents involving a dropped fuel assembly.

TOP

Questions and Answers – ISFSIs

What is dry cask storage?

Dry cask storage allows spent fuel that has already been cooled in the spent fuel pool for several years to be surrounded by inert gas inside a container called a cask. The casks are typically steel cylinders that are either welded or bolted closed. The steel cylinder provides containment of the spent fuel. Each cylinder is surrounded by additional steel, concrete, or other material to provide radiation shielding to workers and members of the public.

TOP

What is an "ISFSI"?

An independent spent fuel storage installation, or ISFSI, is a facility that is designed and constructed for the

interim storage of spent nuclear fuel. These facilities are licensed separately from a nuclear power plant and are considered independent even though they may be located on the site of another NRC-licensed facility.

TOP

What kind of license is required for an ISFSI?

NRC authorizes storage of spent nuclear fuel at an ISFSI in two ways: site-specific or general license. For site-specific applications, the NRC reviews the safety, environmental, physical security and financial aspects of the licensee and proposed ISFSI and, if we conclude it can operate safely, we issue a license. This license contains requirements on topics such as leak testing and monitoring and specifies the quantity and type of material the licensee is authorized to store at the site. A general license authorizes storage of spent fuel in casks previously approved by the NRC at a site already licensed to possess fuel to operate a nuclear power plant. Licensees must show the NRC that it is safe to store spent fuel in dry casks at their site, including analysis of earthquake intensity and tornado missiles. Licensees also review their programs (such as security or emergency planning) and make any changes needed to incorporate an ISFSI at their site. Of the currently licensed ISFSIs, 48 are operating under general licenses and 15 have specific licenses.

TOP

Questions and Answers – Dry Cask Safety

How do you know the dry casks are safe? Does the NRC inspect these facilities, or just the reactor and spent fuel pool?

The NRC is responsible for inspection of dry cask storage. All casks also undergo a safety review before they are certified for use by the NRC. Before casks are loaded, inspectors with specific knowledge of ISFSI operations assess the adequacy of a "dry run" by the licensee; they then observe all initial cask loadings. The on-site resident inspectors or region-based inspectors may observe later cask loadings, and the regional offices also perform periodic inspections of routine ISFSI operations.

TOP

What keeps fuel cool in dry casks?

The fuel is cooled by natural airflow around the cask. Fuel is often moved to dry cask storage after several years in spent fuel pools, so the heat given off by the fuel has significantly decreased.

TOP

Questions and Answers – Waste Confidence & Future Plans

How long is spent fuel allowed to be stored in a pool or cask?

NRC regulations do not specify a maximum time for storing spent fuel in pool or cask. The agency's "waste confidence decision" expresses the Commission's confidence that the fuel can be stored safely in either pool or cask for at least 60 years beyond the licensed life of any reactor without significant environmental effects. At current licensing terms (40 years of initial reactor operation plus 20 of extended operation), that would amount to at least 120 years of safe storage.

However, it is important to note that this does not mean NRC "allows" or "permits" storage for that period. Dry casks are licensed or certified for 20 years, with possible renewals of up to 40 years. This shorter licensing term means the casks are reviewed and inspected, and the NRC ensures the licensee has an adequate aging management program to maintain the facility.

TOP

The most recent waste confidence findings say that fuel can be stored safely for 60 years beyond the reactor's licensed life. Does this mean fuel will be unsafe starting in 2059 [60 years after Dresden 1's original license ended]? What if the spent fuel pool runs out of room even before the end of a reactor license? What is the NRC going to do about this?

The NRC staff is currently developing an extended storage and transportation (EST) regulatory program. One aspect of this program is a safety and environmental analysis to support long-term (up to 300 years) storage and handling of spent fuel, as well as associated updates to the "waste confidence" rulemaking. This analysis will include an Environmental Impact Statement (EIS) on the environmental impacts of extended storage of fuel. The 300-year timeframe is appropriate for characterizing and predicting aging effects and aging management issues for EST. The staff plans to consider a variety of cask technologies, storage scenarios, handling activities, site characteristics, and aging phenomena—a complex assessment that relies on multiple supporting technical analyses. Any revisions to the waste confidence rulemaking, however, would not be an "approval" for waste to be stored longer than before—we do that through the licensing and certification of ISFSIs and casks. More information on the staff's plan can be found in SECY-11-0029.

TOP

Does the waste confidence decision mean that a particular cask is safe?

Not specifically. When the NRC issues of certificates and licenses for specific dry cask storage systems, the staff makes a determination that the designs provide reasonable assurance that the waste will be stored safely for the term of the license or certificate. The Commission's Waste Confidence Decision is a generic action where the Commission found reasonable assurance that the waste from the nation's nuclear facilities can be stored safely and with minimal environmental impacts until a repository becomes available.

TOP

The waste-confidence revision seems like a long-term effort. What is the NRC doing to improve safety of spent fuel storage now?

The NRC staff is currently reviewing its processes to identify near-term ways to improve efficiency and effectiveness in licensing, inspection, and enforcement. We expect to identify enhancements to the certification and licensing of storage casks, to the integration of inspection and licensing, and to our internal procedures and guidance. More information on the staff's plans can be found in COMSECY-10-0007.

TOP

The NRC is reviewing applications for new nuclear power plants. What is the environmental impact of all that extra fuel?

Continued use and potential growth of nuclear power is expected to increase the amount of waste in storage. This increased amount of spent fuel affects the environmental impacts to be assessed by the NRC staff, such as the need for larger storage capacities. In the staff's plan to develop an environmental impact statement for longer-term spent fuel storage, a preliminary scoping assumption is that nuclear power grows at a "medium" rate (as defined by the Department of Energy), in which nuclear power continues to supply about 20 percent of U.S. electricity production.

TOP

Questions and Answers – Security

What about security? How do you know terrorists won't use all of this waste against us?

For spent fuel, as with reactors, the NRC sets security requirements and licensees are responsible for providing the protection. We constantly remain aware of the capabilities of potential adversaries and threats to facilities, material, and activities, and we focus on physically protecting and controlling spent fuel to prevent sabotage, theft, and diversion. Some key features of these protection programs include intrusion detection, assessment of alarms, response to intrusions, and offsite assistance when necessary. Over the last 20 years, there have been no radiation releases that have affected the public. There have also been no known or suspected attempts to sabotage spent fuel casks or storage facilities. The NRC responded to the terrorist attacks on September 11, 2001, by promptly requiring security enhancements for spent fuel storage, both in spent fuel pools and dry casks.

TOP

Questions and Answers – Emergency Planning

What emergency plans are required for spent fuel storage facilities at nuclear power plants undergoing decommissioning or sites that have completed decommissioning?

Decommissioning reactors continue to be subject to the NRC's emergency planning requirements. For some period of time after the licensee ceases reactor operations, offsite emergency planning will be maintained. This period of time depends on when the reactor was last critical as well as site-specific considerations. Offsite emergency planning may be eliminated when the fuel has been removed from the reactor and placed in the spent fuel pool, and sufficient time has elapsed, such that there are no longer any postulated accidents that would result in offsite dose consequences large enough to require offsite emergency planning. There would be no requirement to maintain offsite systems to warn the public. Onsite emergency plans will be required for both the spent fuel pool and the Independent Spent Fuel Storage Installations, but offsite plans will not be required. If, however, an operating plant is located at the same site as the decommissioning plant, the emergency preparedness plans will still be in effect for the operating plant.

Although offsite emergency planning at a decommissioned site may no longer be required, licensees maintain offsite contacts since any emergency declaration requires notification of state and local officials as well as the NRC. In addition, due to the typically reduced staffs at a decommissioning facility they may rely even more on offsite assistance for fire, security, medical or other emergencies. These reduced EP requirements would remain in effect as long as fuel is onsite.

(Note: This general description also applies to emergency planning for specifically licensed ISFSIs; those requirements are spelled out in detail in 10 CFR 72.32.)

TOP

Page Last Reviewed/Updated Friday, April 29, 2011