RULEMAKING ISSUE
NOTATION VOTE

March 7, 2008 SECY-08-0036

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: DENIAL OF TWO PETITIONS FOR RULEMAKING CONCERNING THE ENVIRONMENTAL IMPACTS OF HIGH-DENSITY STORAGE OF SPENT NUCLEAR FUEL IN SPENT FUEL POOLS (PRM-51-10 AND PRM-51-12)

PURPOSE:

To obtain Commission approval to deny two petitions for rulemaking (PRMs) submitted by the Attorney General of the Commonwealth of Massachusetts (Massachusetts AG) and the Attorney General for the State of California (California AG).

SUMMARY

The PRMs presented nearly identical issues and requests for rulemaking concerning the environmental impacts of the high-density storage of spent nuclear fuel in spent fuel pools (SFPs). The Petitioners asserted that "new and significant information" shows that the Nuclear Regulatory Commission (NRC) incorrectly characterized the environmental impacts of high-density spent fuel storage as "insignificant" in its National Environmental Policy Act (NEPA) generic environmental impact statement (EIS) for the renewal of nuclear power plant licenses. Specifically, the Petitioners asserted that spent fuel stored in high-density SFPs is more vulnerable to zirconium-cladding fire than the NRC concluded in its NEPA analysis. The bases for the NRC staff's recommendation to deny the petitions are contained in the Discussion section of this paper and in the enclosed proposed *Federal Register* notice.

BACKGROUND:

The Petitioners requested that Title 10 of the *Code of Federal Regulations* (10 CFR), Part 51, be amended. The Massachusetts AG filed its petition on August 25, 2006 (docketed as PRM-51-10). The NRC published a notice of receipt and request for public comment in the

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Federal Register on November 1, 2006 (71 FR 64169). The California AG filed its petition on March 16, 2007 (docketed as PRM-51-12). PRM-51-12 incorporates by reference the facts and legal arguments set forth in PRM-51-10. The NRC published a notice of receipt and request for public comment on PRM-51-12 in the *Federal Register* on May 14, 2007 (72 FR 27068). The California AG filed an amended petition (treated by the NRC as a supplement to PRM 51-12) on September 19, 2007, to clarify its rulemaking request. The NRC published a notice of receipt for the supplemental petition in the *Federal Register* on November 14, 2007 (72 FR 64003). Because of the similarities of PRM-51-10 and PRM-51-12, the NRC staff evaluated the two petitions together.

Petitioners' Requests

PRM-51-10 requested that the NRC take the following actions:

1. Consider new and significant information showing that the NRC's characterization of the environmental impacts of spent fuel storage as insignificant in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, May 1996 is incorrect.

2. Revoke the regulations which codify that incorrect conclusion and excuse consideration of spent fuel storage impacts in NEPA decision-making documents, namely, 10 CFR 51.53(c)(2), 51.95(c) and Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants," of Appendix B to Subpart A of 10 CFR Part 51. Further, revoke 10 CFR 51.23(a) and (b), 51.30(b), 51.53, 51.61, and 51.80(b) to the extent that these regulations find, imply, or assume that environmental impacts of high-density pool storage are insignificant, and therefore need not be considered in any plant-specific NEPA analysis.

3. Issue a generic determination that the environmental impacts of high-density pool storage of spent fuel are significant.

4. Require that any NRC licensing decision that approves high-density pool storage of spent fuel at a nuclear power plant, or any other facility, must be accompanied by a plant-specific EIS that addresses the environmental impacts of high-density pool storage of spent fuel at that nuclear plant, and a reasonable array of alternatives for avoiding or mitigating those impacts.

5. Amend its regulations to require that severe accident mitigation alternatives (SAMAs) that must be discussed in utility company environmental reports (ERs) and NRC supplemental EISs for individual plants pursuant to 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 ("Postulated Accidents: Severe Accidents") must include alternatives to avoid, or mitigate, the impacts of high-density pool zirconium fires.

PRM-51-12 incorporates by reference PRM-51-10. PRM-51-12 requested that the NRC take the following actions:

1. Rescind all NRC regulations found in 10 CFR Part 51 that imply, find, or determine that the potential environmental effects of high-density pool storage of spent nuclear fuel are not significant for purposes of NEPA and NEPA analysis.

2. Adopt, and issue, a generic determination that approval of such storage at a nuclear power plant, or any other facility, does constitute a major federal action that may have a significant effect on the human environment.

3. Require that no NRC licensing decision that approves high-density pool storage of spent nuclear fuel at a nuclear power plant, or other storage facility, may issue without the prior adoption and certification of an EIS that complies with NEPA in all respects, including full identification, analysis, and disclosure of the potential environmental effects of such storage, including the potential for accidental or deliberately caused release of radioactive products to the environment, whether by accident or through acts of terrorism, as well as full and adequate discussion of potential mitigation for such effects, and full discussion of an adequate array of alternatives to the proposed storage project.

DISCUSSION:

In support of their requests, the Petitioners asserted the following in their petitions:

1. "New and significant information" shows that the NRC incorrectly characterized the environmental impacts of high-density spent fuel storage as "insignificant" in the NRC's NUREG-1437. Specifically, the Petitioners asserted that either an accident or a malicious act, such as a terrorist attack, could result in a SFP being drained, either partially or completely, of its cooling water. The Petitioners further asserted that this drainage would then cause the stored spent fuel assemblies to heat up and then ignite, with the resulting fire releasing a substantial amount of radioactive material into the environment.

2. The bases of the "new and significant information" are the following:

    a. NUREG-1738, *Technical Study of the Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants,* January 2001

    b. National Academy of Sciences Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, *Safety and Security of Commercial Spent Nuclear Fuel Storage* (National Academies Press: 2006) (NAS Report)

    c. Gordon R. Thompson, "Risks and Risk-Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants," May 25, 2006 (Thompson Report)

3. Specifically, the Petitioners asserted that the "new and significant" information shows the following:

   a. The fuel will burn if the water level in an SFP drops to the point where the tops of the fuel assemblies are uncovered (complete or partial water loss resulting from SFP drainage being caused by either an accident or terrorist attack).

   b. The fuel will burn regardless of its age.

   c. The zirconium fire will propagate to other assemblies in the pool.

   d. The zirconium fire may be catastrophic.

   e. A severe accident caused by a terrorist attack on a nuclear power plant SFP is "reasonably foreseeable."

The Petitioners also asserted that new and significant information shows that the radiological risk of a fire in a high-density SFP at an operating nuclear power plant can be comparable to, or greater than, the risk of a core-degradation event of non-malicious origin (i.e., a "severe accident") at the plant's reactor. Consequently, the Petitioners asserted that SFP fires must be considered within the body of SAMAs.

Stakeholder Comments

The NRC received 1,676 public comments, with 1,602 of these being nearly identical, form e-mail comments supporting the petitions. Sixty-nine other comments also supported the petitions. These comments were submitted by States, private organizations, and members of the U.S. Congress. Two letters from the Nuclear Energy Institute (NEI) opposed the petitions, and three nuclear industry comments endorsed NEI's comments.

In general, the comments supporting the petitions focused on the following main elements of the petitions:

- NRC should evaluate the environmental impacts (large radioactive releases and contamination of vast areas) of severe accidents and intentional attacks on high-density SFP storage in its licensing decisions (NEPA analysis).

- The 2006 decision of the United States Court of Appeals for the Ninth Circuit, *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016 (9th Cir. 2006), *cert. denied* 127 S. Ct. 1124 (2007), concluded that the NRC must evaluate the environmental impacts of a terrorist attack on SFP storage in its licensing decisions.

- NRC's claim that the likelihood of a SFP fire is remote is incorrect. Partial loss of water in an SFP could lead to a fire and release radioactivity to the environment.

- NRC's characterization of the environmental impacts of high-density SFP storage as "insignificant" in NUREG-1437 is incorrect, and the NRC should revoke the regulations which codify this.

- Any licensing decision approving high-density spent fuel storage should have an EIS.

Comments opposing the petitions centered on the following:

- Petitioners failed to show that regulatory relief is needed to address "new and significant" information concerning the potential for spent fuel fires in connection with high-density SFP storage. None of the documents that the Petitioners cite or reference satisfied the NRC's standard for new and significant information.

- Petitioners failed to show that the Commission should rescind its Waste Confidence decision codified at 10 CFR 51.23, or change its determination that the environmental impacts of high-density spent fuel storage are insignificant.

- The Commission has recently affirmed its longstanding view that NEPA demands no terrorism inquiry, and that the NRC therefore need not consider the environmental consequences of hypothetical terrorist attacks on NRC-licensed facilities.

- The Commission's rejection of the Ninth Circuit Court's view is consistent with the U.S. Supreme Court's position that NEPA should not be read to force agencies to consider environmental impacts for which they cannot reasonably be held responsible. Moreover, the NRC has, in fact, examined terrorism under NEPA and found the impacts similar to the impacts of already-analyzed, severe reactor accidents.

The NRC staff reviewed and considered the comments in its decision to deny both petitions. In-depth details on the reasons for denial are provided in the enclosed proposed *Federal Register* notice. Reasons for denial are briefly highlighted in the Petitioners' assertions below.

1. New and Significant Information.

The Petitioners asserted that new and significant information shows that the NRC incorrectly characterized the environmental impacts of spent fuel storage as "insignificant." The information relied upon by the Petitioners, however, is neither "new" nor "significant," within the NRC's definition of those terms. The NRC defines these terms in its Supplement 1 to NRC Regulatory Guide (RG) 4.2, *Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses*, Chapter 5, September 2000. "New and significant" information, which would require supplementing NUREG-1437, is defined as follows:

(a) Information that identifies a significant environmental issue that was not considered in NUREG-1437 and, consequently, not codified in Appendix B to Subpart A of 10 CFR Part 51; or

(b) Information that was not considered in the analyses summarized in NUREG-1437 and that leads to an impact finding different from that codified in 10 CFR Part 51.

The Petitioners' "new and significant" information does not meet the RG 4.2, Supplement 1 criteria. Sections 6.4.6.1. to 6.4.6.3 of NUREG-1437, and the analyses cited therein, including

the NRC's "Waste Confidence Rule" (December 6, 1999; 55 FR 38474, 38480-81), extensively considered the risk of SFP accidents. Moreover, to the extent any information submitted by the Petitioners was not considered in NUREG-1437, none of the information is "significant," because it would not lead to "an impact finding different from that codified in 10 CFR Part 51," or as set forth in NUREG-1437.

2. Spent Fuel Assemblies Will Burn If Their Tops Are Uncovered.

The NRC does not agree with the Petitioners' assertions. The NRC has determined that a zirconium-cladding fire does not occur when only the tops of the fuel assemblies are uncovered. In reality, a zirconium fire cannot occur unless fuel uncovering is more substantial. Even then, the occurrence of a zirconium fire requires a number of conditions which are extremely unlikely to occur together. Significant, more detailed and realistic analyses have been performed since September 11, 2001, that support the view that the risk of a successful terrorist attack (i.e., one that results in a SFP zirconium fire and leads to a release of a large amount of radioactive material into the environment), though numerically indeterminate, is very low. The analyses were conducted by the Sandia National Laboratories. The Sandia studies, which are security related, provide a more realistic assessment of the coolability of spent fuel under a range of conditions and a better understanding of the actual safety margins, than was indicated in NUREG-1738. The Sandia studies have conclusively and consistently shown that the safety margins are much larger than indicated by previous studies such as NUREG-1738. The Sandia studies also demonstrate that additional SFP mitigation measures will significantly reduce the likelihood of a zirconium fire.

3. Fuel Will Burn Regardless of its Age.

The NRC disagrees with the Petitioners' assertion that fuel will burn regardless of age. Older fuel (fuel which has been discharged from the reactor for a longer time) is more easily cooled and is less likely to ignite because of its lower decay power. A study relied upon by the Petitioners, NUREG-1738, did conservatively assume that spent fuel stored in an SFP, regardless of age, may be potentially vulnerable to a partial drain down event, and that the possibility of a zirconium fire could not be ruled out on a generic basis. This conclusion, however, was in no sense a statement of certainty and was made in order to reach a conclusion on a generic basis, without relying on any plant-specific analyses.

Furthermore, the SFP zirconium fire frequency in NUREG-1738 was predicated on a bounding, conservative assumption that an SFP fire involving all of the spent fuel would occur if the water level in the SFP dropped below the top of the spent fuel. The NUREG-1738 analysis did not attempt to specifically address a number of issues and actions that would substantially reduce the likelihood of a zirconium fire, potentially rendering the frequency estimate to be remote and speculative. For example, NUREG-1738 did not account for the additional time available following the spent fuel being partially or completely uncovered, but prior to the onset of a zirconium fire, that would allow for plant operator actions, makeup of SFP water levels, and other mitigation measures. In addition, NUREG-1738 did not consider the added benefit provided by plant and procedure changes implemented as a result of the events of the September 11, 2001, terrorist attacks. NUREG-1738 did clarify that the likelihood of a zirconium fire under such conditions could be reduced by accident management measures, but it was not the purpose of NUREG-1738 to evaluate such accident management measures.

4. SFP Zirconium Fire Will Propagate.

Although it is possible that once a spent fuel assembly ignites, the zirconium fire can propagate to other assemblies in the SFP, the NRC has determined that the risk of an SFP zirconium fire initiation is very low.

5. SFP Zirconium Fire May Be Catastrophic.

a. Not New and Significant Information; Extremely Low Probability.

The Massachusetts AG states that, "while such a catastrophic accident is unlikely, its probability falls within the range that NRC considers reasonably foreseeable." Thus, the Petitioners asserted that an SFP fire qualifies as a design-basis accident (DBA) and that the impacts of a SFP fire must be discussed in the ER submitted by the licensee and the NRC's EIS, as well as designed against under NRC safety regulations.

The facts that a SFP contains a potentially large inventory of radionuclides and that a release of that material could have adverse effects are not new. These facts are well known, and were considered in the risk evaluation of spent fuel storage contained in NUREG-1738. Even with the numerous conservatisms in the NUREG-1738 study, the NRC was able to conclude that the risk from spent fuel storage is low, and is substantially lower than reactor risk.

A study relied upon by the Petitioners, the Thompson Report, claims that the probability (frequency) of a SFP fire would be 2E-5 per year[1] for events excluding acts of malice (*e.g.*, terrorism) and 1E-4 per year[2] for acts of malice. With respect to random events (i.e., excluding acts of malice), staff concludes that the Thompson report estimate is overly conservative. A more complete and mechanistic assessment of the event and associated mitigation measures leads to considerably lower values. With respect to events initiated by a terrorist attack, the staff concludes such probability (frequency) estimates are entirely speculative. We also conclude that the additional mitigation of SFP events implemented since September 11, 2001, together with the more realistic assessment of spent fuel cooling, indicates that the likelihood of a zirconium fire is very low, though numerically indeterminate.

b. Shearon Harris Atomic Safety and Licensing Board Panel (ASLBP) Proceeding.

A similar allegation that a severe accident at the adjacent reactor would result in an SFP zirconium fire was raised and litigated before the NRC's ASLBP, with respect to the expansion of the SFP at the Shearon Harris Nuclear Power Plant.[3]

Based on a detailed probabilistic risk assessment, the Sharon Harris licensee calculated the probability of a severe reactor accident causing an SFP fire to be 2.78E-8 per year. The NRC staff calculated the probability to be 2.0E-7 per year. The intervenor calculated the probability to be 1.6E-5 per year. The ASLBP concluded that the probability of the postulated sequence of events resulting in an SFP fire was, "conservatively in the range described by the NRC staff:

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[1] Two occurrences in 100,000 reactor years.
[2] One occurrence in 10,000 reactor years.
[3] *Carolina Power Light Co.*, LBP-01-9, 53 NRC 239 (2001).

2.0E-7 per year (two occurrences in 10 million reactor years) or less."[4] Accordingly, the ASLBP found that the occurrence of a severe reactor accident causing an SFP fire was "remote and speculative." The Commission affirmed the ASLBP's decision, and the United States Court of Appeals, District of Columbia Circuit, upheld the Commission's decision.[5]

In the above proceeding, the intervenor assumed that, given an early containment failure or bypass, a spent fuel zirconium fire would occur (i.e., a conditional probability of 1.0). In order for a reactor accident to lead to a SFP zirconium fire a number of additional conditions must occur. The reactor accident and containment failure must somehow lead to a loss of SFP cooling and must lead to a condition where extreme radiation levels preclude personnel access to take corrective action. There must be then an inability to restart cooling or makeup systems. There must be a loss of significant pool water inventory through evaporation (which can take substantial time). Finally, the event must also lead to a zirconium fire. In contrast to the intervenor's estimate, the licensee and the NRC staff estimated a conditional probability of about one percent that a severe reactor accident with containment failure would lead to a SFP accident. In PRM-51-10, the Petitioner has reduced its conditional containment failure probability estimate to 50 percent. However, no supporting factual basis was provided. In the absence of a technical basis for this assertion, the NRC staff expects that the conditional probability of a SFP zirconium fire, given a severe reactor accident, would be similar to that established in the Shearon Harris proceeding. As such, the probability of a SFP zirconium fire due to a severe reactor accident and subsequent containment failure would be well below that estimated by the petitioner, and within the category of remote and speculative matters.

c. SFP Zirconium Fire Does Not Qualify As a DBA.

Regarding the Petitioners' assertion that an SFP fire qualifies as a DBA, the NRC staff has concluded that a realistic probability estimate would be very low, such that these events need not be considered as DBAs or discussed in ERs and EISs. Moreover, the set of accidents that must be addressed as part of the design basis has historically evolved from deterministic rather than probabilistic considerations (and therefore, would not include SFP fires). These considerations, which include defense-in-depth, redundancy, and diversity, are characterized by the use of the single-failure criterion.[6] The single-failure criterion, as a key design and analysis tool, has the direct objective of promoting reliability through the enforced provision of redundancy in those systems which must perform a safety-related function. The SFP and related systems have been designed and approved in accordance with this deterministic approach.

6. Intentional Attack on a SFP is "Reasonably Foreseeable."

The Petitioner has raised both the NAS Report and the decision by the United States Court of Appeals for the Ninth Circuit, *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016 (9th Cir. 2006), *cert. denied* 127 S. Ct. 1124 (2007), to support its assertion that the NRC's

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[4] *Id.*, 53 NRC at 267.
[5] *Carolina Power Light Co.*, Commission Law Issuance (CLI)-01-11, 53 NRC 370 (2001), *pet. for review denied, sub nom, Orange County, NC v. NRC*, 47 Fed. Appx. 1, 2002 WL 31098379 (D.C. Cir. 2002).
[6] "A single failure means an occurrence which results in the loss of capability of a component to perform its intended safety functions . . . Fluid and electric systems are considered to be designed against an assumed single failure if neither 1) a single failure of any active component . . . nor 2) a single failure of a passive component . . . results in a loss of the capability of the system to perform its safety functions." 10 CFR Part 50, App. A.

NEPA analysis of a license renewal action for a given facility must include analysis of the environmental impacts associated with a terrorist attack on that facility. As described in the enclosed proposed *Federal Register* notice, the NRC staff has considered both the NAS Report and the Ninth Circuit decision, and believes that an analysis of the environmental impacts of a hypothetical terrorist attack on a NRC-licensed facility is not required under NEPA.[7] But, if an analysis of a hypothetical terrorist attack were required under NEPA, the NRC has determined that the environmental impacts of such a terrorist attack would not be significant, because the probability of a *successful* terrorist attack is very low and within the category of remote and speculative matters.

7. SFP Zirconium Fire be Considered within the Analysis of SAMAs.

The anticipated consequences of SFP fires have not changed substantially since the potential for SFP accidents with high density racks was first assessed as part of Generic Issue 82, *Beyond Design Basis Accidents in Spent Fuel Pools*, and later, in NUREG-1738. However, based on the Sandia Studies and on the implementation of additional strategies following the September 11, 2001, terrorist attacks, the probability of an SFP fire is expected to be less than that reported in NUREG-1738 and previous studies. Thus, even if consequences of an SFP fire are comparable to or somewhat higher than those for a severe reactor accident, the extremely low probability of an SFP fire would result in an SFP risk level less than that for a reactor accident.

Given that the SFP risk level is less than that for a reactor accident, a SAMA that addresses SFP accidents would not be expected to have a significant impact on total risk for the site. Despite the low level of risk from fuel stored in SFPs, additional SFP mitigative measures have been implemented by licensees in response to September 11, 2001. These mitigative measures further reduce the risk from SFP fires, and make it unlikely that additional SFP safety enhancements could substantially reduce risk or be cost-beneficial.

RECOMMENDATION:

Based upon its review of the petitions, the NRC staff has determined that the studies upon which the Petitioners rely do not constitute new and significant information. The staff has further determined that its findings related to the storage of spent nuclear fuel in pools, as set forth in NUREG-1437 and in Table B-1, of Appendix B to Subpart A of 10 CFR Part 51, remain valid. Thus, the NRC has met and continues to meet its obligations under NEPA. Accordingly, the staff recommends denying both PRMs, and requests Commission approval to do so and publish the *Federal Register* notice (Enclosure 1) of the denials. Letters are enclosed for the Secretary's signature (Enclosures 2 and 3), informing the Petitioners of the Commission's decision to deny the PRMs. Appropriate Congressional Committees will be informed.

[7] The NRC will, of course, comply with the Ninth Circuit decision for those NRC licensed facilities located within the states subject to the jurisdiction of the Ninth Circuit.

COORDINATION:

The Office of the General Counsel has reviewed this package and has no legal objection.

/RA/

Luis A. Reyes
Executive Director
for Operations

Enclosures:
1. *Federal Register* Notice
2. Letter to MA Attorney General
3. Letter to CA Attorney General

COORDINATION:

The Office of the General Counsel has reviewed this package and has no legal objection.

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