UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

April 25, 2012

The Honorable Gregory B. Jaczko
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SPENT FUEL POOL SCOPING STUDY

Dear Chairman Jaczko:

During the 593rd meeting of the Advisory Committee on Reactor Safeguards, April 12-14, 2012, we reviewed the methods and approaches being used in the Office of Nuclear Regulatory Research (RES) Spent Fuel Pool Scoping Study (SFPSS). Our Materials, Metallurgy, and Reactor Fuels and Reliability and PRA Subcommittees jointly reviewed the methods and approaches as well as preliminary results of this study on March 6, 2012. During these meetings, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

CONCLUSIONS

1. The SFPSS is being performed in an organized and systematic manner, and is using modern NRC codes to evaluate the change in consequences from seismically induced spent fuel pool accidents with high and low-density loading.

2. The SFPSS consists of a detailed deterministic analysis of the consequences of a severe seismic event on a spent fuel pool at a single boiling water reactor (BWR) site.

3. The study will contribute to the technical basis for making decisions regarding expedited transfer of older irradiated spent nuclear fuel (SNF) from spent fuel pools.

BACKGROUND

The SFPSS was initiated in July 2011 and is planned for completion by June 2012. The staff was tasked with developing updated information on key aspects of potential spent fuel pool accident consequences on an aggressive one year schedule. The staff was directed to move expeditiously in a technically rigorous manner, using modern codes and methods.

To accomplish this task, the staff reviewed past consequence and risk assessments related to SNF storage, as well as other reports of relevance that have been developed by other organizations. The staff identified seismic hazard as the logical starting point to assess the continued applicability of past studies and to develop insights for the SFPSS. Depending on the results gained from the SPFSS, additional work may be appropriate to reach generally applicable conclusions for the U.S. BWR and pressurized water reactor (PWR) fleet.

Along with providing general updates to past information within the current operational and regulatory environment, the staff indicated that for the scenarios investigated, the study can address key questions and provide insights, such as:

- Do accident progression timelines for SNF pools proceed more slowly than previously thought?

- Do seismically induced station blackout scenarios contribute significantly to the overall consequences, or are these consequences dominated by seismically induced pool drain down?

- Do low-density loadings in spent fuel pools produce substantially different results in terms of public health effects and offsite consequences compared to high-density loadings?

- Do successful post event mitigation actions substantially reduce offsite consequences?

The staff indicated that answers to these questions are expected to be helpful in determining whether expedited transfers of SNF from pools to dry cask storage systems (DCSS) produce substantial safety benefits, thereby informing future regulatory decision making. Other ongoing efforts, such as planned Level 3 probabilistic risk analyses, will complement and build on this work.

DISCUSSION

The technical approach selected by the staff is focused on a detailed analysis of the spent fuel pool in a General Electric BWR-4 reactor at a single site during five phases of an operating cycle. Two conditions in the pool are considered: one representative of the current high-density loading in a relatively full SNF pool, and another representative of low-density loading in which older SNF has been removed to a dry cask storage facility. The elements of the study will include:

- seismic and structural assessments of the integrity of the pool and liner following seismic events with up to six times greater peak ground acceleration than the design basis safe shutdown earthquake (SSE) for the examined site;

- analysis of reactor building dose rates using the SCALE code package;

- accident progression analyses of fuel damage, fission product release, benefits of mitigation, and other effects using the MELCOR code modified to handle spent fuel pool accidents;

- emergency planning assessment;

- offsite consequences analyses of health effects and land contamination using the MACCS2 code; and

- probabilistic considerations.

The approach taken by the staff is capable of producing useful assessments of the consequences of severe seismic events on the structural integrity of the selected spent fuel pool design. The study is also capable of producing quantitative assessments of the safety benefits of low density fuel pool loading on the extent of fuel damage, land contamination, and off site health effects. However, since the study will not address the safety consequences of the same severe seismic events on cask loading, transportation, or long-term storage; the overall safety benefit will not be quantified. The possibility that there could be negative safety consequences associated the expedited loading, transfer, and long-term storage of possibly thousands of DCSS would need to be considered.

For the reasons noted above, the conclusions of the study may not be broadly applicable to the variety of reactor and pool designs in operation in the United States.

We look forward to a future review of the results and conclusions of the SFPSS.

Additional comments by ACRS Members J. Sam Armijo, Michael T. Ryan, Stephen P. Schultz, and Gordon R. Skillman are presented below.

Sincerely,

/RA/

J. Sam Armijo
Chairman

Additional Comments by ACRS Members J. Sam Armijo, Michael T. Ryan, Stephen P. Schultz, and Gordon R. Skillman

The staff's approach is rightly focused on the effects of severe seismic events on the structural integrity of U.S. spent fuel pools. Absent a failure of the pool structure and liner, there can be no rapid or uncontrollable draining of the pool, overheating and failure of the fuel cladding, release of radioactive fission products, and exposure to workers and the public. In the absence of pool failure and drain down, fuel cooling will be maintained in either the high density or low density loading scenarios to be studied in the SFPSS.

In view of the importance of pool structural integrity following seismic events, the SFPSS should be broadened to consider the performance of the spent fuel pools at the Fukushima Daiichi, Fukushima Daini, Onagawa, and Tokai sites following the severe Tohoku earthquake of March 2011, as well as the performance of the spent fuel pools at the Kashiwazaki-Kariwa site following the severe Chuetsu earthquake of July 2007. None of these pools suffered structural failure or drain down. The demonstrated robustness of the spent fuel pools at Fukushima Daiichi was noteworthy. These pools were subjected to the initial M9 earthquake, followed by several aftershocks greater than M7, and hundreds of lesser magnitude. In addition, the potentially weakened spent fuel pools in Units 1, 3 and 4 survived further structural loading from hydrogen explosions without significant damage or draining of the pool water. Although limited in scope, inspection of the fuel and sampling of the spent fuel pool water in the badly damaged Unit 4 revealed that the fuel had not suffered significant damage. By any reasonable standard, the performance of spent fuel pools protected the fuel from significant damage.

Since the spent fuel pools at Fukushima Daiichi were of the same design and vintage as the design chosen for the SFPSS, this broader approach could provide valuable data to confirm or correct the findings of the study.

REFERENCES

1. Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, NUREG-1738, February 2001(ML010430066)

2. RES Memorandum, Subject: Project Plan for Spent Fuel Pool Scoping Study, July 26, 2011 (ML111570370)

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