POLICY ISSUE
(Information)

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FOR: The Commissioners

FROM: Mark A. Satorius
Executive Director for Operations

SUBJECT: CONSEQUENCE STUDY OF A BEYOND-DESIGN-BASIS EARTHQUAKE AFFECTING THE SPENT FUEL POOL FOR A U.S. MARK I BOILING-WATER REACTOR

PURPOSE:

The purpose of this paper is to provide to the Commission the final report of the enclosed study entitled, "Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor." This paper completes the action directed by the Staff Requirements Memorandum (SRM) dated July 16, 2012 (ADAMS Accession No.: ML121980043). This paper does not address any new commitments or resource implications.

BACKGROUND AND SUMMARY OF STUDY RESULTS:

The March 11, 2011, Tohoku earthquake and subsequent tsunami in Japan resulted in significant damage to the Fukushima Dai-ichi nuclear power station. Although the spent fuel pools (SFPs) and the spent fuel assemblies stored in the pools remained intact, the event led to questions about the safe storage of spent fuel and whether the U.S. Nuclear Regulatory Commission (NRC) should require expedited transfer of spent fuel from pools to dry cask storage at U.S. nuclear power plants.

The purpose of the enclosed study is to help the agency determine if accelerated transfer of spent fuel from the spent fuel pool to dry cask storage significantly reduces risks to public health and safety. The study provides consequence estimates of a hypothetical spent fuel pool

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accident initiated by a low-likelihood seismic event at a reference plant based on the Peach Bottom BWR Mark I spent fuel pool. The study compares high-density and low-density loading conditions and assesses the benefits of post 9/11 mitigation measures.

This study shows the likelihood of a radiological release from the spent fuel after the analyzed severe earthquake at the reference plant to be very low (about 1 time in 10 million years or lower). For the hypothetical releases studied, the study predicted no early fatalities attributable to radiation exposure and individual latent cancer fatality risks are low; however, the study suggested that extensive protective actions may be needed for both the high and low density pool loadings.

DISCUSSION:

Various risk studies (most recently NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," issued February 2001 [ADAMS Accession No. ML010430066]) have shown that storage of spent fuel in a high-density configuration in SFPs is safe and that the risk to public health and safety from a SFP accident is very low. In response to the events of September 11, 2001, the NRC undertook security assessments of spent fuel storage in pools and casks. Moreover, in conjunction with these post-9/11 security assessments, the NRC issued an order─later codified in Title 10 of the *Code of Federal Regulations*, Section 50.54(hh)(2)─that requires reactor licensees to develop and implement guidance and strategies intended, in part, to maintain or restore SFP cooling capabilities following certain beyond-design-basis events (including explosions and fires). The agency also reviewed the safety of spent fuel stored in high-density configurations in a response to Petition for Rulemaking (PRM)-51-10 and PRM-51-12 as well as the revision to NUREG-1437, Revision 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants - Draft Report for Comment," issued July 2009 (the final NUREG is expected to be published soon).

The staff performed the enclosed consequence study to continue NRC's examination of the risks and consequences of postulated spent fuel pool accidents. This study presents detailed analyses using state-of-the-art, validated, deterministic methods and assumptions as well as probabilistic insights where practical. Previous studies have shown that earthquakes present the dominant risk for spent fuel pools. Therefore, this analysis considered a severe earthquake that would be expected to occur once in 60,000 years with ground motion stronger than the maximum earthquake used for the design basis for the reference plant. The staff considers the ground motion used in this study more challenging for the spent fuel pool structure than that experienced at the Fukushima Dai-ichi nuclear power plant from the earthquake that occurred off the coast of Japan on March 11, 2011. That earthquake did not result in any spent fuel pool leaks. This study's results for the specific reference plant and earthquake analyzed are consistent with past studies' conclusions that spent fuel pools are likely to withstand severe earthquakes without leaking. The regulatory analysis included in the study indicates that expediting movement of spent fuel from the pool does not provide a substantial safety enhancement for the reference plant.

The staff presented the report to the Advisory Committee on Reactor Safeguards (ACRS) on July 9, 2013. The ACRS subsequently submitted a letter to the Commission on July 18, 2013 (ML13198A433), and the NRC provided a response on August 14, 2013 (ML13205A242). The NRC released a draft report to the public in a press release on June 24, 2013 (ML13175A104), and published a *Federal Register* notice (FRN) on July 2, 2013, announcing a 30-day public comment period. The report received responses from 14 different public commenters.

Appendix E of the enclosed report contains those comments and the staff's responses. None of the comments or responses has necessitated making substantial changes to the report.

One of the objectives of the current study is to inform the NRC's Japan Lessons Learned Tier 3 activities. The staff will use the results of the study to inform a broader regulatory analysis of the spent fuel pools at U.S. operating nuclear reactors.

Please note that the staff intends to proceed with making the attached report public, and the report will be subsequently published as a NUREG.

COORDINATION:

The Office of the General Counsel has reviewed the draft study and has no legal objections. The Office of the Chief Financial Officer reviewed this paper for resource implications and has no objections.

/RA/

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for Operations

Enclosure:
As stated

cc: SECY
OCA
OGC
OPA
CFO