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ATTORNEY GENERAL

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DIVISION OF SOCIAL JUSTICE
ENVIRONMENTAL PROTECTION BUREAU

March 28, 2012

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Special Counsel
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U.S. Nuclear Regulatory Commission
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Re: Indian Point Nuclear Generating Station, Unit 2 and Unit 3
Docket Nos. 50-247-LR/50-286-LR; ASLBP No. 07-858-03-LR-BD01

Dear Sherwin:

The purpose of this letter is to formally request that NRC Staff, as part of its planned draft supplemental FSEIS for Indian Point, include other important new and significant information for which a supplemental FSEIS is required.[1] In particular, we ask that NRC Staff exercise the obligations imposed by 10 C.F.R. § 51.71(a) to "address the topics in . . . [§] 51.53," particularly 10 C.F.R. § 51.53(c)(3)(iv), which requires that "any new and significant information regarding the environmental impacts of license renewal" must be included in the ER and eventually in the FSEIS. In addition, we ask that NRC Staff carry out its responsibilities to seek Commission approval to include in the supplemental FSEIS information that is new and

[1] Last week, on March 20, 2012 NRC Staff published a notice in the Federal Register of NRC's intent to prepare a supplement to the December 2010 Final Supplemental Environmental Impact Statement for the License Renewal of Indian Point Nuclear Generating Units Nos. 2 and 3, NUREG-1437, Supplement 38. 77 Fed. Reg. 16278 (Mar. 20, 2012).

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significant that relates to matters identified as Category 1 in the 1996 Generic Environmental Impact Statement for License Renewal of Nuclear Plants ("1996 GEIS"). In its Statement of Considerations accompanying the publication of the GEIS and adoption of the rule now codified as 10 C.F.R. Part 51, Appendix B, to Subpart A, the Commission made the following commitment:

> If a commenter provides new, site-specific information which demonstrates that the analysis of an impact codified in the rule is incorrect with respect to the particular plant, the NRC staff *will* seek Commission approval to waive the application of the rule with respect to that analysis in that specific renewal proceeding. The supplemental EIS would reflect the corrected analysis as appropriate.

61 Fed. Reg. 28467, 28470 (Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, Statement of Considerations)(emphasis added) (June 5, 1996).

The attached documents,[2] which assemble information that has been accumulating over the last several years and has now reached what we believe is a "critical mass" of significant information that should not be ignored, demonstrate that the 1996 GEIS analysis of the environmental impacts of the additional 20 years of spent fuel storage at each reactor site as a result of license renewal "is incorrect" as applied to Indian Point, that as to such impacts it can no longer be claimed that "additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation," and that the environmental impacts of severe accidents at the Indian Point facilities can no longer be classified as "small."

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[2] Attachment 1 contains the Supplemental Comments Submitted by the Office of the Attorney General of the State of New York (March 5, 2012) *10 C.F.R. Part 51 Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses*, NRC Docket ID NRC-2008-0608 RIN 3150-AI42 ("GEIS Proposed Rule")("Attachment 1"). Attachment 2 is the Statement of Dr. Richard T. Lahey, Jr. (March 9, 2012) in the GEIS Proposed Rulemaking Proceeding ("Attachment 2").

Before summarizing the ways in which we believe the evidence now requires that the Staff fulfill its obligation to advise the Commission that it should "waive the application of the rule" in the 1996 GEIS that treats spent fuel storage impacts during the period of license renewal as a Category 1 issue which does not require further site-specific analysis, we think it is important to note that the Staff has already reached this conclusion on its own. In testimony to the five NRC Commissioners on January 11, 2012 (ML120180209), addressing proposed amendments to the GEIS, Andy Imboden, Branch Chief of the Environmental Review and Guidance Update Branch in the Division of License Renewal in the Office of Nuclear Reactor Regulation confirmed that spent fuel storage impacts during the term of license renewal are proposed to be Category 2:

> In a NEPA context, radionuclides in groundwater as projected over the period of extended operation and their impact to the groundwater resource, makes radionuclides and groundwater an issue that is appropriately discussed in an Environmental Impact Statement. And given the various sources of radionuclides, such as from the spent fuel pool, buried pipe, et cetera, unique hydrological feature for each plant, the staff concluded that a site-specific review is required.

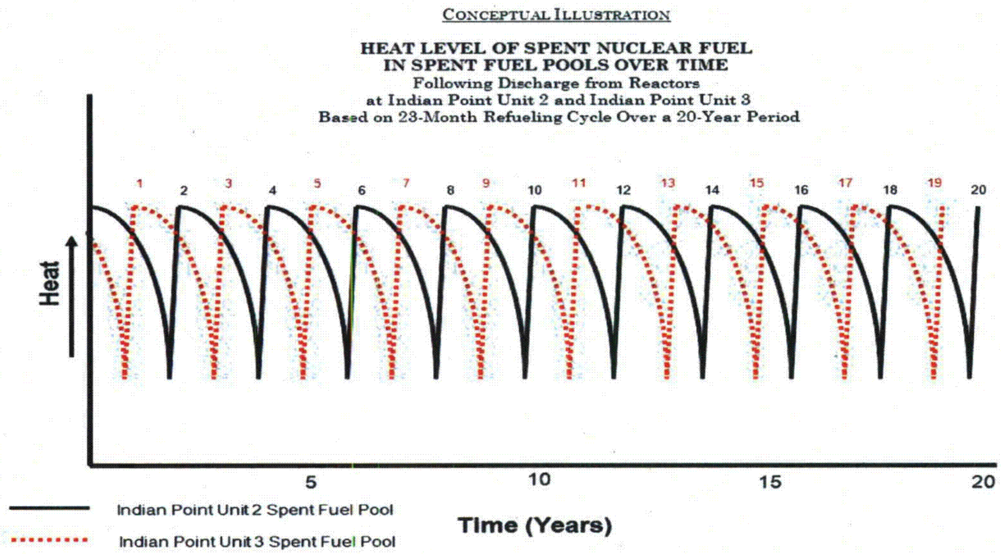
Transcript, Briefing on Proposed Rule to Revise the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, January 11, 2012 (ML120180209) at 63-64. Thus, the issue we present in this request is not whether NRC Staff recognizes the inherent need to consider such impacts on a site-specific basis, which it does, but whether NRC Staff will apply that conclusion to the Indian Point facilities by requesting that the Commission allow NRC Staff to include in its proposed supplement to the FSEIS full consideration of the environmental impacts from on-site spent fuel storage during the period of extended operations as well as alternatives to mitigate those impacts during the license renewal period.

It is also important to note that NRC Staff has already ordered that certain measures be taken at nuclear reactors in an attempt to address some of the environmental and safety problems associated with spent fuel storage. In its March 12, 2012 Status Report on Implementation of the Near-Term Task Force Recommendations Based on Insights from the Fukushima Dai-ichi Accident, NRC announced it had ordered that "strategies shall be developed to add multiple ways to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities in order to improve the defense in depth of licensed nuclear power reactors" and "[l]icensees are ordered to install enhanced SFP instrumentation." *Id.* at 2-3. These recently-announced, first steps underscore the fact that NRC has now recognized that spent fuel pools represent a potential source of significant adverse environmental impacts for which corrective actions are needed. However, under NEPA, a full range of alternatives to address this newly recognized environmental hazard is required. Such a full range of alternatives has not been developed or analyzed for Indian Point relicensing.

Among the ample evidence to support the need to evaluate the site-specific impacts of spent fuel are the following facts:

1. In its 1996 consideration of the environmental impacts from a fire in the spent fuel storage pool during the period of license renewal, the 1996 GEIS relied principally on the earlier 1990 Waste Confidence decision. 1996 GEIS at 6-72 to 6-74 *relying on* 55 Fed. Reg. 38474 (Sept. 8, 1990). However, the 1990 Waste Confidence decision was analyzing the impacts *after* a power reactor ceased commercial electric generation – a time during which presumably no new, and hotter, spent fuel would be added to the pool. Given the 23-month refueling cycle proposed to be in place at the Indian Point reactors, during the requested license renewal period, Indian Point Unit 2 and Unit 3 will likely have 20 instances in which recently-discharged spent nuclear fuel will be added to a spent

fuel pool, meaning that each pool, at any given time, will have spent fuel that has cooled for less than two years and thus is hot enough to generate a zirconium fire in the event of a loss of coolant. *See* Attachment 1 at 16. This phenomenon is illustrated by the following demonstrative illustration:



2. Since the 1996 publication of the GEIS, NRC and its consultants have recognized the much greater potential risk from events occurring in a spent fuel pool including criticality accidents and fire hazards. By way of example, the Sandia National Laboratories have recently acknowledged that reducing the volume of spent fuel in spent fuel pools would mitigate the risks posed by dense storage. *See, e.g.*, *Investigations of Zirconium Fires During Spent Fuel Pool LOCAs* (Slideshow) (Feb. 7, 2012); *see also Responding to Fukushima-Daiichi* (Speech) (Jan. 31, 2012); *Responding to Fukushima-Daiichi* (Slideshow) (Jan. 31, 2012) discussed in Attachment 1 at pp. 39-42; *On Site Spent Fuel Criticality Analyses*, NRR Action Plan (September 19, 2011) ML11251A210

discussed in Attachment 2 at 8; Sandia National Laboratories, *Mitigation of Spent Fuel Pool Loss-of-Coolant Inventory Accidents and Extension of Reference Plant Analyses to Other Spent Fuel Pools* (Redacted) (November 2006) discussed in Attachment 1 at 14-15; NUREG-1738, *Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants* (Feb. 2001) discussed in Attachment 1 at 16-17; NRC Reactor Safety Team (RST), Assessment of Fukushima Daiichi Units, ML11216A018 (Mar. 26, 2011, 2100h) (discussing ejection of fuel and damage to Daiichi facilities).

3. There is also a growing awareness that the site-specific density and manner in which spent fuel is packed into the spent fuel pool as well as the site-specific nature of the spent fuel pool itself including its location within the nuclear complex are important factors in evaluating the potential environmental impacts from increased spent fuel storage during relicensing. *See* Attachment 2 at 7.

4. Indian Point is uniquely vulnerable to earthquake damage since it was initially designed to withstand an earthquake and ground acceleration which are now deemed to be below the reasonably predictable earthquake and ground acceleration for the site and its environs. *See* Attachment 2 at 8.

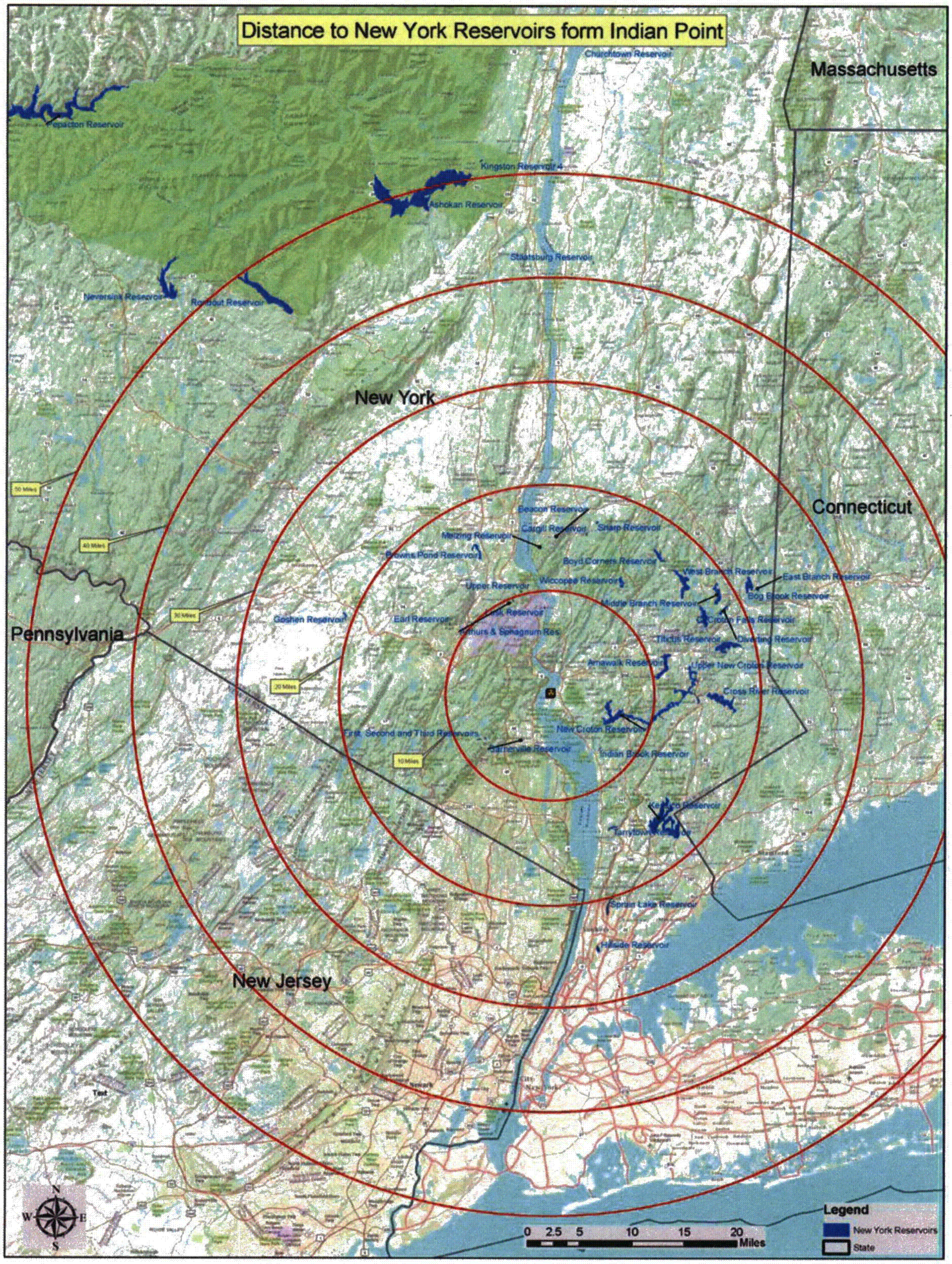
5. Leaks of radionuclides from spent fuel pools have been occurring with disturbing frequency since 1996, including substantial leaks from two spent fuel pools and spent fuel pool transfer canals at Indian Point which have resulted in contamination of drinking water quality groundwater with high levels of strontium and tritium in excess of drinking water standards and tritium and strontium reaching the Hudson River.. *See* Attachment 1 at 20-21.

Not only do these facts, and the facts further developed in Attachments 1 and 2, and the references cited in those Attachments, demonstrate that the impacts of spent fuel storage in the 1996 GEIS findings are incorrect when applied to Indian Point, but they also demonstrate the need for NRC Staff to full explore mitigation measures to address these environmental impacts as part of its NEPA review process.

The Indian Point power reactors and spent fuel pools are also 24 miles north of New York City, 35 miles from Times Square, and approximately 38 miles from Wall Street. The U.S. Census Bureau recognizes that New York City is the largest city in the Nation – with more than 8,000,000 residents.

The facilities are approximately 3 miles southwest of Peekskill, with a population of 22,441, 5 miles northeast of Haverstraw, with a population of 33,811, 16 miles southeast of Newburgh, with a population of 31,400, and 17 miles northwest of White Plains, with a population of 52,802, 23 miles northwest of Greenwich, Connecticut, 37 miles west of Bridgeport, Connecticut, and 37-39 miles north northeast of Jersey City and Newark, New Jersey.

The reactors and fuel pools are also 5 miles west of the New Croton Reservoir in Westchester County, which provides drinking water to New York City. They are also in close proximity to other reservoirs in the New York metropolitan area. *See* Map (below): Distance to New York Reservoirs from Indian Point Spent Fuel Pools and Reactors. NRC's focus on aquatic issues should expand to include the impact of severe spent fuel pool accidents on drinking water resources within NRC's designated 50-mile Emergency Planning Zone around the Indian Point facilities.



Distance to New York Reservoirs form Indian Point
Massachusetts
New York
Connecticut
Pennsylvania
New Jersey
Legend
New York Reservoirs
State
Miles

With more than 17 million people living within 50 miles of Indian Point, no other operating reactor site in the country comes close to Indian Point in terms of surrounding population. In 1979, NRC's Director of State Programs said of the Indian Point site "I think it is insane to have a three-unit reactor on the Hudson River in Westchester County, 40 miles from Times Square, 20 miles from the Bronx." Robert Ryan, NRC Director of State Programs, *quoted in* STAFF REPORTS TO THE PRESIDENT'S COMMISSION ON THE ACCIDENT AT THREE MILE ISLAND (Oct. 1979), Report of the Office of Chief Counsel on Emergency Preparedness, at p. 8.

Given their regulatory history, the three power reactors and their spent fuel pools located at Indian Point were not subjected to a severe accident mitigation alternatives analysis when AEC and NRC issued the construction permits and operating licenses for those facilities. According to AEC and NRC documents, the Consolidated Edison Company ("ConEd") received the following construction permits and operation licenses on the following dates:

	CONSTRUCTION PERMIT ISSUED	OPERATING LICENSE ISSUED
IP Unit 1	May 4, 1956	March 26, 1962
IP Unit 2	October 14, 1966	September 28, 1973
IP Unit 3	August 13, 1969	December 12, 1975

Source: Federal Register and NRC Information Digest.[3]

[3] *See* 21 Fed. Reg. 3,085 (May 9, 1956); 31 Fed. Reg. 13,616-17 (Oct. 21, 1966); 34 Fed. Reg. 13,437 (Aug. 20, 1969); NUREG-1350, Volume 20, *2008 - 2009 Information Digest*, at 103, 113 (Aug. 2008).

When ConEd announced its selection of the Indian Point site back in March 1955 and filed an application for the necessary construction permit, the AEC did not have site selection regulations that addressed population or seismic issues.

To place this initial siting decision in perspective, ConEd selected, and AEC approved, Indian Point as the site for a power reactor before the Windscale (1957), Three Mile Island (1979), Chernobyl (1986), and multi-reactor Fukushima (2011) events. The 1955 selection of Indian Point also came before the enactment of NEPA (1970), the promulgation of CEQ regulations (1978), the Third Circuit's *Limerick* decision (1989), and NRC promulgation of the 10 C.F.R. § 51.53 regulation (1996) that requires an analysis of ways to mitigate the impacts of severe accidents during license renewal proceedings.

All of these unique characteristics of the Indian Point site demonstrate why it is essential that a site-specific analysis of the potential environmental impacts from the storage of spent fuel at the Indian Point facility for the proposed 20 years of extended operation and measures to mitigate those potential impacts must be addressed in a supplement to the FSEIS.

Once NRC recognizes the potential significant environmental impacts that spent fuel storage will have at Indian Point if it is relicensed, there are a wide array of mitigation measures and alternatives that it is obligated to consider as part of the NEPA review. First, NRC is obligated to assure that:

> the Commission has taken all practicable measures within its jurisdiction to avoid or minimize environmental harm from the alternative selected, and if not, to explain why those measures were not adopted.

10 C.F.R. § 51.103(a)(4). Second, where, as here no legally sufficient prior analysis of severe accident mitigation alternatives has been completed, NRC is obligated to assure that such an analysis has occurred and that all reasonable severe accident scenarios and mitigation measures

have been evaluated. 10 C.F.R. §§ 51.53(c)(3)(iii)(L) and 51.71(a).

However, neither the alternatives analysis nor the SAMA analysis for Indian Point considers such alternatives. There is no consideration in the SAMA analysis of severe accidents involving spent fuel pool use during the period of license renewal.

As Attachments 1 and 2 demonstrate there are a wide-range of alternatives and mitigation alternatives that should be considered to the current Entergy plan to continue to crowd more spent fuel into the spent fuel pools and to maintain their current configuration including suggestions from the National Academy of Sciences, *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report*, The National Academies Press (2006), NRC's *Recommendations for Enhancing Reactor Safety in the 21st Century* (ML111861807) ("*Near-Term Task Force Report*") and by numerous well-respected experts in nuclear power plant safety such as Robert Alvarez, et. al., *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, Science and Global Security, Vol. 11:1-51. *See* Attachment 1 at 37-43 and 46-57; Attachment 2 at 11-12.

Among the many feasible and easily implemented measures that could significantly mitigate the environmental impacts of routine operation of spent fuel pools at Indian Point as well as significantly reduce the consequences of severe accidents are the immediate off-loading of all spent fuel that is at least 5 years old to dry cask storage, installation of safety grade spray systems in the spent fuel enclosures to ensure replacement water in the event of loss of coolant accident, re-arrangement of the spent fuel in the pools to allow for better circulation in the event of loss of coolant, to mention only a few of the recommendations contained in the reports identified in the Attachments to this letter.

All of this information provides ample basis for NRC Staff to fulfill its obligation to seek permission from the Commission to expand the scope of its intended supplement to the Indian Point FSEIS to include a full consideration of the environmental impacts of spent fuel storage at Indian Point over the term of the proposed license extension and mitigation measures to address those potential environmental impacts, including severe accident mitigation alternatives.

We are aware of ongoing efforts by NRC to address problems with the spent fuel storage, including the above-mentioned Orders regarding recommendations from the Fukushima Daiichi Near Term Task Force. It is not a satisfactory answer to the State's concerns for NRC to indicate that those efforts should be a substitute for consideration at this time in this licensing proceeding of the serious environmental damage that can be caused by the spent fuel pool use during the period of extended operation and alternatives to mitigate that damage. It is the ongoing operating licensing proceeding that is to decide whether and how to relicense Indian Point Unit 2 and Unit 3. NEPA requires NRC to evaluate, to the fullest extent possible, the environmental impacts of the proposed action and alternatives to mitigate those impacts at the earliest stage, before commitment of resources and other actions narrow the scope and viability of alternatives. As the United States Court of Appeals for the District of Columbia observed in a slightly different context:

> By refusing to consider requirement of alterations until construction is completed, the Commission may effectively foreclose the environmental protection desired by Congress. It may also foreclose rigorous consideration of environmental factors at the eventual operating license proceedings. If "irreversible and irretrievable commitment[s] of resources" have already been made, the license hearing (and any public intervention therein) may become a hollow exercise.

Calvert Cliffs' Coordinating Comm. v. Atomic Energy Comm'n, 449 F.2d 1109, 1128 (D.C. Cir. 1971). *Accord NRDC v. United States NRC,* 539 F.2d 824 (2d Cir. 1976), *vacated sub nom. as moot, Allied-General Nuclear Servs. v. NRDC*, 434 U.S. 1030 (1978):

> "Although an EIS may be supplemented, the critical agency decision must, of course, be made after the supplement has been circulated, considered and discussed in the light of the alternatives, not before. Otherwise the process becomes a useless ritual, defeating the purpose of NEPA, and rather making a mockery of it." (*Natural Resources Defense Council, Inc. v. Callaway, supra,* 524 F.2d at 92.)

Id. 539 F.2d at 845.

As NRC seeks to fulfill its mandate under the National Environmental Policy Act and examine the site-specific environmental impacts associated with authorizing the operation of Indian Point facilities in the future, it should in a proactive way address the issue of how it deals with severe nuclear events – be they releases from reactors or spent fuel pools – that lead to significant environmental impacts including, as in the case of Japan, land contamination and displacement, perhaps permanently, of people from their homes and their livelihoods and their communities.

The State looks forward to NRC Staff's prompt and favorable response to this request. Please call me if you have any questions or need clarification of the points made in this letter and the two Attachments.

Sincerely,

John J. Sipos
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john.sipos@ag.ny.gov

cc: IndianPointEIS@nrc.gov

Cindy Bladey, Chief,
Rules, Announcements and Directives Branch, NRC

ATTACHMENT 1

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:

10 C.F.R. Part 51, Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses

NRC Docket ID
NRC-2008-0608
RIN 3150-AI42

SUPPLEMENTAL COMMENTS SUBMITTED BY THE OFFICE OF THE ATTORNEY GENERAL OF THE STATE OF NEW YORK

SUBMITTED: MARCH 5, 2012

Note about Citations and References Contained in this Document

All citations and references mentioned in this document are hereby incorporated by reference. Should NRC Staff have difficulty obtaining any such citations and references, they are requested to contact the Office of the Attorney General for the State of New York for assistance.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:

10 C.F.R. Part 51, Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses

NRC Docket ID
NRC-2008-0608
RIN 3150-AI42

SUPPLEMENTAL COMMENTS SUBMITTED BY THE OFFICE OF THE ATTORNEY GENERAL OF THE STATE OF NEW YORK

The People of the State of New York by its Attorney General submit these supplemental comments regarding the Nuclear Regulatory Commission's ("NRC") proposed Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses (the "Proposed Rule") and the revised Generic Environmental Impact Statement for License Renewal of Nuclear Plants (the "Proposed GEIS"). Consideration of these supplemental comments is practicable given that NRC's projected schedule does not envision publication of a potential final rule until later this year. Indeed, NRC Staff has yet to provide its recommendations on the rulemaking to the NRC Commissioners, and the Commissioners have not completed their review of the record or the recommendations. Additionally, at the January 11, 2012 public briefing on the Proposed Rule, Riverkeeper and the Office of the Connecticut Attorney General requested that the comment period be briefly re-opened.[1] The State of New York joins this request and asserts that given the

[1] U.S. Nuclear Regulatory Commission, Briefing on Proposed Rule to Revise the Environmental

developments of the past two years, NRC should briefly re-open the comment period.[2] Moreover, since NRC has received recent input from the Nuclear Energy Institute, the Tennessee Valley Authority, the State of Connecticut, and Riverkeeper, New York respectfully requests that NRC receive these supplemental comments.

Review for Renewal of Nuclear Power Plant Operating Licenses (Part 51), Transcript of Proceedings, at 12-13, 17, ML120180209 ("*January 2012 GEIS Briefing Transcript*") (Jan. 11, 2012). NRC Staff invited the Nuclear Energy Institute, the Tennessee Valley Authority, Riverkeeper, and the State of Connecticut to make presentations to the NRC Commissioners.

[2] Although New York provided comments on the rulemaking and has developed additional experience with the 1996 GEIS over the past two years as a result of its participation in the license renewal proceeding for the Indian Point facilities, NRC did not invite New York to attend or participate in the January 11, 2012 meeting and New York was therefore unable to provide its views to the Commissioners. In addition, the State also notes that at the request of industry representatives (apparently made during the March 2011 Regulatory Information Conference), NRC Staffers held an informal meeting on June 21, 2011 to provide a forum for industry to provide comments on the application of any new GEIS or regulation. Despite the State's participation in the rulemaking, NRC Staff did not inform New York about this event or invite the State to participate in this forum. New York ultimately did learn about the June forum—but only through happenstance and at a very late hour.

I. Overview

In its original comments, submitted on January 12, 2010, the State of New York raised numerous concerns regarding the Proposed Rule and the Proposed GEIS. Among these, the State highlighted issues relating to the on-site storage of spent nuclear fuel in pools at nuclear facilities. Specifically, the State asserted that: (1) the Proposed GEIS ignores the impacts on offsite land use values of increased onsite treatment and storage of spent fuel; and (2) the GEIS fails to properly classify broader spent fuel pool impacts as site-specific or "category 2" issues. The State argued that on-site storage of spent nuclear fuel should be considered a category 2 issue because: (1) new information which came to light after the 1996 GEIS shows that the spent nuclear fuel stored in a pool can catch fire, either by accident or sabotage, and release significant amounts of radiation into the surrounding area, causing site-specific impacts; and (2) NRC has sought to address or mitigate the impacts of the risks of such storage on a site-specific basis through site-specific regulatory actions.

In light of the events involving spent nuclear fuel that have occurred over the past two years, the State finds it necessary and appropriate to supplement its original comments. Specifically, in the two past years: the U.S. government abandoned its effort to create a spent nuclear fuel repository at Yucca Mountain; events in Japan and Virginia demonstrated that external events (such as earthquakes or flooding) can pose severe risks to spent nuclear fuel residing at nuclear plants; various reactors whose spent fuel pools have been reconfigured for dense storage of spent nuclear fuel have run out of storage space; the Tennessee Valley Authority, a federal agency that operates commercial nuclear reactors, has announced plans to consider an alternative strategy to shift spent nuclear fuel from spent fuel pools to dry cask storage; and recently-released NRC and Sandia National Laboratories documents confirm the State's concern and that alternatives are readily available. These developments indicate that spent nuclear fuel will continue to be housed indefinitely in densely-packed spent fuel pools at individual nuclear reactor sites, that such storage entails substantial, yet differing, site-specific risks due to the potential for seismic activity and other external events, and also, that alternatives exist to mitigate these site-specific impacts.

These supplemental comments identify new and significant information regarding the storage of spent nuclear fuel in on-site pools and severe accident analyses. NRC is obligated by National Environmental Policy Act ("NEPA") case law and Council on Environmental Quality ("CEQ") regulations to consider such information as part of the GEIS revision process. For this reason, the State respectfully offers the following comments regarding the risk posed by spent nuclear fuel, the significant new information that has come to light over the past two years, and possible alternatives to the current spent fuel storage scheme. It is important that NRC be mindful of these risks when revising the license renewal rules because any plant that is relicensed will continue to generate spent nuclear fuel for the next twenty years and will regularly add that spent fuel to spent fuel pools during that time.

In addition, based on the experience it has gained in the Indian Point license renewal proceeding, the State of New York has concerns over the scope and adequacy of the required site-specific analyses of severe accidents at nuclear power plants, known as severe accident mitigation alternatives analyses, or "SAMA" analyses. NRC conducts SAMA analyses pursuant to NEPA and as a result of the Third Circuit's ruling in *Limerick Ecology Action, Inc. v. Nuclear Regulatory Commission*, 869 F.2d 719 (3d Cir. 1989). However, the SAMA analyses submitted with license renewal applications examine only severe accidents resulting in releases from the reactor core; they do not consider the site-specific impacts of spent fuel pool accidents. Because NRC Staff and reactor owners do not consider the environmental impacts of spent fuel pool accidents as part of their NEPA analysis when reviewing an application to renew an operating license, they do not consider alternatives to current spent fuel pool storage configurations. Moreover, NRC Staff and the industry steadfastly oppose any State or citizen request under NEPA to review the environmental impacts of spent fuel pool accidents or alternatives to current spent fuel pool practices. It does not appear that NRC Staff's NEPA-based SAMA analyses take severe accidents resulting in a radiological release from the spent fuel pools into consideration at all. By these supplemental comments, the State seeks to inform the Commissioners about this significant gap in Staff's NEPA analyses. To close that gap, the State requests that the Commission require the site-specific analysis of severe accidents to include both reactor core and spent fuel pool releases as well as the means and alternatives to mitigate the impacts of such accidents when a nuclear power plant seeks to renew its initial 40-year operating license or a previously-renewed operating license (*e.g.*, when a nuclear plant seeks NRC authority to operate beyond 60 years).

The State also wishes to bring to the Commissioners' attention a separate concern over the conduct of site-specific severe accident mitigation alternatives analyses. Separate and apart from the concern over dense storage of spent nuclear fuel in spent fuel pools, the State is also concerned that site-specific SAMA alternatives have relied on inputs developed for Surry, a relatively rural reactor site, that are not appropriate for reactors whose emergency planning zones include more suburban or urban areas. The revised GEIS should make clear that site-specific SAMA reviews must rely on site-specific data from the region around the specific reactor in question, and not replicate the data from the Surry site.

Moreover, given the importance of these issues, the NRC should revise the GEIS and implementing regulations as requested by these comments and apply the GEIS, as so revised, to all license renewal applications that are currently pending.

The State's comments are organized as follows: first, they provide background on the generation of spent nuclear fuel, the danger of this material, the history of its on-site storage in pools, and the environmental impacts of such storage; second, they discuss the significant new information that has arisen in the past two years regarding the storage of spent fuel and spent fuel pool accidents; third, they examine the alternatives to the current dense-storage scheme for spent fuel pools; and finally, they discuss deficiencies in NRC Staff's approach to site-specific severe accident reviews conducted to date with respect to spent fuel pools and the Surry-derived inputs.

II. Generation of Spent Nuclear Fuel

A nuclear reactor is powered by enriched uranium fuel. Fission (the splitting of atoms) generates heat, which produces steam that turns turbines to produce electricity. Over time, the ability of nuclear fuel to produce sufficient fission to generate commercial quantities of energy diminishes. After it has been used to generate power in a reactor core for approximately six years, plant operators remove the spent nuclear fuel and replace it with new nuclear fuel. The spent nuclear fuel removed from the reactor core is transferred to a swimming pool-like structure known as a spent fuel pool. Although it no longer produces sufficient fission to generate commercial amounts of energy, spent nuclear fuel continues to give off significant amounts of thermal energy (or heat) and radiation after the fuel is removed from the reactor.

Unlike the reactor core, spent fuel pools are located outside containment.

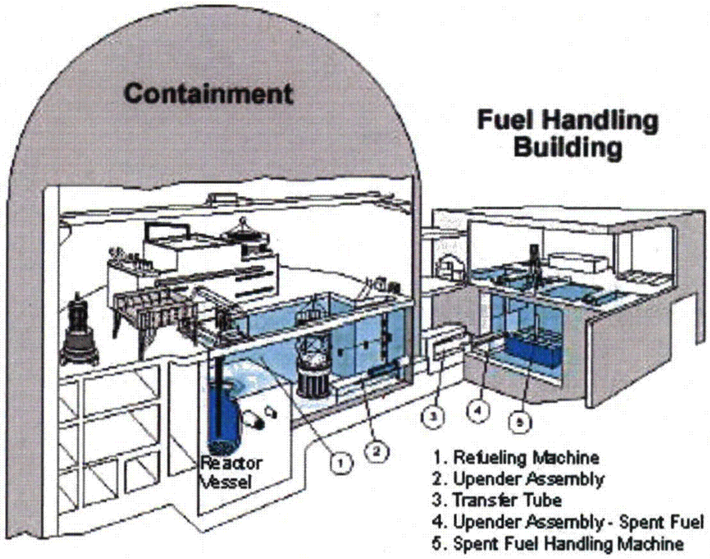

Diagram of Pressurized Water Reactor. Source: The Union of Concerned Scientists, *available at*: http://www.ucsusa.org/nuclear_power/nuclear_power_technology/

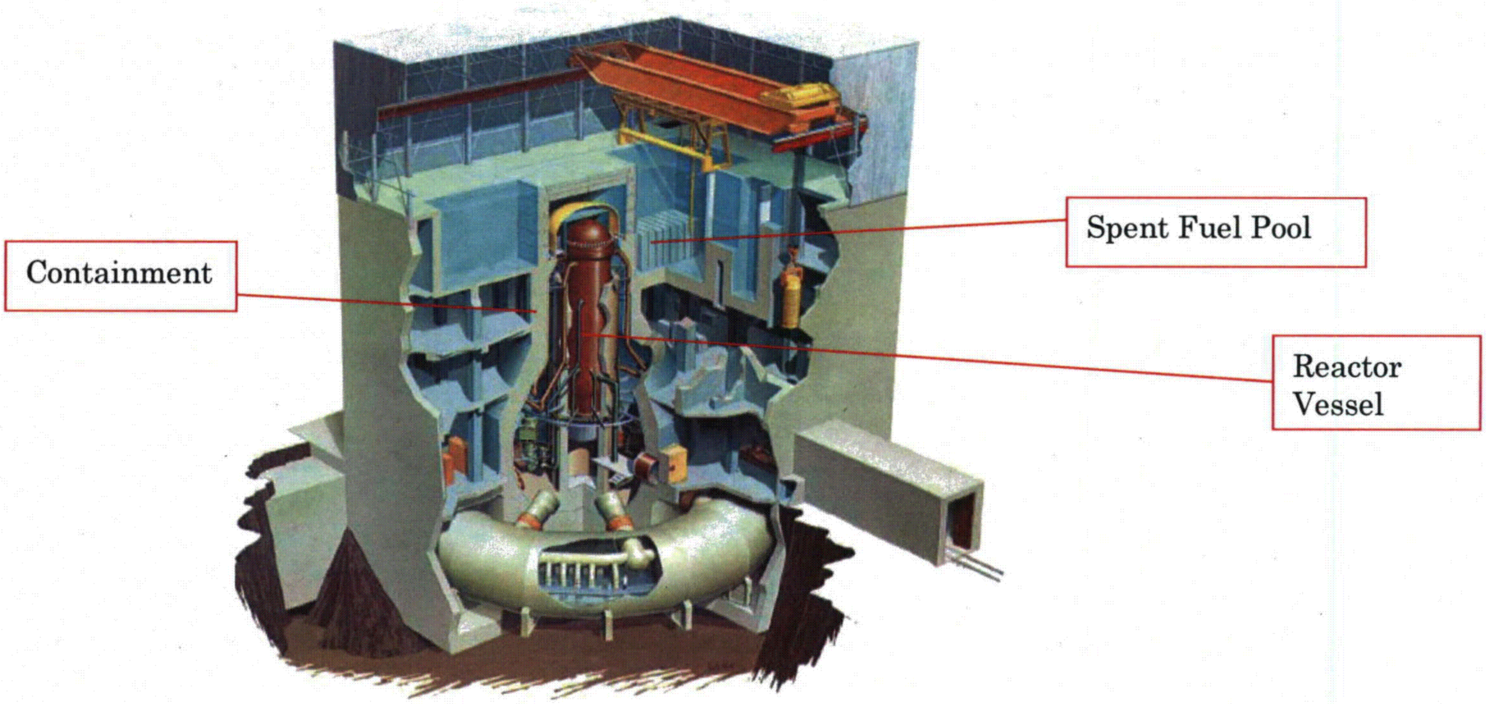

Diagram of Boiling Water Reactor. Source: Nuclear Regulatory Commission, *available at*: http://www.nrc.gov/reading-rm/basic-ref/teachers/03.pdf at 3-16 (captions added).

III. Toxicity and Longevity of Spent Nuclear Fuel

The toxicity of high level spent nuclear fuel to humans is "greater than that of any hitherto familiar industrial poison."[3] "At massive levels, radiation exposure can cause sudden death."[4] Exposed spent nuclear fuel will deliver a lethal dose nearly instantly if it has cooled less than one year; within about one minute if it has cooled for 5 years; in about 2 minutes if it has cooled for 10 years; and in about 5 minutes if it has cooled for 50 years. Spent fuel that has cooled for 100 years can still deliver a lethal dose after 25 minutes of exposure.[5] Even "[a]t lower doses, radiation can have devastating health effects, including increased cancer risks and serious birth defects such as mental retardation, eye malformations, and small brain or head size."[6] Although a few isotopes in spent nuclear fuel have short half-lives of only several hours or a few days, "[r]adioactive waste and its harmful consequences persist for time spans seemingly beyond human comprehension."[7]

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[3] *Industrial Radioactive Waste Disposal*, Summary-Analysis of Hearings, Joint Committee on Atomic Energy, Congress of the United States, at 6 (Aug. 1959).

[4] *Nuclear Energy Institute v. U.S. Environmental Protection Agency*, 373 F.3d 1251, 1258 (D.C. Cir. 2004)(internal citations omitted) (hereinafter *NEI v. EPA*).

[5] United States Department of Energy, Statement of Position of the United States Department of Energy, Proposed Rulemaking on the Storage and Disposal of Nuclear Waste (Waste Confidence Rulemaking), DOE/NE-0007, page II-56, Table II-4 (April 15, 1980); *see also id.*, pages II-8 – II-9, Table II-1; U.S. Department of Energy, Dose Ranges (rem) Chart (June 2010). *Available at*: http://lowdose.energy.gov/pdf/DoseRanges.pdf. The calculations set forth above are based on the surface dose rates in rem/hr from the DOE report and the lethal dose rate of approximately 800 rem from DOE's Dose Ranges chart. The lethal dose of 800 rems means that 50% of the population exposed at that rate will die within 30 days even with medical treatment.

[6] *NEI v. EPA*, 373 F.3d at 1258.

[7] *Id.*

IV. History of On-Site Storage of Spent Nuclear Fuel

During the first two decades of nuclear power production in the United States, the Atomic Energy Commission and the Nuclear Regulatory Commission assured host communities that spent nuclear fuel from commercial nuclear reactors would be promptly removed from the sites and sent to off-site facilities for reprocessing or disposal.[8] Based upon the belief that spent nuclear fuel would be stored on-site only temporarily before it was transported off-site for reprocessing, nuclear plants were built with relatively small spent fuel storage pools.[9] Moreover, the public was informed that spent fuel would not be stored long-term at nuclear plant sites. The Atomic Energy Commission ("AEC") told the public that the facilities' radioactive waste would be transported away from the host communities to distant facilities such as West Valley, New York or Morris, Illinois, where the spent fuel would be reprocessed.[10] For example, the Final Environmental

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[8] Government Accountability Office, Report to Congressional Requesters, *Nuclear Fuel Cycle Options* (GAO 12-70), at 2(Oct. 2011); *see also* Statement of NRC Commissioner Victor Gilinsky, 48 Fed. Reg. 22730, 22733 (May 20, 1983) ("The current generation of nuclear power plants was licensed on the assumption that spent fuel would be retained on site for a brief period, prior to being sent away for reprocessing.").

[9] Blue Ribbon Commission on America's Nuclear Future, Reactor and Fuel Cycle Technology Subcommittee, Draft Report to the Full Commission, at 10 ("*RAFCT Report*") (June 2011); *see also* Blue Ribbon Commission on America's Nuclear Future, Transportation and Storage Committee, Draft Report to the Full Commission, at 2 ("*Storage Committee Report*")(May 31, 2011) ("These pools were not intended or designed for permanent storage; the assumption was that spent fuel assemblies would spend a few years immersed in the pools before being transferred out for reprocessing or final disposition.").

[10] *See, e.g., Vermont Yankee Nuclear Power Station Final Environmental Impact Statement*, U.S. Atomic Energy Commission, at 93-94, ML061880207 (July 1972) (irradiated fuel elements will be shipped after minimum 90-day cooling period); *Prairie Island Final Environmental Statement*, U.S. Atomic Energy Commission, at 192, ML081840311 (May 1973) (spent nuclear fuel elements will be shipped to Nuclear Fuel Services Preprocessing Plant at West Valley, NY); *Final Environmental Statement for Indian Point, Unit 2*, Volume I, U.S. Atomic Energy Commission, at 257, ML072390276 (Sept. 1972) (approximately 35 truckloads of irradiated fuel per year will be transported to Midwest Fuel Recovery Plant in Morris, IL); *Final*

Statement for Indian Point, Unit 2 stated that radioactive wastes generated at the plant would be released to the environment or shipped to a reprocessing facility in Illinois.[11]

However, in the mid-1970's, problems developed at the West Valley and Morris reprocessing facilities,[12] and the U.S. abandoned commercial reprocessing of spent nuclear fuel due to concerns over nuclear weapons proliferation and cost.[13] In order to deal with the spent fuel accumulating at plants, NRC authorized re-racking of the spent fuel assemblies (also known as dense storage) in spent fuel pools so that they held much larger amounts of spent fuel than initially contemplated.[14] While the original open-racks were designed to promote water circulation, the high-density racks eliminated many of the channels between the fuel assemblies so they could be packed closer together.[15] This means there is less water circulation to cool the assemblies (or air circulation in an event causing the loss of water in the pool).[16] The following charts summarize how NRC has authorized increasing amounts of

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Environmental Statement for Indian Point, Unit 3, Volume I, U.S. Nuclear Regulatory Commission, NUREG-75/002, at 412, ML072390284 (Feb. 1975) (irradiated fuel could be transported to the Allied-Gulf Nuclear Services Plant in Barnwell, SC).

[11] *Final Environmental Statement for Indian Point, Unit 2,* at IX-3 (PDF, 298). The report estimated that approximately 35 truckloads of irradiated fuel per year, from Units 1 and 2, would be transported from the plant to Midwest Fuel Recovery Plant in Morris, IL (p. V-87, PDF 258).

[12] *See generally* 40 Fed. Reg. 42801 (Sept. 16, 1975) (discussing problems with West Valley and Morris reprocessing facilities).

[13] *RAFCT Report* at 10. *See also* Statement by the President, 3 Pub. Papers 2763, 2767-68 (Oct. 28, 1976) (President Ford's announcement of moratorium); Statement by the President, 1 Pub. Papers 581, 587-83 (Apr. 7, 1977) (President Carter's announcement of moratorium).

[14] *See generally Minnesota v. NRC,* 602 F.2d 412, 414 (D.C. Cir 1979) (describing requests by Vermont Yankee and Prairie Island to store 3 times as much spent fuel as originally envisioned).

[15] National Academy of Sciences, *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report,* The National Academies Press, at 23 ("*NAS Report*") (2006).

[16] *Id.*

spent nuclear fuel to be stored in the spent fuel pools for Indian Point Unit 2 and Unit 3,

IP2 Spent Fuel Pool Storage Limits[17]	
Date	Fuel Assemblies
1973	264
1980	482
1985	980
1989	1,376

IP3 Spent Fuel Pool Storage Limits[18]	
Date	Fuel Assemblies
1975	264
1978	840
1989	1,345

With reprocessing no longer a viable option and fuel pools quickly filling, reactor operators and the federal government attempted to locate and develop a single, common national radioactive waste repository. The federal government told the public and courts that the repository would be operational in 1985.[19] Thereafter, the government represented that the common national repository would be available between 2007 and 2009 for Prairie Island and Vermont Yankee's spent fuel waste.[20] Those dates have also come and passed, and the revised date of 2025

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[17] Consolidated Edison, *Final Design Report for Reracking the Indian Point Unit No. 2 Spent Fuel Pool,* at 1, ML100200292 (May 1980); Consolidated Edison, *Supplemental Spent Fuel Safety Analysis,* at 3-1, ML100350310 (Nov. 1985); and Consolidated Edison, *Indian Point Unit 2 Spent Fuel Pool Increased Storage Capacity Licensing Report,* at 1-2, ML100200114 (June 1989).

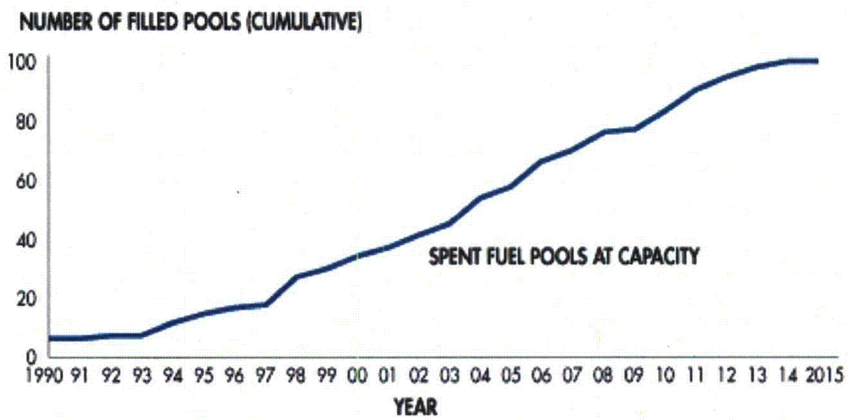
[18] USAEC, *Safety Evaluation Report by the Directorate of Licensing U.S. AEC In the Matter of Consolidated Edison Co. of New York, Inc. Indian Point Nuclear Generating Unit No. 3,* at 4-1, 9-2, ML072260465 (Sept. 21, 1973); USNRC, *Indian Point, Unit 3, Amendment 13, Authorizing Modifications to the Spent Fuel Pool, Increasing Capacity from 264 to 840 Fuel Assemblies,* attached to *Letter from A. Schwencer, NRC to New York State Power Authority,* ML003778668 (Mar. 22, 1978); and USNRC, *Indian Point, Unit 3, Amendment 90, Allowing for the Expansion of the Spent Fuel Pool Storage Capacity,* attached to *Letter from Joseph Neighbors, NRC to New York Power Authority,* ML003778816 (Oct. 12, 1989).

[19] *NRDC v. NRC,* 582 F.2d 166, 173 (2d Cir. 1978) (federal "goal is to have an operating high-level waste repository at the soonest possible time, namely 1985"). In 1980, the federal Department of Energy represented that a national repository "should be available for use in the 1997-2006 time period." DOE/NE-0007, at IV-4.

[20] *Minnesota,* 602 F.2d at 418.

was formally abandoned in a 2010 rulemaking proceeding.[21] As will be discussed below on page 26, the federal government recently abandoned its decades-long effort to create a national repository at Yucca Mountain in Nevada.

The current de facto national spent fuel storage strategy involves maximizing the amount of spent fuel that can be stored in reactor pools through use of high-density storage racks, and then moving the older fuel into on-site dry storage casks as needed to maintain enough free space in the pools for discharge of the full reactor core. As the chart below shows, the spent fuel pools at nuclear plants around the country are quickly reaching capacity.[22] NRC is aware that at some reactors, such as Indian Point Unit 3 located in New York, the spent fuel pools have already reached maximum capacity—even with dense storage.



Note: All operating nuclear power reactors are storing used fuel under NRC license in spent fuel pools. Some operating nuclear reactors are using dry cask storage. Information is based on loss of full-core reserve in the spent fuel pools.

Source: Energy Resources International and DOE/RW-0431 – Revision 1

[21] 75 Fed. Reg. 81040 (Dec. 23, 2010).
[22] The figure below is taken from NRC's website, *available at*: http://www.nrc.gov/waste/spent-fuel-storage/nuc-fuel-pool.html.

V. Environmental Hazards and Impacts of Spent Fuel Pools

Spent fuel pools have different designs and liners, and some are located at ground level while others are located above the ground. The design and placement of spent fuel racks, air circulation and convection mechanisms, type of reactor, and amount of heat generated by the fuel itself also differ from plant to plant. Unlike nuclear power reactors, which are located within containment shells, spent fuel pools are not protected by thick concrete domes,[23] making them susceptible to radiological release as a result of fires or leaks. Their susceptibility, however, is affected by the site-specific differences between the pools.[24]

A. Fires

When fuel is removed from a nuclear reactor, it is extremely hot and continues to generate large amounts of energy. It must be submerged in cold water for five years so that it does not spontaneously ignite. The figures below, taken from a report prepared by Sandia National Laboratories,[25] show that spent fuel can generate close to 10 MW of energy when it is first removed from a reactor and placed in a spent fuel pool. To put this amount of energy in perspective, one megawatt of capacity produced by a conventional generator (such as a coal plant) will produce enough electricity to provide for the annual electric needs of 400 to 900 homes.[26] This considerable amount of residual or "decay" heat causes the

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[23] *NAS Report* at 40.
[24] *Id.* at 8, 31, 40-43.
[25] Sandia National Laboratories, *Mitigation of Spent Fuel Pool Loss-of-Coolant Inventory Accidents and Extension of Reference Plant Analyses to Other Spent Fuel Pools*, at 54 ("*2006 Sandia Report*") (Nov. 2006).
[26] Bob Bellemare, *What is a Megawatt?* (June 24, 2003). *Available at*:

temperature of the pool water to increase rapidly, and cooling water is required to constantly refresh the pool and replenish the water lost through evaporation so that the fuel assemblies do not overheat.

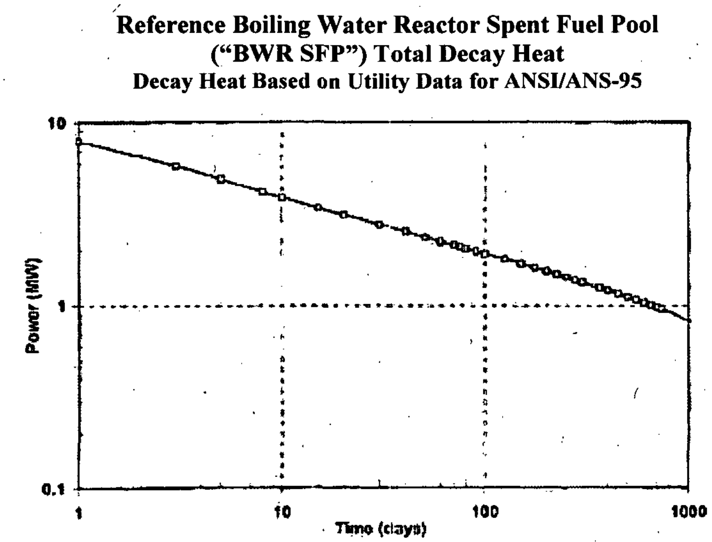

Figure: Total Pool Decay Heat Power in the Reference BWR SFP.

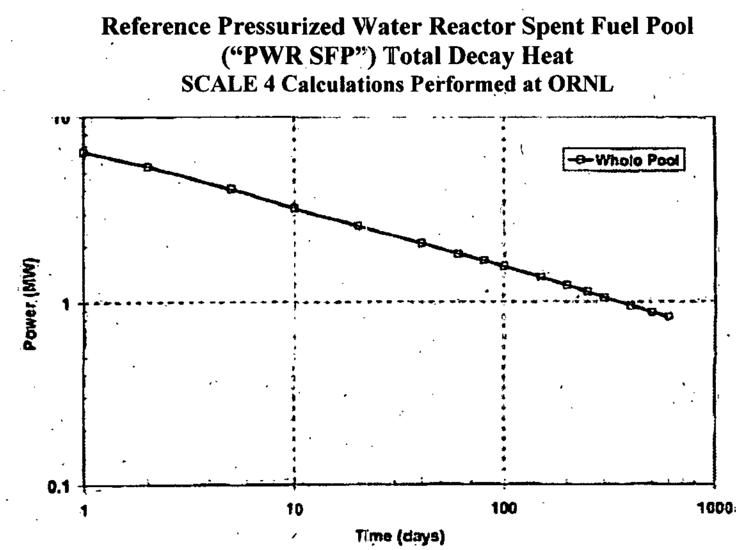

Figure: Total Pool Decay Heat Power in the Reference PWR SFP.

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http://www.utilipoint.com/2003/06/what-is-a-megawatt/.

Assuming that a reactor has a 23-month refueling cycle, the scenario depicted by the above figures could take place ten times during a twenty year operating license authorized by a renewed reactor operating license. For sites, such as Indian Point, that have two operating power reactors, this scenario could occur approximately twenty times during the additional twenty year operating period.

In 2001, NRC issued a technical study called NUREG-1738 that examined the risk of spent fuel pool fire.[27] That study found that, if a pool lost enough water to uncover the spent fuel assemblies, the spent fuel could heat to the point where the fuel's zirconium cladding might catch fire.[28] A zirconium fire could generate a radioactive plume causing thousands of deaths from cancer.[29] Other studies submitted to NRC reached the same conclusion about the adverse consequences of a zirconium fire.[30] The graph below, taken from NUREG-1738, shows that for decay times of less than about 2 years for pressurized water reactors ("PWRs") and 1.5 years for boiling water reactors ("BWRs"), "it would take less than 10 hours for a zirconium fire to start or for significant fission product releases to begin once the fuel was fully uncovered and the fuel was cooled by an air flow of about two building volumes per hour. The figure also shows that after 4 years, PWR fuel could reach

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[27] Nuclear Regulatory Commission, NUREG-1738, *Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants*, ("*NUREG-1738*") ML010430066 (Feb. 2001).
[28] *Id.* at 2-1 to 2-3, A1A-1 to A1A-6. For an illustrated explanation of how a zirconium fire could occur, *see* The New York Times, Hazards of Storing Spent Fuel, (Mar. 18, 2011), *available at*: http://www.nytimes.com/interactive/2011/03/12/world/asia/the-explosion-at-the-japanese-reactor.html?ref=asia.
[29] *Id.* at Appendix 4A, Attachment 1; *NAS Report* at 49-50.
[30] Robert Alvarez, et al., *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*. Science and Global Security, Vol. 11:1-51, at 7-11 ("*Reducing the Hazards*") (Jan. 22, 2003); Beyea, Lyman, von Hippel, *Damages from a Major Release of 137Cs into the Atmosphere of the United States*, Science and Global Security, Vol. 12:125-136 ("*Damages from a Major Release*") (Jan. 21, 2004).

the point of fission product release in about 24 hours."[31]

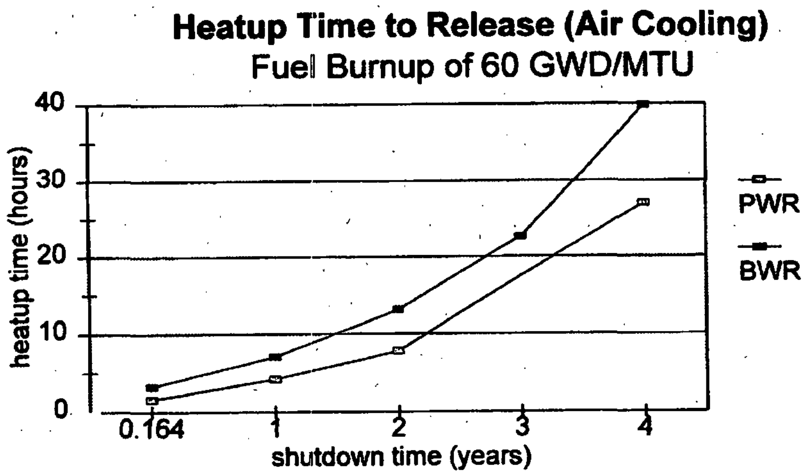

Figure 1A-1 Heatup time from 30 °C to 900 °C

NUREG-1738 also found that "[h]eat removal is very sensitive to" plant-specific factors, including "fuel assembly geometry" and "rack configuration," and is "subject to unpredictable changes after an earthquake or cask drop that drains the pool."[32] Following the release of NUREG-1738, NRC's Director of Operations issued a memorandum acknowledging that "a zirconium fire event can have public health and safety consequences similar to a severe core damage accident with a large offsite release" and "that the possibility of a zirconium fire cannot be dismissed even many years after final reactor shutdown."[33]

A 2003 peer-reviewed article by Robert Alvarez, a Senior Scholar at Princeton University's Institute for Policy Studies and a former Senior Policy Advisor to the

[31] *NUREG-1738* at A1A-4.
[32] *NUREG-1738* at x.
[33] Nuclear Regulatory Commission, SECY-01-0100, NRC Policy Issue (Notation Vote) Memorandum from William D. Travers, Executive Director for Operations to NRC Commissioners, *Policy Issue Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools (WITS 200000126)*, at 5, 2 (June 4, 2001).

U.S. Secretary of Energy, concluded that the dense packing of spent fuel in cooling pools does not provide a sufficient safety margin in the event of a pool breach and consequent water loss from an accident or terrorist attack.[34] In such cases, the fuel most recently placed in the pool could heat up enough to ignite its zirconium cladding, possibly resulting in the release of large amounts of radioactivity to the environment.[35] To reduce this risk, the Alvarez article recommended moving spent fuel that had cooled for five years to dry-cask storage.[36] The graph below, taken from the Alvarez article, shows that several days after being removed from the reactor, nuclear fuel is releasing 100 kilowatts of radioactive heat per metric ton of uranium (kWt/tU).[37]

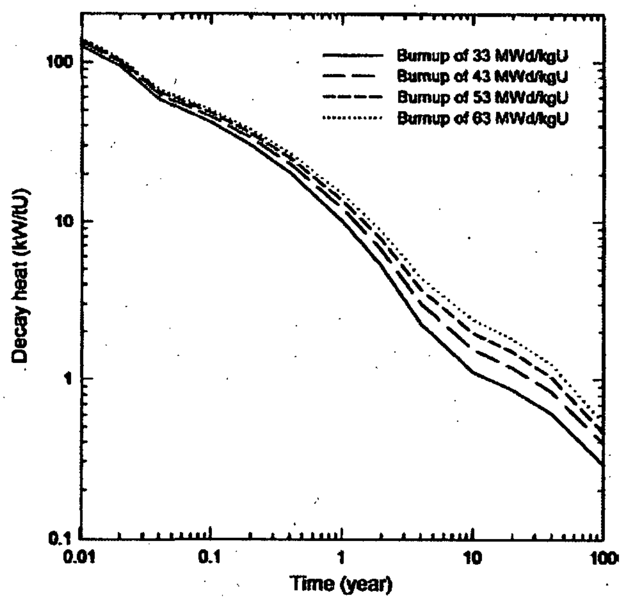

Figure 5: Decay heat as a function of time from 0.01 years (about 4 days) to 100 years for spent-fuel burnups of 33, 43, 53 and 63 MWd/kgU. The lowest burnup was typical for the 1970s. Current burnups are around 50 MWd/kgU (Source: authors[38]).

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[34] *See Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, Science and Global Security, Vol. 11:1-51 ("*Reducing the Hazards*") (2003).
[35] *Id.*
[36] *Id.* at 27.
[37] *Id.* at 12.

Gordon Thompson of the Institute for Resource and Security Studies has also issued a report concluding that increased storage of spent fuel in dry casks would allow lower-density packing of spent fuel pools and decrease the risk of pool fires.[38] But, as yet, only 22% of spent nuclear fuel is stored in dry casks.[39] Other scientists and engineers have raised similar points.[40] NRC disagreed with *Reducing the Hazards* and criticized Alvarez and the Institute for Policy Studies for questioning NRC's and industry's reliance on densely packed spent fuel pools.

Concerned about the implications of the Alvarez article and NUREG-1738, the United States Congress directed NRC to seek independent technical advice from the National Academy of Sciences ("NAS") on the safety and security of spent fuel storage.[41] In response, NAS confirmed the potential for a pool fire that could result in the release of a substantial portion of a fuel pool's radioactive inventory.[42] The NAS report also agreed with NUREG-1738 that the risk of spent fuel pool fires cannot be determined on a generic basis: "[t]he 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

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[38] Gordon R. Thompson, *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*, at 49-50 (Feb. 6, 2009).
[39] Nuclear Regulatory Commission, *Spent Fuel Storage in Pools and Dry Casks Key Points and Questions and Answers* (Apr. 29, 2011). *Available at*: http://www.nrc.gov/waste/spent-fuel-storage/faqs.html.
[40] *See Damages from a Major Release* (discussing accident costs at Indian Point and four other sites).
[41] U.S. Congress, Conference Report 108-357, *Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2004, and for Other Purposes*, at 191 (Nov. 7, 2003).
[42] *NAS Report* at 1.

storage at each plant."[43] The NAS report also found that sabotage of spent fuel pools is possible and that under some conditions, a terrorist attack that partially or completely drained a spent fuel pool could lead to a zirconium cladding fire that would "propagate"—*i.e.*, spread from the spent fuel rod or assembly that initially caught fire to other assemblies—and cause the release of large quantities of radioactive materials to the environment.[44] Following the completion of the NAS Report, Congress directed NRC to develop site-specific mitigation models for different spent fuel sites.[45]

B. Leaks

Although NRC has described spent fuel pools as "leak tight," the experience has shown that description to be inaccurate. In 2005, Indian Point identified leakage of radionuclide-contaminated water from cracks in two different spent fuel pools and subsequently discovered tritium, strontium, and other radionuclides in groundwater underneath the site.[46] Strontium and tritium from Indian Point's spent fuel pools have reached the Hudson River.[47]

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[43] *Id.* at 8.
[44] *Id.* at 38-39, 48.
[45] U.S. Congress, Conference Report 108-792, *Making Appropriations for Foreign Operations, Export Financing, and Related Programs for the Fiscal Year Ending September 30, 2005, and For Other Purposes,* at 982 (Nov. 20, 2004).
[46] Nuclear Regulatory Commission, NRC Talking Points Slide Entitled, "Tritium at Nuclear Power Plants in the United States, Slide 3: Background," ML063260464 (Nov. 7, 2006); Nuclear Regulatory Commission Office of Nuclear Reactor Regulation, *Ground-Water Contamination Due to Undetected Leakage of Radioactive Water*, NRC Information Notice 2006-13, at 3-4 ("*Ground-Water Contamination*") ML060540038 (July 10, 2006).
[47] *Ground-Water Contamination* at 3-4; Entergy, Indian Point License Renewal Application, Environmental Report at 5-4, ML071210530 (Apr. 23, 2007).

Existing radioactive leaks at Indian Point have already far exceeded national drinking water standards.[48] All fresh groundwater in New York State is Class GA, the best use of which is as a source of potable water supply.[49] Indian Point groundwater concentrations have exceeded national drinking water standards for tritium in six locations, sometimes by more than four times the tritium concentrations considered harmful to human health, and exceed national drinking water standards for Strontium-90 in ten locations, by almost five times in some locations.[50]

While NRC has recently acknowledged tritium leaks, it has been reluctant to acknowledge leaks of strontium and other radionuclides. In November 2010, the State of New York sought to draw the Commission's attention to the fact that radionuclides in addition to tritium have leaked from reactors.[51] Moreover, the subsurface radiation plumes have exceeded EPA drinking water standards.[52] The concerns outlined in the State's 2010 letter further support treating groundwater contamination as a site-specific environmental impact.

In 2002, water from a spent fuel pool at Salem Nuclear Power Plant in New Jersey was discovered to have leaked into a narrow seismic gap between two buildings, and further investigation revealed tritium in the groundwater near one of

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[48] *See* GZA GeoEnvironmental, Inc., *Hydrogeologic Site Investigation Report, Indian Point Energy Center*, at 90, 126, ML080320540 ("*GZA Report*") (Jan. 7, 2008); *see also* 40 C.F.R. § 141.66 (establishing drinking water standard for tritium at 20,000 pCi per liter and strontium at 8 pCi per liter).
[49] 6 N.Y.C.R.R. § 701.15.
[50] *GZA Report* at 125-26.
[51] State of New York Comment Letter on Groundwater Task Force Report, Docket ID NRC-2010-0302, 75 Fed. Reg. 57987 (Nov. 1, 2010) ML103080060.
[52] *Id.*

the buildings.[53] These leaks occurred during the reactors' initial licensing term, calling into question the structural integrity of spent fuel pools as many reactors approach the end of their initial terms and seek license renewals.

Radioactive water has also leaked from spent fuel pools at the Seabrook Nuclear Power Station in Seabrook, New Hampshire in 1999, at the Tennessee Valley Authority's Watts Bar Nuclear Generating Station in Spring City, Tennessee in 2002, and at Palo Verde Nuclear Generating Station, Unit 1 in Wintersburg, Arizona in 2005.[54]

In 1997, groundwater samples taken by Brookhaven National Laboratories in Long Island, New York revealed concentrations of tritium at twice the allowable federal drinking-water standards.[55] Subsequent samples were found to contain thirty-two times the standard.[56] The tritium was leaking from the spent fuel pool serving the laboratory's nuclear reactor into the aquifer that provides the sole source of drinking water for nearby Suffolk County residents.[57] The Department of Energy's and laboratory's investigations concluded that the tritium had been leaking for as long as twelve years without the Department's or laboratory's

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53 Nuclear Regulatory Commission Office of Nuclear Reactor Regulation, *Spent Fuel Pool Leakage to Onsite Groundwater*, NRC Information Notice 2004-05 (Salem, New Jersey, Nuclear Generating Station), ML040580454 (Mar. 3, 2004).

54 Nuclear Regulatory Commission, *Liquid Radioactive Release Lessons Learned Task Force Final Report*, at 9, 24, and 35, ("*Radioactive Release Lessons Learned*") ML062650312 (Sept. 1, 2006).

55 General Accounting Office, Report to Congressional Requesters, Department of Energy, *Information on the Tritium Leak and Contractor Dismissal at the Brookhaven National Laboratory* (GAO/RCED-98-26), at 1-9 ("*Tritium Leak and Contractor Dismissal*")(Nov. 1997).

56 *Id.* at 4.

57 *Id.* at 7-9; 43 Fed. Reg. 26,611, 26,612 (June 21, 1978) (EPA designation of sole source aquifer).

knowledge.[58] A subsequent federal investigation concluded that Brookhaven employees did not aggressively monitor its spent fuel pool for leaks—even postponing an agreed-upon monitoring-well system—so that years passed before tritium contamination was discovered in the aquifer near the spent fuel pool.[59]

In 1986, in an "acute unmonitored release of large volumes of contaminated liquids to onsite ground surfaces and surface waters," 124,000 gallons of water containing 0.20 curies of tritium and 0.373 curies of mixed fission products leaked from the spent fuel pool at the Edwin I. Hatch nuclear power plant in Baxley, Georgia to a nearby swamp and into the Altamaha River.[60] The plant's owner did not calculate the maximum possible offsite doses, because no regulation required it to do so, but NRC found that the accident "demonstrated a lack of insistence on procedural adherence and attention to detail." and levied a civil monetary penalty.[61]

NRC acknowledged this Hatch leak in its 1990 waste confidence findings and also that on August 16, 1988 a seal on a fuel pool pump failed at the Turkey Point nuclear plant near Miami, Florida causing approximately 3,000 gallons of radioactive water to leak into a nearby storm sewer, contaminating the shoes and clothing of approximately 15 workers.[62]

NRC recently acknowledged that "leaks can develop in [spent fuel pools] and go undetected for long periods of time absent appropriate monitoring, resulting in the contamination of onsite groundwater and the potential for undetected,

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[58] *Tritium Leak and Contractor Dismissal* at 9.
[59] *Id.* at 9-12.
[60] *Radioactive Release Lessons Learned* at 5, 14; 55 Fed. Reg. 38474 (page 54) (Sept. 18, 1990).
[61] *Radioactive Release Lessons Learned* at 34.
[62] 55 Fed. Reg. 38474, (p. 54) (Sept. 18, 1990).

unevaluated releases of radioactivity to an unrestricted area."[63] The NRC has also acknowledged that its current regulations do not require groundwater monitoring and that licensees typically initiate groundwater monitoring only in response to known leaks.[64] But NRC has not required plants to monitor for, assess, or remediate leaks, instead relying on voluntary initiatives undertaken by industry.[65]

VI. Significant New Information Regarding Spent Fuel Pools

The past two years have seen several developments involving the storage of spent nuclear fuel that NRC should take into consideration in the Proposed Rule and the Proposed GEIS. CEQ regulations, to which NRC gives deference, and NEPA caselaw recognize that over time new information may become available that should be factored into the decision-making process or used to update a previous EIS. Agencies must supplement a previously issued EIS when "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts."[66] Similarly, when new information comes to light over the course of a rulemaking, the federal agency should ensure that such information is taken into account in the rulemaking

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[63] *Ground-Water Contamination* at 5.
[64] *Id.* at 5-6.
[65] Nuclear Regulatory Commission, *Senior Management Review of Overall Regulatory Approach to Ground Water Protection,* SECY-11-0019 (Feb. 9, 2011); *Ground-Water Contamination* at 5-7.
[66] 40 C.F.R. § 1502.9(c). *See also Marsh v. Oregon Natural Resources Council,* 490 U.S. 360, 374 (1989) ("If there remains major Federal action to occur, and if the new information is sufficient to show that the remaining action will affect the quality of the human environment in a significant manner or to a significant extent not already considered, a supplemental EIS must be prepared" (internal citations omitted)).

process and that any resulting NEPA rulemaking does not impede consideration of such information in site-specific regulatory proceedings.

Since the issuance of the 1996 GEIS for license renewals, NRC Staff has employed a very narrow definition of what constitutes significant information. According to NRC Staff, to date, there have been 71 applications to renew the operating licenses of power reactors and though much new information has been presented to NRC Staff, none of it has been deemed significant by Staff.[67] Moreover, as the colloquy during the January 11, 2012 meeting made clear, with respect to severe accidents, Staff's position is not that real world consequences and environmental impacts of such accidents would be insignificant, but rather that there is a low probability that precursor accidents will occur. Based on this supposed low probability, the Staff then categorizes the environmental impacts from severe reactor accidents as "small."[68] But NRC's characterization of severe accidents as "small" ignores the significant consequences that would ensue if a severe accident were to occur. The reports and photographs of the consequences of Fukushima's multi-reactor accidents depict impacts that were anything but "small." NRC's logic is simply no longer tenable in a NEPA review of the site-specific environmental impacts associated with issuing an operating license.

In the Indian Point license renewal proceeding, Staff has used the GEIS's statement that severe accidents could result in "small" environmental impacts to oppose and minimize the review of alternatives to mitigate the site-specific

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[67] *January 2012 GEIS Briefing Transcript* at 85.
[68] *Id.* at 80-81.

environmental impacts flowing from severe accidents at the Indian Point facilities—the most densely populated reactor and spent fuel pool site in the nation, a site located 5 miles from a reservoir in New York City's drinking water system, and near the Nation's financial center.[69] Not only is this practice not tenable in the face of NRC's conclusion that severe accidents warrant *site-specific* analysis, but it inconsistent with the Entergy's revised environmental analysis that identified at least 20 upgrades to the facilities that would mitigate the impacts of severe accidents at Indian Point and are potentially cost beneficial.

The destruction of four GE-designed reactors at Fukushima-Daiichi in March 2011 shows that severe accidents are neither improbable nor are the environmental impacts of severe accidents at power reactors or spent fuel pools "small." The consequences of those severe accidents, including the radiological contamination of portions of Fukushima Prefecture, show that the real world consequences of severe accidents are not "small." In light of the Fukushima accidents, recent regulatory actions and statements, and newly released documents, the State believes that NRC should consider the information contained herein to be significant because it shows that NRC was operating under different assumptions about the environmental impacts of relicensing when it prepared the 1996 GEIS and when it drafted the revised draft GEIS.

[69] The Indian Point power reactors and spent fuel pools are 5 miles west of the New Croton Reservoir in Westchester County, which provides drinking water to New York City. They are also 24 miles north of New York City, 35 miles from Times Square, and approximately 38 miles from Wall Street.

A. Yucca Mountain Repository Project Formally Abandoned and Temporary Storage Rule Modified

In 2009, the federal government announced that the long awaited nuclear repository at Yucca Mountain, Nevada, was no longer a viable option.[70] Subsequently, in March 2010, the Department of Energy ("DOE") submitted to NRC a request to withdraw its license application for the Yucca repository.[71] Although the NRC's Atomic Safety and Licensing Board ("Board") denied DOE's request,[72] the decision was appealed and, after an evenly divided vote, the Commission ordered the Board to suspend its review by the end of fiscal year 2011, due to lack of funding for the upcoming fiscal year.[73] In its final report, the federal Blue Ribbon Commission noted:

> The Obama Administration's decision to halt work on a repository at Yucca Mountain in Nevada is but the latest indicator of a policy that has been troubled for decades and has now all but completely broken down. The approach laid out under the 1987 Amendments to the Nuclear Waste Policy Act (NWPA)—which tied the entire U.S. highlevel waste management program to the fate of the Yucca Mountain site—has not worked to produce a timely solution for dealing with the nation's most hazardous radioactive materials. The United States has traveled nearly 25 years down the current path only to come to a point where continuing to rely on the same approach seems destined to bring further controversy, litigation, and protracted delay. . . . Put simply, this nation's failure to

[70] Nuclear Regulatory Commission, Draft Report for Comment, *Background and Preliminary Assumptions For an Environmental Impact Statement—Long-Term Waste Confidence Update, at 2,* ML11340A141 (Dec. 2011).
[71] Dep't of Energy Motion to Withdraw, *In re U.S. Dep't of Energy (High–Level Waste Repository),* Docket No. 63–001, ASLBP No. 09–892–HLW–CAB04 (United States Nuclear Regulatory Commission), ML100621397 (Mar. 3, 2010).
[72] HLW License Application Docket No. 63-001, Board Memorandum and Order (LBP-10-11), ML101800299, (June 29, 2010).
[73] HLW License Application Docket No. 63-001, Commission Memorandum and Order (CLI-11-07), ML11252A532 (Sept. 9, 2011). *See also* Memorandum from Catherine Haney, Director, Office of Material Safety and Safeguards, to Commission, *Update on the Yucca Mountain Program,* ML11180A265 (Sept. 1, 2011) (stating that the Yucca Mountain Program is on track to complete the closure of the Yucca Mountain licensing review by the end of Fiscal Year 2011).

come to grips with the nuclear waste issue has already proved damaging and costly and it will be more damaging and more costly the longer it continues . . . .[74]

With little prospect of a central repository or disposal site for decades to come, spent nuclear fuel continues to accumulate at nuclear plants around the country. Currently, there is an inventory of approximately 65,000 metric tons of spent fuel from commercial nuclear plants, the majority of which is being stored in pools at those plants, and this inventory is growing at a rate of 2,000 to 2,400 metric tons per year.[75] In December 2010, NRC modified its temporary storage rule that precludes the analysis of the environmental impacts of storing spent nuclear fuel from the cessation of power generation to 60 years beyond that date.[76]

The abandoning of the Yucca Mountain repository project and the extending of the temporary storage rule show that the problem of long-term storage of spent fuel in on-site pools is not going to improve any time soon.[77] The Blue Ribbon Commission concluded, "Simply put, it will take years to more than a decade to open one or more consolidated storage facilities and even longer to open one or more disposal facilities. This means that storage of substantial quantities of spent fuel at

[74] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy, at vi ("*Blue Ribbon Commission Report*") (Jan. 2012).

[75] Blue Ribbon Commission on America's Nuclear Future, Disposal Subcommittee, Draft Report to the Full Commission, at 2 (June 1, 2011). Even if the Yucca Mountain disposal site had been licensed and constructed, it could not hold more than 70,000 metric tons of waste.

[76] 75 Fed. Reg. 81037 (Dec. 23, 2010).

[77] Please note, these comments do not challenge the updated Waste Confidence Decision or the Long Term Waste Confidence process, but rather, take those NRC actions into account and focus on the environmental impacts during the period of operation, including the 20 year license renewal period. Various petitioners, including the State of New York, are elsewhere seeking judicial review of the December 2010 NRC Rulemaking. State of New York v. NRC, D.C. Cir. no. 11-1045(L).

operating reactor sites can be expected to continue for some time."[78] The NRC must take this fact into consideration when extending the licenses of nuclear plants because such extensions will only increase the amount of spent fuel stored in pools at those plants, increasing the risk of zirconium fires. The reality of the situation, demonstrated by these developments, is that the U.S. does not have a comprehensive policy for spent nuclear fuel, and is far from establishing one.

The State disagrees with NRC Staff that the availability of a repository should be considered only in the context of the Waste Confidence Decision and not in the GEIS for license renewal. The Waste Confidence Decision looks only at whether there is a reasonable assurance that an off-site disposal solution will be available by the expiration of a plant's operating license. However, whether or not there is a repository affects the storage of spent nuclear fuel during the relicensing period as well. Moreover, 10 C.F.R. § 51.23(c) does not exempt NRC from considering the environmental impacts of spent fuel storage during the term of a reactor operating license. Without a repository, spent fuel will continue to be densely stored in pools during the relicensing period, and every time the reactor core is offloaded into the pool during that 20 year period, the risk of a zirconium fire increases as a result of the substantial thermal energy emitted by the newly-discharged fuel. It is this 20-year term of the renewed operating license during which newly-discharged fuel is added to the spent fuel pools at regular intervals that is the focus of the revised GEIS and these supplemental comments. If a repository was available or if the transfer of spent fuel from pools to dry cask

[78] *Blue Ribbon Commission Report* at 44.

storage was increased, the volume of spent fuel in the pools could be reduced and the risk of zirconium fire during the relicensing period could be lessened or mitigated. Thus, the unavailability of a repository and the alternative of moving spent fuel to dry cask storage is also significant for the relicensing period and any revised GEIS should clearly provide that such issues must be considered on a site-specific basis.

B. External Events in Japan and Virginia

The draft revised GEIS claims that "[t]he expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on-site with small environmental effects through dry or pool storage at all plants, if a permanent repository or monitored retrievable storage is not available."[79] However, the recent earthquakes in Japan and Virginia present significant new information that put this finding into question and reaffirm the importance of site-specific evaluation of spent fuel pool risks.

1. Fukushima Daiichi

On March 11, 2011, the Japanese earthquake and tsunami led to the largest nuclear disaster since the Chernobyl accident in 1986.[80] A 100 square mile zone around the Fukushima Daiichi nuclear facility was evacuated, and, a year later, at

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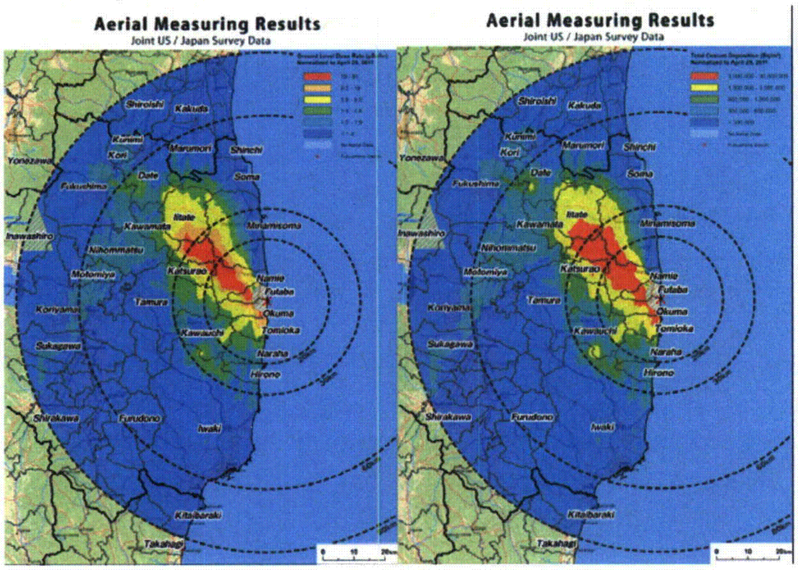
[79] Nuclear Regulatory Commission, *GEIS for License Renewal, Draft Report for Comment*, Vol. 1, at S-17, ML091770049 ("*Draft GEIS for License Renewal*") (July 2009).

[80] The Fukushima nuclear disaster has been rated as a 7 on the International Atomic Energy Agency's ("IAEA") International Nuclear and Radiological Event Scale ("INES").[80] Level 7, the most serious level on the INES scale, constitutes a "major accident." It is described as "A major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures." IAEA, Fukushima Nuclear Accident Update, (Apr. 12, 2011), *available at*: http://www.iaea.org/newscenter/news/2011/fukushima120411.html.

least 80,000 people remain displaced from their homes.[81] The Japanese Environment Ministry plans to decontaminate only two-thirds of the evacuation zone, as radiation levels in the last third of the zone are too high to be brought down to safe levels with current technology.[82]

In the weeks following the disaster, the U.S. Department of Energy and the National Nuclear Security Administration prepared maps depicting the ground level dispersion of radionuclides in Fukushima Prefecture. While these maps show large areas of ground contamination, they do not depict the dispersion of radionuclides in the groundwater, rivers, or ocean.



The image on the left shows the ground level dose rate of cesium in Japan normalized to April 29, 2011. The image on the right shows the total cesium deposition normalized to the same date. Source: U.S. DOE and NNSA,

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[81] Hiroko Tabuchi, A Confused Nuclear Cleanup, New York Times (Feb. 10, 2012), *available at*: http://www.nytimes.com/2012/02/11/business/global/after-fukushima-disaster-a-confused-effort-at-cleanup.html?pagewanted=1&_r=1.

[82] Martin Fackler, Japan: Nuclear Contamination Cleanup Near Stricken Plant to Start in Spring, New York Times (Jan. 26, 2012), *available at*: http://www.nytimes.com/2012/01/27/world/asia/japan-nuclear-contamination-cleanup-near-stricken-plant-to-start-in-spring.html?_r=1

Radiological Assessment of Effects From Fukushima Daiichi Nuclear Power Plant, (May 6, 2011).

Each of Fukushima Daiichi's 6 reactor units has a spent fuel pool, in addition to one common larger pool shared by all 6 units.[83] The spent fuel cooling flow was lost for all units following the loss of power, and it was not restored when the emergency generators started.[84] In addition, workers were unable to monitor the spent fuel pools.[85] There are unconfirmed reports that shaking of the earthquake caused loss of pool water, and the hydrogen explosions at one or more of the units may have caused additional water loss.[86] Spent fuel may also have been damaged by falling debris.[87]

After a hydrogen explosion at Unit 4, operators feared that the water had boiled off of the fuel assemblies in Unit 4's pool because the entire core of the Unit 4 reactor had been off-loaded into the pool for maintenance three months earlier.[88] The responders faced very challenging conditions at the plant, making it difficult to assess the status of the pool. Equipment was non-functional, parts of the plant were inaccessible, supplies of fresh water were interrupted, and there was high

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[83] Institute of Nuclear Power Operations, Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station, INPO 11-005, at 35, ML11347A454 ("*INPO Report*") (Nov. 2011). It should be noted that the pools at each of Fukushima's 6 units contain much less spent fuel than pools at typical U.S. plants. Nuclear Regulatory Commission, *Recommendations for Enhancing Reactor Safety in the 21st Century*, at 43, ML111861807 ("*Near-Term Task Force Report*") (July 12, 2011).
[84] *Id.* at 12.
[85] *Near-Term Task Force Report* at 9.
[86] *Id.* at 36.
[87] *Id.* at 37.
[88] *Id.* at 36. The cause of the explosion has not yet been conclusively established; at present, NRC Staff is pursuing a hypothesis that the explosion was not caused by the spent fuel, but by hydrogen from Unit 3 that had entered Unit 4 through the ventilation system.

radiation, high temperature, smoke, steam, and debris.[89] Fire engines, helicopters, and water cannons were all unable to add water to the spent fuel pool.[90] Finally, on March 18, concrete pumping trucks (with long articulated booms for transferring concrete) successfully added water to the pools. The Institute of Nuclear Power Operations ("INPO") notes, "The delay in refilling the SFPs may have contributed to increased radiation levels in the area around the spent fuel pools because less shielding was provided with the reduced water level."[91]

Several reports have discussed the significant new information generated by the Fukushima accident. On April 19, 2011, Dr. Arjun Makhijani of the Institute for Energy and Environmental Research submitted to NRC a declaration in support of an emergency petition to suspend all pending reactor licensing decisions pending investigation of the lessons learned from the Fukushima disaster.[92] Dr. Makhijani outlined the significant new information that has come out of the Fukushima accident including: the unanticipated compounding effects of simultaneous accidents at multiple co-located reactor units, including spent fuel pools; the unanticipated risks of spent fuel pool accidents, including explosions; the frequency of severe accidents and explosions; the inadequacy of safety systems to respond to

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[89] Gordon R. Thompson, *New and Significant Information From the Fukushima Daiichi Accident in the Context of Future Operation of the Pilgrim Nuclear Power Plant*, A Report for the Office of the Attorney General, Commonwealth of Massachusetts, at 18 ("*Thompson 2011 Report*") (June 1, 2011).
[90] *INPO Report* at 36.
[91] *Id.*
[92] Declaration of Dr. Arjun Makhijani in Support of Emergency Petition to Suspend all Pending Reactor Licensing Decisions and Related Rulemaking Decisions Pending Investigation of Lessons Learned from Fukushima Daiichi, ML111091181 (Apr. 19, 2011).

long-duration accidents; and the health effects and costs of severe accidents.[93] Makhijani highlighted the unprecedented nature of the accident, noting, "In the entire history of nuclear power, there has not been another major accident (level 5 or above) that has involved multiple major sources of radioactivity—including multiple reactors and multiple spent fuel pools."[94] He asserted that the information from the simultaneous system failures at Fukushima should be used by NRC to evaluate the safety and environmental implications of co-locating multiple reactors and spent fuel pools.

Similarly, in the relicensing proceeding for the Pilgrim nuclear power plant in Massachusetts, Dr. Gordon R. Thompson of the Institute for Resource and Security Studies submitted a report in June 2011 discussing the significant new information coming from Fukushima.[95] Thompson explained that the "Fukushima experience shows clearly that the operators' capability to mitigate an accident . . . can be severely degraded in the accident environment."[96] One example of this was the operators' inability to add water to Unit 4's spent fuel pool for several days following the hydrogen explosion.

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[93] *Id.* at 5.
[94] *Id.* at 6. The Near-Term Task Force acknowledged that before the Fukushima accident, NRC had not anticipated an accident involving multiple units and spent fuel pools. In a May briefing one member stated, "Also, if you look at the way that we've analyzed accidents in the United States and the way that we deal with them, it really focused on a single unit being affected. Fukushima is a situation where multiple units were affected at the same time. So our EP [emergency preparedness] requirements focus on a single unit event . . . And if you're dealing with a multiple unit event at the same time, you have considerations with regard to adequate staffing, how to triage, who makes the decisions on how to triage, and how you go about proceeding with what you need to do first." Nuclear Regulatory Commission, Briefing on the Task Force Review of NRC Processes and Regulations Following the Events in Japan, Transcript of Proceedings, at 19-20, ML111360513 (May 12, 2011).
[95] *See Thompson 2011 Report.*
[96] *Id.* at 20.

In October 2011, the NRC Advisory Committee on Reactor Safeguards ("ACRS") acknowledged that the Fukushima accident has provided new information regarding the hazards posed to spent fuel pools by falling debris.[97] It noted, "The Fukushima accident clearly demonstrates that hydrogen combustion events can cause significant structural damage. Such damage can also cause debris to fall into the spent fuel pools with subsequent potential ramifications not heretofore considered."[98] The ACRS found that the leaching of the debris may change the pool water chemistry, causing the aluminum racks to corrode and eventually degrading their integrity.[99] It also noted, "These events at Fukushima have reminded us that spent fuel pools at nuclear power plants can be contributors to the overall risk posed by the plants."[100]

Various other organizations and individuals have pointed out the lessons to be learned from the Fukushima accident. For example, Allison MacFarlane, a Blue Ribbon Commission member, wrote an article in the *Bulletin of the Atomic Scientists*, arguing, "In light of Japan's nuclear disaster, a major lesson can be learned related to the back end of the fuel cycle: Planning is necessary for the safe and secure management of spent nuclear fuel and nuclear waste."[101] Former NRC Commissioner Victor Gilinsky wrote in the *New York Times*: "[F]ederal regulators

[97] Advisory Committee on Reactor Safeguards, Initial Review of: (1) the Near-Term Task Force Report on Fukushima and (2) Staff's Recommended Actions to be Taken Without Delay, at 7 ML11284A136 ("*ACRS Review*") (Oct. 13, 2011).
[98] *Id.*
[99] *Id.* at 9.
[100] *Id.* at 10.
[101] Allison Macfarlane, It's 2050: Do you know where your nuclear waste is?, Bulletin of Atomic Scientists, 67(4), 30-36 (2011).

have yet to absorb the lessons from this crisis" and pointed out the dangers of a Fukushima-like accident at Indian Point.[102] Additionally, the Natural Resources Defense Council ("NRDC") released a document warning, "An accident at one of Indian Point's reactors on the scale of the recent catastrophe in Japan could cause a swath of land down to the George Washington Bridge to be uninhabitable for generations due to radiation contamination."[103]

Furthermore, the findings of the Near-Term Task Force support the argument that the Fukushima accident provides significant new information that must be considered in the revised GEIS. "The Task Force concluded that the Fukushima Dai-ichi accident . . . provides new insights regarding low-likelihood, high-consequence events that warrant enhancements to defense-in-depth on the basis of redefining the level of protection that is regarded as adequate."[104] In short, based on the information from the Fukushima accident, the Task Force found that NRC should create new regulations to protect against occurrences that it previously characterized as having "small impacts" due to their low probability. Fukushima has shown that low probability, high consequence events do occur and therefore, they must be considered and measures must be taken to mitigate their potential consequences. In acknowledging this fact and suggesting measures to mitigate such dangers, the Task Force Report constitutes significant new information that must be considered in this proceeding.

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102 Victor Gilinsky, Indian Point: The Next Fukushima?, New York Times (Dec. 16, 2011).
103 Natural Resources Defense Council, Nuclear Accident at Indian Point: Costs and Consequences, (Oct. 2011), *available at*: http://www.nirs.org/reactorwatch/aging/nrdcaccidentip1011.pdf
104 *Near-Term Task Force Report* at viii.

The Fukushima accident and the recommendations of the Task Force also show that site-specific factors must be taken into consideration with regard to accidents involving spent fuel pools. The different characteristics of each pool affect the chances of a radionuclide release and the appropriate response to prevent a release. At Fukushima's boiling water reactors, the spent fuel pools are located high up in the reactor buildings, making it difficult for water to be added in an emergency, "[h]owever, TEPCO's approaches to adding water to pools revealed a lack of preparation for this contingency."[105] Responding to the site-specific problems at Fukushima, "many of the actions recommended in the Task Force report have plant-specific features, and therefore require plant-specific regulatory attention."[106] For example, the Task Force recommends that plants install "seismically qualified means to spray water into the spent fuel pools."[107] Such means will vary due to site-specific factors such as the location of the spent fuel pool. Additionally, the ACRS noted:

> The vulnerabilities of spent fuel pools under accident conditions and the need for measures to assure adequate coolant levels are design specific. . . . Staff should initiate a request for information for licensees to document details such as their current plant-specific spent fuel pool instrumentation, sources of spent fuel pool makeup and cooling, power supplies, contingencies and procedures for alternate makeup sources, etc. This information would better inform subsequent staff efforts and would help focus industry communications with respect to these issues.[108]

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[105] *Thompson 2011 Report* at 19. The boiling water reactor design was developed by the federal government's Idaho National Laboratories and the General Electric Company in the 1950's.
[106] Gordon R. Thompson, Declaration of Gordon R. Thompson Addressing New and Significant Information Provided by the NRC's Near-Term Task Force Report on the Fukushima Accident, at 2, ML11223A283 (Aug. 11, 2011).
[107] *Near-Term Task Force Report* at 46. This proposal is similar to a recommendation made by the National Academy of Sciences back in 2006. *NAS Report* at 55.
[108] *ACRS Review* at 10.

The Fukushima disaster also highlighted the importance of safety-related systems for spent fuel pools. According to a Near-Term Task Force member,

> Typically the spent fuel pool makeup and cooling systems in the United States are not safety-related systems. Loss of cooling in the spent fuel pool was expected to be a very slow-evolving, non-design basis accident situation. So the requirements for those systems are less stringent than they are for other systems addressing design basis accidents.[109]

For this reason, the Task Force recommendations include measures such as providing safety-related AC electrical power for pools and installing safety-related instrumentation to monitor the pools from the control room that can withstand design-basis natural phenomena. The GEIS must take into consideration the fact that pools are not currently equipped with such safety-related systems, an omission that increases their vulnerability. The GEIS should also acknowledge that NRC's Appendix R fire safety regulations (promulgated in the wake of the Brown Ferry fire) do not extend to spent fuel pool facilities. The GEIS should require the review of such issues and alternatives in license renewal proceedings.

The Blue Ribbon Commission recommended that the National Academy of Sciences ("NAS") conduct its own separate assessment of the lessons learned from Fukushima and the implications of these lessons for the conclusions reached in earlier NAS studies on the safety and security of spent nuclear fuel.[110] As part of this assessment, the Commission suggested that NAS conduct "an analysis of the

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[109] Comments of Jack Grobe Deputy Director of the Office of Nuclear Reactor Regulation, before Advisory Committee on Reactor Safe Guards, Fukushima Subcommittee, at 87, ML11229A243 (Aug. 16, 2011).

[110] *Blue Ribbon Commission Report* at 44.

advantages and disadvantages of moving spent fuel from densely packed pools to on-site dry cask storage to facilitate low-density packing in the pools."[111] However, the Near-Term Task Force report did not address this issue. When asked by Commissioner Ostendorff why this issue was not included, Task Force members replied that it was not clear what exactly happened to the spent fuel pools at Fukushima, that there was no "overwhelming evidence that the fuel would be safer outside of the pool than in it," and that their recommendations enhance pool safety more than removing fuel would.[112] However, Task Force members failed to acknowledge that dry cask storage has numerous safety advantages over pool storage[113] and that some of the safety measures they recommended are necessary because of the dense-storage of fuel in U.S. spent fuel pools. In short, the recommendations deal with symptoms of the problem (e.g., the rapid heat up of densely packed spent fuel once water is removed from the pool) but do not offer alternatives or solutions to the problem itself. Even NRC Staff recognized that the transfer of spent fuel to dry cask storage has "a clear nexus to the Fukushima Daiichi event [and] may warrant regulatory action but [was] not included with the NTTF recommendations."[114]

It also appears that the Commissioners were not informed that Sandia National Laboratories has recently acknowledged that reducing the volume of spent

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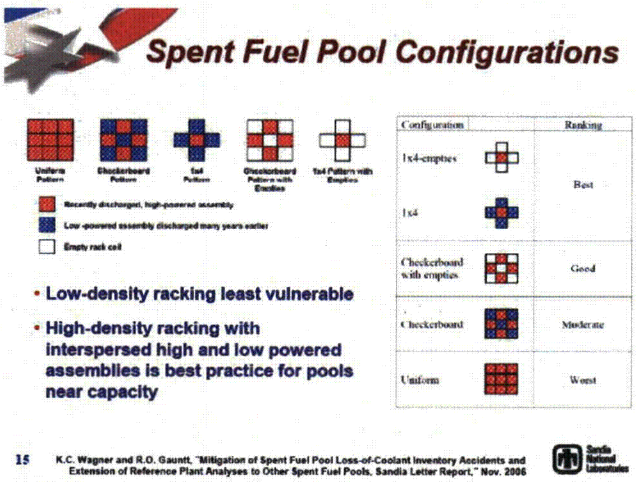
[111] *Id.*

[112] Nuclear Regulatory Commission, Briefing on the Task Force Review of NRC Processes and Regulations Following the Events in Japan, Transcript of Proceedings, at 36-37, ML112020051 (July 19, 2011).

[113] *NAS Report* at 70.

[114] Nuclear Regulatory Commission, SECY-11-0317: Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned, at 5, ML11269A204 (Oct. 3, 2011).

fuel in spent fuel pools would mitigate the risks posed by dense storage. On February 7 and 8, 2012, NRC Staff made publically available three documents discussing the safety of spent fuel pools. The first is a slideshow explaining the findings of a study conducted by Sandia National Laboratories, which investigated zirconium fires during spent fuel pool loss of coolant accidents ("LOCAs").[115] The study found that low density racking is the spent fuel configuration that is least vulnerable to zirconium fires.[116]



The disclosure of this study and its conclusion constitute significant new information because it is now clear that federal laboratories recognize that safer options are available for the storage of spent nuclear fuel. This recognition and the alternative of reducing the volume of waste stored in pools must be considered when NRC Staff examines the alternatives to the proposed federal action authorizing a 20-year extension of a facility's operating license. NRC should require the review of such alternatives, not issue a GEIS or promulgate regulations under NEPA that

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[115] Samuel G. Durbin and Eric R. Lindgren of Sandia National Laboratories, Investigations of Zirconium Fires During Spent Fuel Pool LOCAs (Slideshow), ML120380359 (Feb. 7, 2012).
[116] *Id.* at slide 15.

precludes the review of such alternatives.

The next two recently released documents are a speech and slideshow presented by Michael Weber, NRC's Deputy Executive Director for Operations, at the U.S. Nuclear Infrastructure Council Meeting on January 31, 2012.[117] These documents discuss NRC's response to the Fukushima accident, focusing in particular on spent fuel pools. Director Weber acknowledged that the pools were not designed for the long-term storage of spent nuclear fuel, that zirconium fires can occur in pools, and that the consequences of a zirconium fire could be very large.[118] Furthermore, he stated that since the fuel pools are located outside of the primary containment that houses the reactor, a release of radionuclides from the pool can reach the environment much more easily than a release from the reactor core.[119] Director Weber further acknowledged that thinning the spent fuel pools would reduce the potential land contamination and economic impacts if a large release occurred.[120] He stated that due to the threat of zirconium fires, NRC is studying the benefits of removing spent fuel to achieve lower fuel density in the pools. Additionally, Mr. Weber disclosed that NRC Staff is currently conducting a Spent Fuel Pool Scoping Study to assess the impacts of thinning the pools.[121] This development reflects NRC's new understanding of the risks posed by spent fuel pools, due in large part to the events at Fukushima. The State believes this new

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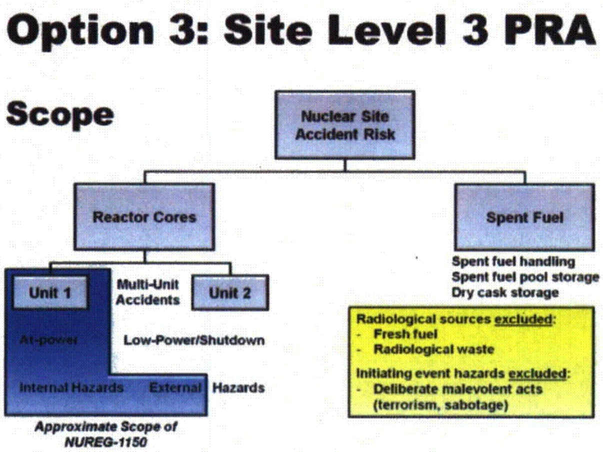
[117] Michael Weber, Responding to Fukushima-Daiichi (Speech), ML12037A072 ("*Weber Speech*") (Jan. 31, 2012); Michael Weber, Responding to Fukushima-Daiichi (Slideshow), ML120310267 ("*Weber Slideshow*") (Jan. 31, 2012).
[118] *Weber Speech* at 4-5.
[119] *Id.* at 4.
[120] *Weber Slideshow* at slide 20.
[121] *Weber Speech* at 5.

understanding must be reflected in the revised GEIS for license renewal.

In the wake of the Fukushima disaster, NRC is considering conducting site-specific reviews of the risks involved with spent fuel pools as part of a Level 3 Probabilistic Risk Assessment ("PRA"). In the policy position paper on options for PRA activities, NRC wrote, "To be complete, estimation of total site accident risk should also include an assessment of the risk from accidents involving other site radiological sources, to include spent nuclear fuel."[122] The scope of the proposed PRA is depicted in the diagram below.[123]



In a July 28, 2011 public meeting on PRA activities, Commissioner Apostolakis observed:

> It seems to me that a major change in the way that we think about things . . . after Fukushima, is that we really have to talk about the site risk. We should start talking about site years rather than reactor years. So that is probably a major change.[124]

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[122] Nuclear Regulatory Commission, *Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities*, SECY-11-0089, at 6, ML11090A042 (July 7, 2011).
[123] Figure taken from slides prepared by NRC Staff: Nuclear Regulatory Commission Office of Nuclear Regulatory Research, *Severe Accidents and Options for Proceeding with Level 3 PRA Activities*, ML11209B927 (July 28, 2011).
[124] *Id.* at 83. Also in that meeting, Stuart Lewis, Program Manager for Risk and Safety Management, Electric Power Research Institute, Inc., said, "[W]e have started to do some

During the same meeting, NRC Chairman Jaczko stated:

> I think that there's no question that the state of the art has improved significantly over the last two decades and that there are new issues that perhaps should be examined through the completion of Level 3 PRAs. As the staff notes in their paper, those include issues raised by the Fukushima accident, specifically the challenges posed by multi-unit events in the risks of radiological releases from spent fuel pools.[125]

The State supports a comprehensive and realistic analysis of the risks posed by spent fuel pools and requests that such a review be brought into the site-specific NEPA review that accompanies the review of an application to renew an existing nuclear power plant's operating license. Taking site-specific spent fuel pool risks into consideration gives a more realistic view of the potential environmental impacts of relicensing.

2. North Anna, Virginia

On August 23, 2011, a 5.8 magnitude earthquake occurred in Virginia with the epicenter located approximately 11 miles from the North Anna Power Station. The earthquake exceeded the spectral and peak ground accelerations that the plant was built to withstand and the plant temporarily lost power.[126] The tremor was felt in various northeast cities, including Washington and New York. While initial review by North Anna's owner concluded that there was no major damage to the reactors or spent fuel pools, the incident highlighted the fact that U.S. nuclear

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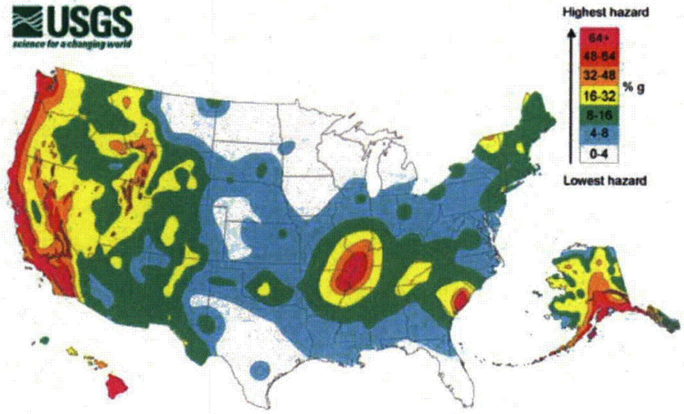
investigations that lead us to believe there is more that ought to be done in the area of understanding spent fuel pool risk . . . " *Id.* at 26.

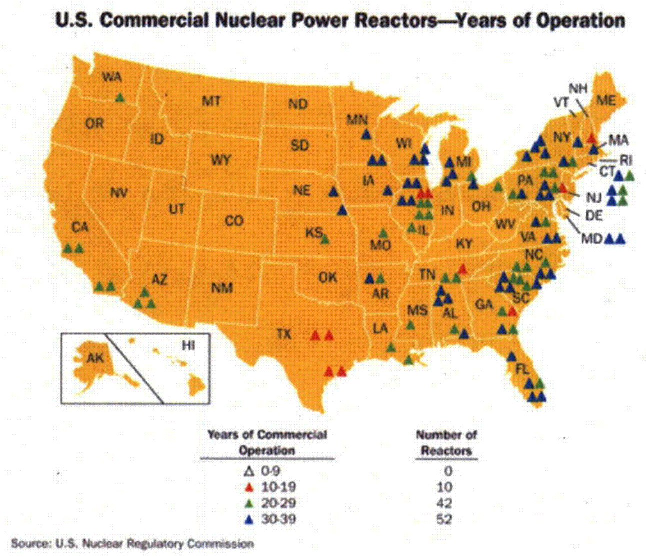
125 Nuclear Regulatory Commission, *Briefing on Severe Accidents and Options for Proceeding with Level 3 Probabilistic Risk Assessment Activities*, Transcript of Proceedings, at 3, ML112140574 (July 28, 2011).

126 Nuclear Regulatory Commission, *NRC Technical Audit Report of North Anna Post-Seismic Fuel Inspections*, at 3, ML11305A239 (Oct. 27, 2011).

facilities are also subject to beyond-design-basis earthquakes. As indicated by the figures below, many nuclear reactors in the U.S. are located in areas with potentially dangerous seismic activity.[127] The first figure is the U.S. Geological Survey National Seismic Hazard Map, updated in 2008, showing the earthquake ground motion (peak acceleration or PGA) for a 2% probability over 50 years. The second image, from NRC, shows the locations of nuclear reactors in the U.S.



Source: U.S. Geological Survey, *available at*: http://earthquake.usgs.gov/hazards/products/graphic2pct50.jpg



Source: U.S. NRC, *available at*: http://www.nrc.gov/reactors/operating/map-power-reactors.html

[127] Figure provided by Greenpeace, using data from the US Geological Survey Geological Hazards Team and the US Energy Information Administration. *Available at*: http://www.greenpeace.org/usa/en/news-and-blogs/campaign-blog/new-maps-of-nuclear-power-plants-and-seismic-/blog/33826/

On January 31, 2012, NRC, DOE, and EPRI released a new seismic study, revealing significantly higher earthquake risks in the central and eastern United States. According to NRC, "Calculations with the new model are expected to result in a higher likelihood of a given ground motion compared to calculations done using previous models."[128] Nuclear power plants will use the new model to re-evaluate their seismic risk. The State urges NRC to change the draft revised GEIS to allow seismic risks to be taken into consideration in the facility relicensing process by conducting a site-specific review of seismicity risks for spent fuel pools.

C. The Revised GEIS

The revised GEIS was released over two years and a half ago under very different assumptions about the availability of a nuclear repository and the safety of spent nuclear fuel. Recent events have altered these assumptions and NRC must consider this significant new information in the GEIS.

In the January 11, 2012 GEIS briefing, NRC Staff said that new information from Fukushima does not need to be considered in the GEIS because new requirements can be imposed on licensees at a later point through the rulemaking process.[129] The State of New York submits that Staff's position is inconsistent with NEPA's objective of forcing federal agencies to examine previously-held assumptions, confront the environmental consequences of their present decisions, and meaningfully weigh reasonable alternatives or conditions to the requested federal action before the federal agency takes action. Staff's approach fails to take

[128] Nuclear Regulatory Commission, Press Release: New Seismic Model Will Redefine Hazard Analysis at U.S. Nuclear Plants, No. 12-010 (Jan. 31, 2012).
[129] *January 2012 GEIS Briefing Transcript* at 75-78.

the NEPA-required "hard look" at the environmental consequences of relicensing. NRC regulations require that new and significant information be considered in the GEIS and if it is not, it must be addressed in individual relicensing proceedings.[130] Since the significant new information emphasizes the site-specific nature of spent fuel pool risks and mitigation measures, these issues should be classified as a Category 2 issue in the GEIS and considered on a site-specific basis.

VII. Consideration of Site-Specific Alternatives

NEPA requires a federal agency to prepare "to the fullest extend possible" an environmental impact statement ("EIS") regarding proposed "major Federal actions significantly affecting the quality of the human environment."[131] An EIS must discuss, among other things, the adverse environmental impacts of the action and alternatives to the action.[132] "[O]ne important ingredient of an EIS is the discussion of steps that can be taken to mitigate adverse environmental consequences."[133]

This directive that federal agencies meaningfully consider alternatives and mitigation measures to the proposed action is one of NEPA's hallmarks.[134] The requirement that alternatives be studied, developed, and described both guides the substance of agency environmental decision making and provides evidence that the mandated decision making process has actually taken place.[135] NEPA is not

[130] 10 C.F.R. §§ 51.53(c)(iv) and 51.92(a)(2).
[131] 42 U.S.C. § 4332(2)(C).
[132] *Id.;* 40 C.F.R. §§ 1502.2, 1502.14, 1507.2, 1508.9.
[133] *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 351 (1989).
[134] 42 U.S.C. § 4332(2)(C),(E).
[135] *Calvert Cliffs' Coordinating Committee, Inc. v. United States Atomic Energy Comm'n*, 449

intended to simply confirm or insulate previous agency decisions or assumptions. Rather, NEPA forces federal agencies with discretionary regulatory authority to confront and publicly evaluate the environmental impacts of proposed action, the alternatives to that action, and the means to mitigate or minimize the adverse impacts of the final agency action.[136]

As discussed above (p.15), if the water in a spent fuel pool boils or drains away, the zirconium cladding that forms the spent fuel rods may melt or catch on fire, potentially causing a major release of radiation. NRC does not dispute that a spent fuel pool fire could have catastrophic environmental impacts. Indeed, it has acknowledged that "a zirconium fire event can have public health and safety consequences similar to a severe core damage accident with a large off-site release."[137] Therefore, NRC must consider alternatives to the current storage scheme that reduce the risk of a zirconium fire. Moreover, these issues must be considered on a site-specific Category 2 basis, since plant-specific factors may make facilities more or less vulnerable to such fires, may require different mitigative measures, and may lead to different environmental impacts.[138] The State

F.2d 1109, 1114 (D.C. Cir. 1971).
[136] *Dep't of Transportation v. Public Citizen*, 541 U.S. 752, 768-69 (2004).
[137] Nuclear Regulatory Commission, Policy Issues Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools (WITS 200000126), NRC SECY-01-0100, at 5 (June 4, 2001).
[138] This fact was recognized by Congress when it directed NRC to implement the recommendations of the 2006 NAS Report on spent nuclear fuel storage. In particular, Congress asked NRC to prepare site-specific models to mitigate the risks associated with spent fuel storage. U.S. Congress, Conference Report 108-792, *Making Appropriations for Foreign Operations, Export Financing, and Related Programs for the Fiscal Year Ending September 30, 2005, and For Other Purposes*, at 982 (Nov. 20, 2004). Former NRC Commissioner Victor Gilinsky also recommended that spent fuel storage be examined on a site-specific basis in his *Separate Views Regarding Proposed Amendments to 10 CFR Parts 50 and 51, Waste Confidence*

recommends that the following alternatives be considered in a site-specific review of a facility's spent fuel pool.

A. Thinning of Spent Fuel Pools and Use of Dry Cask Storage

One alternative that should be considered is the thinning of spent fuel pools. Densely packed spent fuel heats up faster in the event of the loss of cooling water than more loosely packed fuel,[139] giving workers and emergency crews less time to respond to prevent fire or other damage to the fuel assemblies.[140]

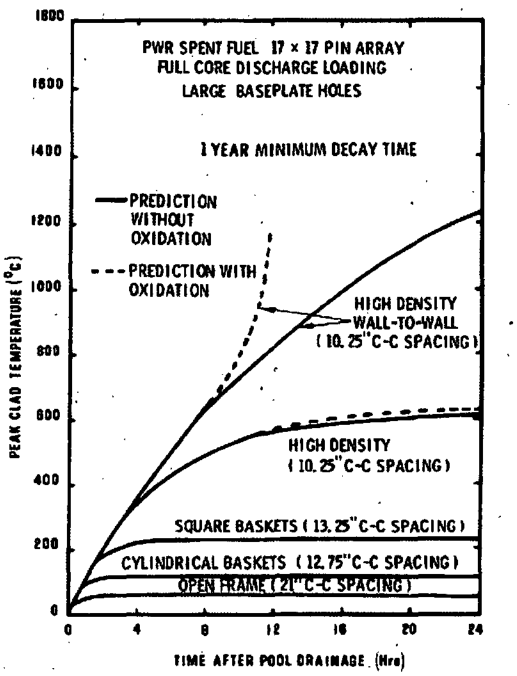


Figure: Effect of Storage Rack Configuration on Heatup of PWR Spent Fuel, Well-Ventilated Room. *Source*: *1979 Sandia Report* at 51.

Proceeding, 48 FR 22730 (May 20, 1983) ("While 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.").

139 Allan S. Benjamin et al., *Spent Fuel Heatup Following Loss of Water During Storage* (Sandia National Laboratory, NUREG/CR-0649, SAND77-1371) at 50 ("*1979 Sandia Report*") (Mar. 1979) ("The high density holders . . . are the least well-suited to heat removal, as expected, particularly if the spent fuel is packed wall-to-wall so as to preclude a down-comer space at the edge of the pool.").

140 *See 2006 Sandia Report* at viii ([D]ispersed configurations [of spent fuel assemblies] provided additional time for mitigative actions before the release of fission products versus a non-dispersed configuration.); *See also NAS Report* at 103 ("[M]odifying the storage racks to provide for closer spacing of the fuel assemblies. . . . can make it more difficult to cool the freshly discharged fuel if there is catastrophic loss of the fuel pool water.").

'Alvarez et al. recommend moving away from the current "dense-pack" configurations and returning to open-rack configurations, for which the spent fuel pools were originally designed.[141] The figures below illustrate the different designs.[142]

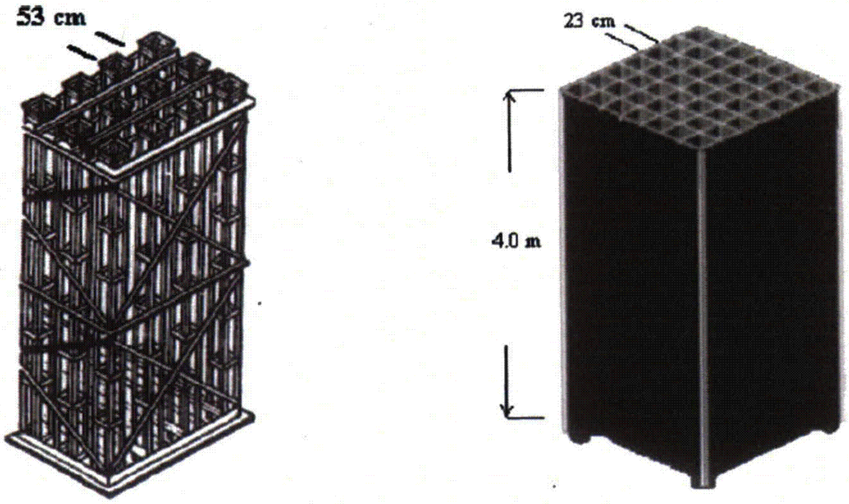


Figure 7: Open and dense-pack PWR spent-fuel racks (*Sources:* Left: NUREG/CR-0649, SAND77-1371, 1979; right: authors).

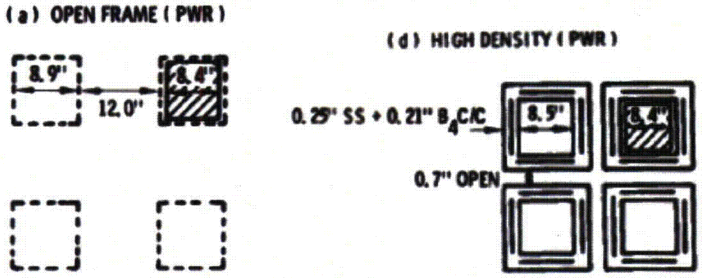


Figure 3. Cross Sectional Dimensions of Spent Fuel Holders Shown in Fig. 2.

[141] *Reducing the Hazards* at 23.
[142] First figure: *Reducing the Hazards* at 17. Second figure: *1979 Sandia Report* at 20.

In the original design for pressurized-water reactor spent fuel pools, fuel assemblies were packed 53 cm apart, allowing the cooling water to channel between them.[143] In the densely packed design, fuel assemblies are only 23 cm apart (close to the 21.4 cm spacing in reactor cores),[144] allowing about five times as many assemblies to be stored in the pool.[145] To keep these closely packed fuel rods sub-critical, they are placed in metal boxes containing neutron-absorbing boron.[146] In a loss of coolant accident, where pool water is lost, these boxes would prevent the horizontal circulation of cooling air.[147] A 1979 Sandia report[148] prepared for NRC found that with an open frame storage configuration in a well-ventilated facility, spent fuel in a drained storage pool would not overheat if it was cooled for five days before being transferred to the pool.[149] Also, as mentioned above on pages 37-38, Sandia recently released the results of a study finding that low density racking is the spent fuel configuration that is least vulnerable to zirconium fires.[150]

If there is not enough room in the pool to permit open frame storage—because too much fuel is unloaded from a reactor during a given five year period—Alvarez et al. recommend considering: "(1) an arrangement where one fifth of the fuel assemblies are removed in a pattern in which each of the remaining fuel assemblies has one side next to an empty space; (2) an arrangement where

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143 *Reducing the Hazards* at 17.
144 *Id.* at 16.
145 *NAS Report* at 43.
146 *Id.*
147 *Id.* at 17.
148 *1979 Sandia Report.*
149 *Reducing the Hazards* at 23.
150 Samuel G. Durbin and Eric R. Lindgren of Sandia National Laboratories, Investigations of Zirconium Fires During Spent Fuel Pool LOCAs (Slideshow), ML120380359 (Feb. 7, 2012).

alternate rows of fuel assemblies are removed from the rack."[151] The first suggestion is illustrated in the figure below.[152]

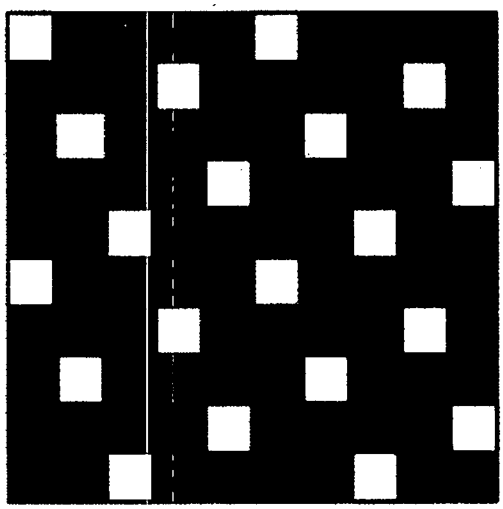

Figure 2: Removal of one fifth of the spent-fuel assemblies could result in every fuel assembly having one side exposed to an empty channel.

If this suggestion is found to be effective at allowing spent fuel in a drained pool to be convectively air cooled, it would reduce the amount of spent fuel that would need to be removed from pools in the U.S. in 2010 from 35,000 tons (under an open frame storage plan) to 9,000 tons.[153] However, Alvarez et al. recommend that all spent fuel be removed from pools and placed in dry cask storage after it has cooled for five years.

Similarly, the NAS report recommended that, space permitting, empty slots be arranged throughout the pool to promote natural air convection in the event that the pool is completely drained.[154] That report also found that spent fuel is less at

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[151] *Id.*
[152]Figure is taken from: *Damages From a Major Release* at 133.
[153] *Id.*
[154] *NAS Report* at 55.

risk from accident or attack in dry cask storage than in a fuel pool.[155] This is because the spent fuel stored in dry casks has been cooled for at least five years, and is therefore, not prone to zirconium cladding fires.[156] Moreover, the dry cask system divides the spent fuel between many different casks—each cask stores only 10 to 15 tons of fuel, as opposed to a pool, which stores hundreds of tons—so if an individual cask is compromised, there is less potential radiation to be released. Additionally, since dry cask storage relies on natural air circulation for cooling, a breach would not release contaminated water into the environment and emergency crews would not need to find an alternative source of water with which to fill them.

In the wake of the Fukushima nuclear disaster, nuclear plant operators are beginning to consider thinning spent fuel pools as a safety precaution. For example, in April 2011, the Tennessee Valley Authority issued a nuclear program update that said it was considering moving spent fuel out of pools and into dry cask storage.[157] Although TVA attended the January 11, 2012 public meeting, this initiative was not discussed.

Others have called for the removal of spent fuel that is more than five years old from storage pools. In March 2011, David Lochbaum, of the Union of Concerned Scientists, stated before the U.S. Senate Energy and Natural Resources Committee, "A better strategy would be to reduce the inventory of irradiated fuel in the pools to

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[155] *NAS Report* at 68.
[156] *NAS Report* at 69.
[157] Tennessee Valley Authority, "Fact Sheet: Nuclear Program Update" (Apr. 14, 2011). *Available at*: http://www.tva.gov/news/releases/aprjun11/pdf/nuclear_program-update_fact_sheet.pdf. The Tennessee Valley Authority owns and operates various nuclear power reactors and is an agency of the United States.

the minimum amount, which would be only the fuel discharged from the reactor core within the past five years."[158] This, he said, would lower the risk of fire by decreasing the heat load of the pool, giving workers more time to respond in the event of the loss of cooling water. Also, if radiation was released, it would be significantly lower in a less densely packed pool. That same month at a meeting on Capital Hill, Energy Secretary Steven Chu recognized that the storage of spent nuclear fuel in dry casks is much safer than storage in pools.[159] In May 2011, the Institute for Policy Studies released a report authored by Robert Alvarez, also recommending that all spent fuel that has been in pools for five years be removed and placed in dry storage.[160] Additionally, in April 2011, U.S. Senator Diane Feinstein called upon the NRC Commissioners to enact regulatory policies that reduce the amount of spent fuel stored in pools.[161]

In August 2011, Chairman Jaczko acknowledged the benefits of transferring spent fuel to dry cask and said the Commission should consider this alternative:

> I also believe the Commission should consider in the long term if there should be new regulations to require licensees to move spent fuel to dry

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[158] Statement by David Lochbaum, Director of Nuclear Safety Project, Before the U.S. Senate Energy and Natural Resources Committee, at 2 (March 29, 2011). *Available at*: http://www.ucsusa.org/assets/documents/nuclear_power/lochbaum-senate-energy-3-29-2011.pdf

[159] Hearing on the Fiscal Year 2012: Department of Energy and Nuclear Regulatory Commission Budgets, House of Representatives, Subcommittee on Energy and Power joint with the Subcommittee on Environment and the Economy Committee on Energy and Commerce, at 77 (March 16, 2011). *Available at*: http://democrats.energycommerce.house.gov/sites/default/files/image_uploads/031611%20EP-EE%20Fiscal%20Year%202012%20DOE%20and%20NRC%20Budgets.pdf (Chu stated: "After you take the fuel rods out of the reactor, immediately you put them in a pool of water for a period of time where they are actually still dissipating a considerable amount of heat. But then after that, the next stage is that you can put them in dry cask storage, which is much safer.").

[160] Robert Alvarez, *Spent Nuclear Fuel Pools in the U.S.: Reducing the Deadly Risks of Storage*, at 21 (May 2011).

[161] Letter from Senator Feinstein to NRC Chairman Jaczko, ML11108A038 (April 8, 2011).

cask storage within a specific timeframe. This step, recognizing the inherent safety benefits of dry storage and combining that knowledge with the new ISFSI security regulations under development, may provide a safer and more secure disposition for spent fuel. I also believe that an NRC-developed pilot probabilistic risk assessment provides additional supporting evidence of the benefits of having more of the spent fuel held in dry storage.[162]

B. Other Alternatives

While removing spent fuel and placing it in dry cask storage remains the safer alternative, there are other steps that can be taken to reduce the risk of zirconium cladding fires in spent nuclear fuel pools. For example, the fuel assemblies in pools can be arranged in a checkerboard pattern so that newly discharged fuel is surrounded by older, cooler fuel. The cooler fuel will act as heat sink, absorbing the heat from the newer fuel.[163] Similarly, newly discharged fuel can be placed near the walls of the pool, which will also act as a heat sink. Water spray systems can be installed to cool fuel in the case of loss of pool coolant and pool walls can be reinforced to prevent their damage.[164] Also, limiting the frequency of full core offloads into pools and delaying the transfer of fuel into a pool after a reactor shutdown would reduce the heat-load in the pool.[165] What is possible at each facility will vary, and therefore, a site-specific evaluation must be conducted.

Although the recent Near-Term Task Force report does not call for the transfer of fuel to dry storage, Recommendation 7 of the report addresses some

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[162] Nuclear Regulatory Commission, Commission Voting Record: Near-Term Report and Recommendations for Agency Actions Following the Events in Japan, at PDF page 9, ML112310746 (Aug. 19, 2011).
[163] *NAS Report* at 54.
[164] *NAS Report* at 55.
[165] *NAS Report* at 55.

concerns about enhancing the safety of spent fuel pools. The Task Force recommends that licensees be required to install or enhance equipment that will allow workers to better monitor spent fuel pools in emergencies, as well as improve the ability of workers to get water to the pools if necessary.[166] The State urges NRC to include such requirements for relicensing, in addition to requiring the thinning of spent fuel pools.[167]

C. Severe Accident Mitigation Alternatives Analyses and Spent Fuel Pools

The destruction of the Fukushima facilities demonstrates that severe accidents can occur and can have significant, real world consequences.[168] The State of New York further calls on NRC to revise its approach to severe accident mitigation alternatives (or SAMA) analyses that it conducts in response to license renewal applications with respect to the dense storage of spent nuclear fuel in spent fuel pools. Under 10 C.F.R. § 51.53(c)(3)(ii)(L), NRC must conduct a site-specific review of alternatives to mitigate a severe accident at a reactor that seeks to renew its operating license. NRC promulgated this regulation in 1996 in response to the court ruling in *Limerick Ecology Action, Inc. v. Nuclear Regulatory Commission*, 869 F.2d 719 (3d Cir. 1989). However, while NRC purports to examine alternatives to mitigate severe accidents that occur in the reactor, applicants and NRC do not

[166] *Near-Term Task Force Report* at 45-46.
[167] In the briefing on the proposed GEIS, held on January 11, 2012, Chairman Jaczko indicated that license renewal is an opportunity to get requirements implemented at nuclear facilities. *January 2012 GEIS Briefing Transcript* at 86. The State recommends that license renewal be made conditional upon the implementation of the requirements recommended by the Near-Term Task Force. This will ensure that the changes are implemented by licensees prior to license renewal.
[168] NRC Chairman Gregory Jaczko, *Looking to the Future*, S-12-002 (Feb. 9. 2012).

review alternatives to mitigate severe accidents that occur in the spent fuel pool that is adjacent to the reactor but outside of the containment shell. In fact, the SAMA analyses only take into account releases from the reactor core. Releases from spent fuel pools that would occur during a severe accident are not taken into consideration at all in the SAMA analyses. Thus, the communities and states that host power reactors do not receive a comprehensive review of all severe accidents at a licensed facility or the available means to mitigate the environmental effects of such severe accidents. It is important that radionuclide releases from spent fuel pools be considered as part of the SAMA analyses because the offsite cost risks of these releases can be higher than those from the reactor core.[169]

Today's reality is that large quantities of spent fuel are being stored at nuclear reactor sites. Indeed, under the dense storage regime in place today at Indian Point and other reactors, the spent fuel pool holds considerably more fuel assemblies than the reactor core. The NEPA review of severe accident mitigation alternatives should not exclude releases from these spent fuel pools or alternatives that could mitigate severe spent fuel pool accidents or releases. NRC Commissioners should revise current NRC NEPA policy and ensure that during a license renewal proceeding, a comprehensive and objective review of severe accidents takes place for the entirety of each facility that NRC licenses. Similarly, for sites that have more than one reactor and spent fuel pool, the SAMA review should not be limited to a severe accident at a single reactor or a single pool, but

[169] Gordon R. Thompson, Risk-Related Impacts from Continued Operation of the Indian Point Nuclear Power Plants, at 28 (Nov. 28, 2007).

should examine the consequences of, and mitigation alternatives for, a severe accident that affects more than one reactor or pool at a NRC licensed site.

VIII. The Severe Accident Mitigation Alternatives Analyses Should be Based on Site-Specific Data and Not Simply Replicate Inputs from Another Reactor

In addition, the SAMA analyses must reflect the true, site-specific costs of an accident involving a spent fuel pool or resulting in a release from a spent fuel pool. As the State has pointed out in Contention 12 in the Indian Point relicensing proceeding, in the context of SAMA analyses for severe nuclear reactor accidents, applicants have not been using site-specific data to calculate the economic costs. Instead, licensees have been relying on data from "Sample Problem A" to calculate the economic costs associated with a severe nuclear reactor accident in their SAMA analyses. Sample Problem A was one of fourteen sample problems provided with the MACCS2 code as an example for users to check whether the MACCS2 software was installed and operating properly. Sample Problem A is an example set of inputs that were developed for the Surry reactor site located in rural Virginia and was not meant to serve as default input values in the MACCS2 program.[170] Yet NRC Staff, Entergy, and other applicants rely on Surry's Sample Problem A in conducting SAMA analyses for other reactor sites, such as Indian Point, that differ markedly from Surry and its environs.

[170] The "Sample Problem A" values were derived from the Surry facility and discussed in NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (Dec. 1990).

Each of the approximately 65 sites that host the 104 operating nuclear power reactors has a different profile and "context."[171] NRC cannot credibly maintain that all U.S. reactor sites are the same or that an accident at one site will have the same consequences as an accident at another site. Stated differently, the 50-mile emergency planning zone around the two operating Indian Point reactors in New York is materially different from the 50-mile emergency planning zone around the single Fort Calhoun reactor in Nebraska. The two Indian Point plants and single Calhoun plant are different with respect to: electrical output; spent fuel pool inventory; surrounding population; topography; prevailing wind; precipitation and snowfall; seismic hazards; tornado hazards; surrounding agricultural resources; and surrounding public drinking water/reservoirs—to name just a few material differences.

By using Sample Problem A inputs instead of inputs derived from site-specific data, applicants are failing to conduct the required site-specific SAMA analyses for nuclear reactor accidents in violation of NEPA, CEQ regulations, and NRC regulations. This error should not be carried into ongoing or future SAMA analyses of the reactor accidents, risks from a spent fuel pool accident, or radiological releases from a spent fuel pool. Any such SAMA analyses must rely on site-specific data from the plant at issue and its surrounding community and environment, not from Surry and its inputs in Sample Problem A.

[171] "Context is the geographic, biophysical, and social context in which the effects will occur. In the case of license renewal, the context is the environment surrounding the facility." *Draft GEIS for License Renewal* at 1-5.

Use of accurate, site-specific cost is especially important in light of a recent inter-agency dispute among federal agencies over which agency is responsible for ensuring the clean-up and decontamination of contaminated property and the funding source of such decontamination. A November 2010 article entitled *Agencies Struggle To Craft Offsite Cleanup Plan For Nuclear Power Accidents*, reported:

> EPA, the Nuclear Regulatory Commission (NRC) and the Federal Emergency Management Agency (FEMA) are struggling to determine which agency—and with what money and legal authority—would oversee cleanup in the event of a large-scale accident at a nuclear power plant that disperses radiation off the reactor site and into the surrounding area.
>
> The effort, which the agencies have not acknowledged publicly, was sparked when NRC recently informed the other agencies that it does not plan to take the lead in overseeing such a cleanup and that money in an industry-funded insurance account for nuclear accidents would likely not be available . . . .
>
> [T]he NRC officials also indicated during the meetings that the industry-funded account established under the Price Anderson Act—which Congress passed in 1957 in an effort to limit the industry's liability—would likely not be available to pay for such a cleanup.[172]

Moreover, meaningful site-specific severe accident mitigation alternatives analyses should be conducted each time a facility seeks to extend its operating license. This is so because the population in the emergency planning zones, characteristics of the surrounding community, set of potential mitigation alternatives, and economic cost values may all experience significant change over the course of a 20-year operating license.

[172] Douglas P. Guarino, *Agencies Struggle To Craft Offsite Cleanup Plan For Nuclear Power Accidents,* Inside EPA (Nov. 10, 2010).

IX. Conclusion

Spent nuclear fuel, one of the most dangerous and long-lasting substances known to humans, was never meant to be stored long-term and densely packed in pools at nuclear plants. When many of these facilities were built, AEC and NRC told the public that the spent fuel would be stored temporarily in pools only for a brief time before being promptly removed from the host communities. Contrary to those assurances, spent nuclear fuel has remained in densely packed spent fuel pools for decades. The events at the Fukushima nuclear facilities should serve as a lesson to reinforce what is already known—long-term storage of spent fuel in pools poses significant environmental risks and impacts. NEPA requires that NRC consider safer storage alternatives such as the thinning of spent fuel pools and the use of dry cask storage. These alternatives must be considered in a site-specific analysis that evaluates the unique features of each fuel pool and its surrounding environment. The State of New York urges NRC to consider both the potential hazards posed by the relicensing of nuclear facilities and the readily-available alternatives to make storage of nuclear waste safer and mitigate the environmental impacts of a severe spent fuel pool accident during the term of the operating license. The State further urges NRC to ensure that the severe accident mitigation alternatives analyses rely on site-specific cost estimates and are reanalyzed at each operating licensing milestone. Moreover, given the importance of these issues, the NRC should revise the GEIS and implementing regulations as requested by these comments and apply the GEIS, as revised, to all license renewal applications that are currently pending.

Dated: March 5, 2012
Albany, New York

Laura Heslin
Kathryn Liberatore
John J. Sipos

State of New York
Office of Attorney General

ATTACHMENT 2

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:

10 C.F.R. Part 51, Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses

NRC Docket ID
NRC-2008-0608
RIN 3150-AI42

STATEMENT OF DR. RICHARD T. LAHEY, JR.

MARCH 9, 2012

STATEMENT OF DR. RICHARD T. LAHEY, JR.

I, Richard T. Lahey, Jr., state as follows:

1. I am currently the *Edward E. Hood Professor Emeritus of Engineering* at Rensselaer Polytechnic Institute (RPI) in Troy, New York. I hold the following academic degrees: a B.S. in Marine Engineering from the United States Merchant Marine Academy, a M.S. in Mechanical Engineering from RPI, a M.E. in Engineering Mechanics from Columbia University, and a PhD. in Mechanical Engineering from Stanford University. At RPI, I have served as both the Dean of Engineering and the Chairman of the Department of Nuclear Engineering & Science. In addition, I have been the lead engineer and manager of various departments responsible for safety analyses, heat transfer mechanisms, and core & safety development for the General Electric Company (GE), including both military (*i.e.,* Naval) and commercial nuclear reactors.

2. I am a member of various professional societies, including: the American Nuclear Society (ANS), where I was a member of the Board of Directors, and the ANS's executive committee, and was the founding Chair of the ANSs' Thermal-Hydraulics Division; the American Society of Mechanical Engineers (ASME), where I was Chair of the Nucleonics Heat Transfer Committee, K-13; the American Institute of Chemical Engineering (AIChE), where I was the Chair of the Energy Transport Field Committee; and the American Society of Engineering Educators (ASEE), where I was Chair of the

Nuclear Engineering Division. I have also been an editor of *Nuclear Engineering & Design*, and international journal devoted to fission energy. I am a member of the National Academy of Engineering (NAE), and have been elected Fellow of both the ANS and the ASME.

3. Moreover, I have received numerous honors and awards for my career accomplishments, including: the ANS's Seaborg Medal and Compton Award, the U.S. Department of Energy's E.O. Lawrence Memorial Award, and the AIChE's Donald Q. Kern Award. Over the last 40 years, I have published numerous books, monographs, chapters, articles, studies, reports, and journal papers on nuclear engineering and nuclear reactor safety technology, and most of these publications have been peer reviewed.

4. In addition, I have served on numerous panels and committees for the United States Nuclear Regulatory Commission (USNRC), Idaho National Engineering Laboratory (INEL), Oak Ridge National Laboratory (ORNL), and the Electric Power Research Institute (EPRI). I served as a member of a committee that conducted a study under the auspices of the National Research Council (NRC) of the National Academy of Sciences (NAS) to review the safety and security of spent nuclear fuel storage (discussed in more detail below).

5. My *Curricula Vitae*, which more fully describes my educational and professional background and qualifications, is available at: http://www.rpi.edu/~laheyr/laheyvita.html.

6. I am very familiar with the operation of, and safety analyses associated with, pressurized water nuclear reactors (PWRs), the type of reactor currently in operation at the Indian Point (IP) site in Buchanan, Westchester County, New York and their spent fuel pools.

7. The Indian Point power reactors and spent fuel pools are 5 miles west of the New Croton Reservoir in Westchester County. They are also approximately 24 miles north of New York City, 35 miles from Times Square, 38 miles from Wall Street, 5 miles northeast of Haverstraw, 16 miles southeast of Newburgh, 17 miles northwest of White Plains, 23 miles northwest of Greenwich, 37 miles west of Bridgeport, and 37-39 miles north northeast of Jersey City and Newark.

8. Having received their initial operating licenses in 1973 and 1975, the Indian Point facilities are close to the end of their initial 40-year license terms. The facilities are currently in the midst of a proceeding concerning their application to the USNRC for permission to operate for an additional 20 years. I have reviewed the license renewal application and the Final Safety Analysis Reports (FSAR) that were submitted by Entergy Nuclear Operations, Inc. (Entergy) for the two operating Indian Point nuclear reactors, spent fuel pools, and associated systems. These plants are known as Indian Point Unit 2 (IP2) and Indian Point Unit 3 (IP3). I have also reviewed additional documents referred to below.

9. In my opinion, and as I explain more fully below, there are some important concerns associated with spent fuel storage pools at these plants that urgently need to be addressed, including the vulnerabilities of these spent fuel storage pools to natural disasters, sabotage, and fires.

10. Even after it is used in nuclear reactors to generate energy, spent nuclear fuel remains extremely radioactive. To protect workers, facilities, and neighboring communities, most nuclear power plants have constructed large swimming-pool-like structures in which the spent fuel was to be stored temporarily until it cooled sufficiently to allow its transfer to a reprocessing facility or disposal site in the United States (*e.g.*, West Valley (NY), Yucca Mountain (NV)). Because no reprocessing facility or final disposal site is operational, the spent fuel has remained for decades in these temporary storage pools and some of the spent nuclear fuel has subsequently been transferred from the pools to associated dry cask storage facilities. Unfortunately, the storage pools are susceptible to fire and radiological releases in the event the pools drain and the fuel becomes partially or completely uncovered.

11. Like other power reactors in the United States, the two operating Indian Point reactors have spent fuel pools located outside their containment buildings that contain significant quantities of radioactive material. At Indian Point, the spent fuel pools are within the fuel services buildings (FSBs).

12. It should be noted that nuclear emergencies associated with inadequately cooled spent fuel pools are not currently addressed by USNRC's Severe Accident Mitigation Alternatives (or SAMA) analyses and environmental review for the renewal of operating licenses conducted pursuant to the National Environmental Policy Act (or NEPA). In addition, a detailed probabilistic risk assessment (PRA) of spent fuel storage pools has not been done, and the USNRC has implicitly assumed that a station blackout, a loss of both offsite electrical power and onsite emergency power, will be corrected within 48 hours. Moreover, virtually all of the procedures to mitigate radiation releases to the environment from a stricken nuclear site are associated with relatively short-term releases. Those assumptions are dramatically different from the extended station blackouts and radiation releases that occurred at the nuclear power reactor plants at the Fukushima Daiichi site in Japan.

13. The recent nuclear emergency at the Fukushima Daiichi nuclear facilities in Japan has focused world-wide attention on severe accidents at nuclear power plants. In particular, the consequences of the release to the environment of significant quantities of radiation from inadequately cooled nuclear reactor cores and spent fuel storage pools (both of which depend on the availability of electrical power for that cooling) have been graphically demonstrated.

14. While all the details of what took place during this disaster in Japan have yet to be determined, it is clear that spent fuel storage pools are potentially a significant source for radiation releases to the environment. Furthermore, according to USNRC documents and statements, it appears that the spent fuel pools at Fukushima Daiichi Unit 3 and Unit 4 contained less spent fuel assemblies than the spent fuel pools for Indian Point Unit 2 and Unit 3. Moreover, since the proximity of the Indian Point plants to the major population center of New York City (24 miles) is much closer than the proximity of Fukushima Daiichi to Tokyo (~150 miles), it is clear that the spent fuel storage pools at Indian Point present important environmental and safety concerns, with the potential for major environmental damage.

15. The Indian Point facilities are susceptible to a wide range of natural disasters, including: earthquakes; hurricanes; lightning strikes; tornados; and fires. In particular, tornados have recently resulted in the loss of offsite power and the shutdown of a number of nuclear power plants in the South (*e.g.*, within TVA) and the Midwest. Indeed, a very strong tornado (*e.g.,* Category 5, with wind speeds > 200 mph) has the potential to significantly damage the relatively weak fuel service buildings housing the spent fuel storage pools at Indian Point, and it could also result in a loss of water from the pools, uncovering the spent fuel. If so, significant fuel heat up and radiation releases to the environment may occur.

16. While some have concluded that, unlike at Fukushima, a major tsunami at the Indian Point site is not likely, it should be noted that Indian Point has experienced internal flooding events.[1]

17. Also, other factors specific to the Indian Point spent fuel pools increase the relative risk of accidents occurring. For example, the packing density of the spent fuel pools at Indian Point is several times (*i.e.*, > 5) larger than the density that the pools were originally designed for and, thus, it is more difficult to maintain adequate cooling during emergency events.

18. The following charts summarize how USNRC has authorized increasing amounts of spent nuclear fuel to be stored in the spent fuel pools for Indian Point Unit 2 and Unit 3:

IP2 SPENT FUEL POOL STORAGE LIMITS[2]	
Date	Fuel Assemblies
1973	264
1980	482
1985	980
1989	1,376

IP3 SPENT FUEL POOL STORAGE LIMITS[3]	
Date	Fuel Assemblies
1975	264
1978	840
1989	1,345

[1] *See* USNRC Information Notice No. 80-37, Containment Cooler Leaks and Reactor Cavity Flooding at Indian Point Unit 2 (ML031180421).
[2] *Source*: Consolidated Edison, *Final Design Report for Reracking the Indian Point Unit No. 2 Spent Fuel Pool,* at 1, ML100200292 (May 1980); Consolidated Edison, *Supplemental Spent Fuel Safety Analysis,* at 3-1, ML100350310 (Nov. 1985); and Consolidated Edison, *Indian Point Unit 2 Spent Fuel Pool Increased Storage Capacity Licensing Report,* at 1-2, ML100200114 (June 1989).
[3] *Source*: USAEC, Safety Evaluation Report by the Directorate of Licensing U.S. AEC In the Matter of Consolidated Edison Co. of New York, Inc. Indian Point Nuclear Generating Unit No. 3, at 4-1, 9-2, ML072260465 (Sept. 21, 1973); USNRC, Indian Point, Unit 3, Amendment 13, Authorizing Modifications to the Spent Fuel Pool, Increasing Capacity from 264 to 840 Fuel Assemblies, attached to Letter from A. Schwencer, NRC to New York State Power Authority, ML003778668 (Mar. 22, 1978); and USNRC, Indian Point, Unit 3, Amendment 90, Allowing for the Expansion of the Spent Fuel Pool Storage Capacity, attached to Letter from Joseph Neighbors, NRC to New York Power Authority, ML003778816 (Oct. 12, 1989).

19. In fact, the USNRC recently has expressed significant concern about the possibility of having an uncontrolled recriticality in densely packed pools due to uncertainties about fuel/poison burnup and related mechanical changes, both of which factors affect reactivity, and due to the age-related degradation of the Boron-based neutron absorbers used in densely packed spent fuel pools.[4] If a recriticality were to occur, it could lead to the release of massive amounts of radiation from the fuel stored in the pools.

20. Additionally, NUREG/CR-1429 (1980) indicates that both IP-2 and IP-3 were designed for a safe shutdown earthquake (SSE) ground acceleration of 0.15g horizontal and 0.10g vertical. It is significant that the ground accelerations experienced by the North Ana reactors in Virginia (which recently experienced a 5.9 Richter Scale earthquake) produced ground accelerations more than three (3) times this level, which appears to be why the reactors remained shut down for a number of months following the earthquake. Considerably more attention needs to be paid to the seismic design capabilities of the Indian Point reactors and spent fuel pools to ensure that adequate cooling is maintained.

21. Clearly the risks posed by the dense storage of spent fuel, and the consequences of a natural disaster (*e.g.*, an F5 tornado) or a sabotage attack on the spent fuel pools at the Indian Point nuclear power plants are

[4] *See* USNRC, On Site Spent Fuel Criticality Analyses, NRR Action Plan (Sept. 19, 2011) (ML11251A210).

very important issues, since they has the potential for major harm to the environment. Significantly, this issue is not addressed by the USNRC's severe accident mitigation alternatives (SAMA) analysis and the reviews of environmental impacts under the National Environmental Policy Act. The SAMA analysis examines severe *reactor* accidents, but not severe *spent fuel pool* accidents. A natural disaster or a sabotage/terrorist attack on the spent fuel pools may result in radiation releases that could cause significant adverse environmental and health effects and property damage in one of the most populated areas of the country – the New York City metropolitan area.

22. I served as a member of a Committee that conducted a study under the auspices of the National Research Council (NRC) of the National Academy of Sciences (NAS) to review the safety and security of spent nuclear fuel storage. This committee was called the "Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage of the Board of Radioactive Waste Management," and it reported directly to the United States Congress. In 2005, the National Research Council published a public version of its report of the Committee's findings, which I co-authored. The public report, "*Safety and Security of Commercial Spent Nuclear Fuel Storage,*" is available to the public and the USNRC [National Research Council of the National Academies, Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report, International Standard Book Number 0-309-09647-2, Library of Congress Control Number 2005926244 (copyright

2006) (hereinafter the "NAS Study")].[5] (In addition, I understand that the National Research Council's confidential report may also be made available to those with appropriate security clearances and "need to know.") In any event, as discussed in the public NAS Study, my colleagues on the National Research Council Committee and I studied various possible terrorist attack and sabotage scenarios, and we concluded that spent fuel pools, such as those at Indian Point, are indeed vulnerable to such attacks.

23. Regarding the consequences of sabotage attacks on a nuclear power reactors, the USNRC's 1996 Generic EIS states that "if such events were to occur, the commission would expect that the resultant core damage and radiological release would be no worse than those expected from internally initiated events" [*See* USNRC's Generic Environmental Impact Statement (NUREG-1437, Vol. 1) (May 1996), § 5.3.3.1 (Review of Existing Impact Assessments)]. The 1996 Generic EIS conclusion may be true for a terrorist attack on or within the primary containment of these nuclear reactors, but it is most certainly <u>not</u> true for a terrorist attack on the two operational spent fuel pools at Indian Point. Indeed, far more radioactivity is present in the spent fuel located in the two operational spent fuel storage pools at Indian Point than there is in the active core of the two operating nuclear reactors.

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[5] The NAS Study also is available through the NRC's public ADAMS system within accession number ML11297A091. *See also* NRC Statement No. 05-061 (Apr. 6, 2005).

24. It is important to note that spent fuel pools are not enclosed by a leak-tight containment structure. Rather, they are surrounded by only a confinement building, which is not a leak-tight containment structure. Thus, if a natural disaster or terrorist attack leads to sufficient pool drainage or coolant evaporation and a propagating zirconium fire, much of the radioactive inventory in the spent fuel could be released to the environment. The resulting plume of radiation released into the atmosphere can result in significant adverse environmental and health effects and property damage in and around the Indian Point plants, including New York City (NYC), and the immediate portions of northern New Jersey and southwestern Connecticut. More than seventeen million people reside or work within a fifty-mile radius of Indian Point, so a timely evacuation would be impossible. Significantly, the surrounding population is projected to grow over the next 20 years. At risk, too, are trillions of dollars of property in the tri-state region and, of course, the financial capital of the world (NYC) could be contaminated with radiation, and seriously disrupted.

25. The 2005 public NAS Study made several recommendations for mitigation, including moving older spent fuel into dry cask storage, rearrangement of the spent fuel that is required to be in the storage pools, and the installment of a seismically-qualified spray cooling system. *See, e.g.,* NAS Study, Chapters 3 & 4. At that time, USNRC did not accept these recommendations.

26. Recently, the Tennessee Valley Authority announced that it was considering moving spent nuclear fuel from the spent fuel pools at its reactors to dry storage casks.[6]

27. I also understand that the USNRC is in the process of revisiting its previous position concerning the installation of seismically-qualified spray cooling systems in spent fuel storage pools.

28. Entergy has not indicated in its relicensing application that it has adopted these mitigation measures for any of the spent fuel pools at Indian Point. Although Entergy is apparently moving some of its spent fuel from the Indian Point spent fuel pools to dry cask storage, this is to ensure that IP3 has the ability to remove the entire inventory of nuclear fuel inside the reactor core (*i.e.,* a full core offload).[7] In any event, this proposal will not mitigate the threat outlined above since more-recently discharged spent nuclear fuel is both the most highly radioactive fuel and generates the most decay heat, and thus must remain in the spent fuel pools until it is adequately cooled (about five years).[8] Rather, Entergy should accelerate the

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[6] Tennessee Valley Authority, "Fact Sheet: Nuclear Program Update" (April 14, 2011), http://www.tva.gov/news/releases/aprjun11/pdf/nuclear_program-update_fact_sheet.pdf.

[7] The ability to remove the entire core of nuclear fuel from the reactor core and transfer it to a spent fuel pool, known as a "full core off load," is generally recognized as a basic precondition to the operation of a power reactor.

[8] Entergy is running out of space in the Indian Point Unit 3 spent fuel pool – even with the allowance for dense storage configuration – and if spent nuclear fuel is not removed it will not be able to accomplish a full core off load. *See* Entergy communication NL-09-076 to USNRC, Application for Unit 2 Operating License Condition Change and Units 2 and 3 Technical Specification Changes to Add Inter-

removal of older spent nuclear fuel that currently resides in the densely packed IP3 and IP2 spent fuel pools and the placement of that fuel in dry casks. In addition, the two active reactors will continually generate more spent fuel during the proposed twenty year license renewal period, and because of its decay heat and radioactivity, this spent fuel must remain in the spent fuel pools for some time before it can be moved to dry cask storage (*i.e.*, the natural convective cooling by air in dry cask storage can not keep this fuel cool enough).

29. Finally, given the proximity of these plants to New York City, the potential health, environmental, real estate, and financial impacts are very significant – much more so than at any other nuclear power plant in the nation. Thus, I believe it is vital that Entergy, the USNRC Staff, and USNRC Commissioners consider all reasonable severe accident mitigation alternatives (SAMA) concerning natural disasters and terrorist attacks on the spent fuel pools. USNRC should allow interested States or local governments to raise alternatives to the continuation of dense storage of spent fuel in spent fuel pools as part of the license renewal process for a given reactor on a site-specific basis.

Unit Spent Fuel Transfer Requirements, ML091940177 ("Approval of these changes is needed to restore and maintain full core off load capability in the Unit 3 spent fuel pit for the remainder of its service life and to allow for periodic receipt of new fuel in support of future refueling outages.").

Conclusion

30. In summary, the continued dense storage of spent nuclear fuel in the Indian Point Unit 2 and Unit 3 spent fuel pools pose significant environmental risks that need to be addressed and mitigation alternatives need to be explored. To date, unfortunately, Entergy and the USNRC have glossed over many of these issues, to the extent that they have addressed them at all. Unfortunately, the environmental impact of the release of a significant amount of radiation from the spent fuel storage pools at Indian Point could be catastrophic, and, thus, the examination of readily available mitigation alternatives for these spent fuel storage pools must have a very high priority before USNRC authorizes them for the period of extended commercial operation.

R. T. Lahey

Dr. Richard T. Lahey, Jr. March 9, 2012

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