



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON NUCLEAR WASTE AND MATERIALS  
WASHINGTON, D.C. 20555-0001**

April 9, 2008

The Honorable Dale E. Klein  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

**SUBJECT: BURNUP CREDIT FOR DESIGN OF CRITICALITY SAFETY SYSTEMS  
IN PWR SPENT NUCLEAR FUEL CASKS**

Dear Chairman Klein:

During its 187<sup>th</sup> meeting, March 18-20, 2008, the Advisory Committee on Nuclear Waste and Materials (the Committee) heard presentations on the use of burnup credit for design of criticality safety systems in PWR spent nuclear fuel transportation casks. The presenters were Nuclear Regulatory Commission (NRC) and Oak Ridge National Laboratory (ORNL) staff. Comments were made by a representative of the Nuclear Energy Institute (NEI).

The Committee had been briefed on moderator exclusion and burnup credit at its 176<sup>th</sup> meeting on February 13-15, 2007, and its 177<sup>th</sup> meeting on March 20-22, 2007.

In its letter of April 23, 2007 (Reference 1), the Committee addressed moderator exclusion. The Committee recommended that staff use the existing regulation 10 CFR 71.55(c) as the basis for taking credit for moderator exclusion in certification of transportation casks to gain experience in processing such applications. This recommendation was summarized in the Committee's briefing to the Commission on November 14, 2007. A subsequent Staff Requirements Memorandum (SRM) (Reference 2) directed the staff to consult with the Committee to consider various sources of data for validating computer codes used to take burnup credit. The observations and recommendations that follow respond to this SRM.

## **OBSERVATIONS**

1. The Committee learned that burnup credit is not necessary for spent fuel storage casks because there is no credible mechanism for the cask to fill with water. However, there is such a credible mechanism for transportation casks where it is possible for a cask near a body of water along the transportation route to be breached and fill with water. Some spent fuel is currently stored in casks that could not be transported without burnup credit.
2. NRC Staff has stated that regulations in 10 CFR Parts 71 pertaining to maintaining subcriticality are deterministic.
3. The staff provided an example of radionuclides that contribute to burnup credit for Westinghouse PWR 17x17 fuel assemblies having an initial enrichment of 4%

and a burnup of 40 GWd/MTU. Credit for actinides provides a margin of subcriticality of about 20% (Reference 3). Credit for the six most important fission products increases the margin of subcriticality by an additional approximately 5% (Reference 4) and credit for all fission products would add another 1% increase. Although the margin of subcriticality would increase by only about 6%, the amount of fuel that could be loaded per cask would increase substantially.

4. Interim Staff Guidance-8, Revision 2, "Burnup Credit in the Criticality Safety Analyses of PWR Spent Fuel in Transport and Storage Casks," (Reference 5), allows applicants to take credit for actinide burnup and staff has certified transportation casks on this basis. Full burnup credit for fission products has not been allowed because of a paucity of benchmark data needed to establish biases and uncertainties in depletion and criticality calculations.
5. French benchmarking data, applicable to burnup credit for the key actinides has been purchased by DOE. The NRC staff and their contractors reported that these data are adequate for the foreseeable future. The French also have benchmark data applicable to burnup credit for the key fission products. These data have been favorably evaluated by ORNL for the NRC but are only available for evaluation and must be purchased to be used for licensing purposes. The staff is recommending that these data be acquired.
6. The Transportation, Aging and Disposal (TAD) canister proposed by the Department of Energy (DOE) for disposal at the proposed Yucca Mountain repository would render the burnup credit question moot for transportation of spent nuclear fuel and for fuel stored in accordance with a prospective DOE TAD requirement. A TAD can accommodate 21 PWR fuel assemblies or 44 BWR fuel assemblies and burnup credit would not be needed.

## **RECOMMENDATIONS**

1. The Committee recommends that the staff take a risk-informed approach to evaluating burnup credit, including consideration of realistic and credible scenarios, probabilities, and consequences. Such an approach would provide insights on the magnitude and uncertainties of the safety margin in meeting the current deterministic requirements of 10 CFR 71.55(b). In particular, the probabilities of criticality under a variety of transportation scenarios relevant to burnup credit should be investigated.
2. The Committee recommends that staff systematically evaluate the costs and benefits of acquiring the French criticality benchmark data for key fission products. Factors that should be considered include: (1) the potential use of TADs; (2) delays that would result from obtaining criticality data from other sources; (3) the cost and risk reduction from making fewer shipments with higher

fuel loading per cask; and (4) the absence of better depletion benchmark data for the key fission products.

Sincerely,

**/RA/**

Michael T. Ryan  
Chairman

## REFERENCES

1. Ryan, 2007. Letter from M. T. Ryan to Chairman Dale Klein: "Use of Credit for Moderator Exclusion in the Licensing Of Spent Nuclear Fuel Transportation Packages," April 23, 2007. (ML071150483)
2. NRC, 2007. Memorandum from A. Vietti-Cook to L. Reyes: "Staff Requirements – SECY-07-0185 – Moderator Exclusion in Transportation Packages," December 18, 2007. (ML073520174)
3. Parks, 2008a. Presentation of Dr. Cecil Parks, Transcript of Proceedings of the 187<sup>th</sup> meeting of the Advisory Committee on Nuclear Waste [sic], March 19, 2008, p. 33 line 7.
4. Parks, 2008b. Presentation of Dr. Cecil Parks, Transcript of Proceedings of the 187<sup>th</sup> meeting of the Advisory Committee on Nuclear Waste [sic], March 19, 2008, p. 36 line 4.
5. NRC, 2002. Spent Fuel Project Office, Interim Staff Guidance (ISG) – 8, Rev. 2, "Burnup Credit in the Criticality Safety Analyses of PWR Spent Fuel in Transport and Storage Casks," September 27, 2002. (ML022700555)

fuel loading per cask; and (4) the absence of better depletion benchmark data for the key fission products.

Sincerely,

**/RA/**

Michael T. Ryan  
Chairman

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