



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

ACNWR-0260

April 23, 2007

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

**SUBJECT: USE OF CREDIT FOR MODERATOR EXCLUSION IN THE LICENSING OF
SPENT NUCLEAR FUEL TRANSPORTATION PACKAGES**

Dear Chairman Klein:

At the 176th meeting of the Advisory Committee on Nuclear Waste (the Committee or ACNW) on February 13–15, 2007, staff from the Office of Nuclear Materials Safety and Safeguards, Division of Spent Fuel Storage and Transportation, briefed the Committee on taking credit for moderator exclusion for spent nuclear fuel (SNF) transportation packages. The staff of the U.S. Nuclear Regulatory Commission (NRC) sought advice from the Committee on its intention to begin background preparation for a rulemaking on moderator exclusion. At the Committee's 177th meeting on March 20–22, 2007, representatives from the Nuclear Energy Institute (NEI), the Electric Power Research Institute (EPRI), the Idaho National Laboratory (INL), and H322 Consulting LLC briefed the Committee on this topic. The briefings addressed the advantages and disadvantages of taking credit for moderator exclusion (with some discussion of burnup credit) in preventing criticality during transportation. The meeting included a roundtable discussion involving all presenters. The participants did not discuss safeguards and security aspects of the transportation of SNF.

The NRC staff briefing highlighted the current regulatory framework for transportation of fissile material, regulations for fissile material packages, current staff practice with respect to criticality prevention and moderator exclusion, considerations if the practice is changed, and interim staff guidance (ISG-19, "Moderator Exclusion under Hypothetical Accident Conditions and Demonstrating Subcriticality of Spent Fuel under the Requirements of 10 CFR 71.55(e)").

The current rule (Title 10, Section 71.55, "General Requirements for Fissile Material Packages," of the *Code of Federal Regulations* (10 CFR 71.55)) requires that fissile material being transported be in a configuration such that criticality cannot occur even if water, a neutron moderator, partly or completely fills the package. The requirements of 10 CFR 71.83, "Assumptions as to Unknown Properties," provide a bounding case for determining the assumptions for fissile content of SNF. If the inventory of germane radionuclides is known, burnup credit can be granted. Prevention of criticality could be demonstrated by either guaranteeing that water is excluded (moderator exclusion) or recognizing that the material does not have its original fissile content and contains some fission poisons (burnup credit), or both. Presenters from NEI and EPRI indicated that if burnup credit, including credit for fission products, were considered for commercial SNF in criticality analyses, credit for moderator exclusion might not be needed because the combination of less fissile material and poisoning by fission products could be shown to prevent a criticality.

Industry participants reported that if burnup credit were granted for the current fleet of dual-purpose storage and transportation casks, some of these casks could then be transported. This would avoid the need to repackage them for transport.

In addition, the U.S. Department of Energy has an inventory of noncommercial SNF destined for the proposed high-level waste repository. This noncommercial SNF exhibits such a wide range of enrichment and burnup that it is difficult to adequately characterize it for burnup credit. The INL representative presented the test sequence for the canister-in-canister transportation package, showing that water would not infiltrate the inner canister and thereby strengthening the proposal for moderator exclusion.

SNF could be shipped more efficiently than at present in transportation packages granted an exception under 10 CFR 71.55(c). This exception would allow such shipments with the following conditions:

if the package incorporates special design features that ensure that no single packaging error would permit leakage, and if appropriate measures are taken before each shipment to ensure that the containment system does not leak.

ACNW Observations

- The regulations in 10 CFR 71.55(b) require that fissile transportation packages be subcritical even when optimally moderated (fully flooded), so that criticality is impossible in the as-loaded condition. Credit for moderator exclusion is a demonstration of subcriticality without moderator (no water in-leakage) inside a transportation package containment system. Under 10 CFR 71.55(c), the NRC can approve an exception to 10 FR 71.55(b) if the applicant can show that water in-leakage can be completely excluded from the transportation package, or if the amount of water that could enter is not sufficient to cause criticality. To date, the NRC has not received a request for an exception for an SNF transportation package design or for shipments that rely on moderator exclusion for criticality safety, though industry participants seem willing to make such requests.
- As currently written, 10 CFR 71.55 is deterministic and not risk-informed. Exceptions to 10 CFR 71.55 may be risk-informed, but this does not affect the deterministic nature of the regulation. The regulation as written concentrates on preventing a criticality during transportation but considers alternate methods of reducing risks only as case-by-case exceptions.
- ISG-19 allows moderator exclusion for commercial SNF transportation during hypothetical accident conditions (as described in 10 CFR 71.55(e)). However, ISG-19 does not give relief from 10 CFR 71.55(b) (i.e., subcriticality must still be ensured with water inside the containment system with the fuel in the as-loaded configuration).
- Moderator exclusion and burnup credit are not separate issues. Either or both would allow a larger amount of SNF to be transported in a single package.

- To date, the NRC staff has approved one application for a transportation package with partial (actinide plus some fission products) burnup credit. The staff is now considering a second application.
- Current staff thinking suggests that rulemaking might be appropriate to codify moderator exclusion for certain packages under certain conditions. In addition, rulemaking would provide an opportunity for public input.
- The staff expressed concern that if major vendors seek exceptions under 10 CFR 71.55(c), many SNF shipments will be made under an exception rather than an affirmative rule. Routine use of the exception under 10 CFR 71.55(c) may call into question the assumptions underlying the generic environmental impact statement for transportation of radioactive materials.

ACNW Recommendations

- The Committee recommends that the staff use the existing rule at 10 CFR 71.55(c) to evaluate submittals from applicants seeking to apply moderator exclusion provisions of the rule. A decision about rulemaking should be deferred until more experience is obtained using the existing provisions of the rule.
- The Committee recommends that guidance be made risk-informed and include consideration of both moderator exclusion and burnup credit.

Sincerely,

/RA/

Michael T. Ryan
Chairman

References

1. *Code of Federal Regulations*, Title 10, Part 71, "Packaging and Transportation of Radioactive Material."
2. Nuclear Regulatory Commission, "Moderator Exclusion under Hypothetical Accident Conditions and Demonstrating Subcriticality of Spent Fuel under the Requirements of 10 CFR 71.55(e)," Interim Staff Guidance 19, Rev. 0, May 2003.

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