UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D.C. 20555-0001

November 12, 1999

Dr. William D. Travers
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Dr. Travers:

SUBJECT: SPENT FUEL FIRES ASSOCIATED WITH DECOMMISSIONING

During the 467th meeting of the Advisory Committee on Reactor Safeguards, November 4-6, 1999, we reviewed a draft report of a technical study prepared by the NRC staff on the spent fuel pool accident risk at decommissioning plants. During our review, we had the benefit of discussions with representatives of the NRC staff, the Nuclear Energy Institute (NEI), and two members of the public. We also had the benefit of the documents referenced.

Background

The staff discussed with us the status of its ongoing work on this issue. We appreciate the opportunity to provide our views on the direction of this effort at this interim stage.

The staff has formed a Technical Working Group with the objective of assessing the risks associated with spent fuel pools for decommissioning plants. The intent is to assist the Office of Nuclear Reactor Regulation in developing an integrated rule for decommissioning, to provide guidance for interim exemption requirements, and to identify areas where additional work is needed.

Fuel removed from a reactor must be covered with water for cooling until its decay heat generation rate falls below a critical value. Risks posed by fuel stored in a pool arise from the possibility that this water cooling may be lost. The staff has a two-fold approach to evaluating the issues of spent fuel storage: (1) develop estimates of the decay time required to avoid runaway oxidation of spent fuel clad in the event of accidental uncovery, and (2) develop a risk assessment using a broad set of initiating events and using the end-state consequence of uncovery to the top of the fuel.

NEI has interacted with the staff on this effort and has provided a review of the draft report entitled, "Technical Study of Spent Fuel Pool Accidents for Decommissioning Plants." NEI provided us with its assessments. Our understanding of the more substantive issues raised by NEI is:

1. Conservatism, especially in human error rates, has skewed the preliminary risk insights.

2. The choice of uncovery to the top of the fuel as the endpoint is difficult to relate to public risk. NEI believes that the analyses should be carried all the way to postulated runaway oxidation.

3. The cladding temperature used as the threshold for onset of runaway oxidation is too low.

We also had benefit of the remarks by a member of the public who expressed concern about the:

- Degree of public participation in this effort
- Acceptability to the public of PRA (probabilistic risk assessment) based regulations
- Lack of sufficient margins and defense-in-depth
- Severity of the consequences
- Vulnerability to terrorism
- Applicability of the database used for equipment failures
- Potential for recriticality

Conclusions and Recommendations

1. We agree with the general approach for determining the decay time beyond which runaway oxidation cannot occur. However, an uncertainty analysis related to the oxidation kinetics and the heat rejection mechanisms is needed. The present analysis is limited to relatively low-burnup levels and associated clad hydriding and oxidation. There are no experimental data on the behavior of realistic fuel and cladding under representative conditions. Either very conservative choices will have to be made for decay times or additional experimental research will have to be conducted.

2. We support the staff's approach to developing a decay heat critical temperature for the onset of runaway oxidation. Uncertainties in these analyses need to be quantified and factored into any decisions regarding the required decay time.

3. PRAs should be as realistic as possible. The staff should reevaluate the basis for its choices particularly for human error rates. We agree with the staff's proposal to use expert opinion to validate or modify the human reliability analyses to ensure that the analyses are not overly conservative.

4. Arguments about conservative versus realistic values are aggravated when point estimates are used for the input parameters to the risk assessments. As stated in our December 16, 1997 report, we believe that uncertainties can be best addressed by expressing the inputs as probability distributions rather than point estimates. Such distributions are easier to defend. In addition, the insights to be gained from the risk analysis would greatly benefit if the results were presented as distributions.

5. We agree with the choice of uncovery to the top of the fuel as being an appropriate end state for the PRA consequence analysis. The database on air oxidation kinetics for high-burnup fuel, subsequent fuel damage behavior, and fission product release is too sparse and the uncertainties too great to provide confidence in carrying the analyses any farther. The acceptable frequency of this end point can be based on consideration of the health consequences resulting from postulated fuel failures. Because prompt fatalities cannot be ruled out, we recommend that the acceptable frequency for this end point be the same as that for large, early release frequency in Regulatory Guide 1.174, which is a surrogate for the prompt fatality Safety Goal.

With the choice of uncovery as the end state of the analysis, the uncertainties due to model inadequacies associated with fire risk assessment are not large. We believe that the spent fuel fire issue would be a good candidate for testing the development of a rationalist regulatory approach, as discussed in our May 19, 1999 report.

We look forward to reviewing the staff's progress in this area.

Sincerely,

Dana A. Powers

Dana A. Powers
Chairman

References:

1. Draft report entitled, "Technical Study of Spent Fuel Pool Accidents for Decommissioning Plants," prepared by NRC Technical Working Group, June 1999.
2. A Review of Draft NRC Staff Report: "Draft Technical Study of Spent Fuel Pool Accidents for Decommissioning Plants," prepared by ERIN Engineering and Research, Inc., for Nuclear Energy Institute, dated August 27, 1999.
3. Draft (undated) EPRI Technical Report, "Evaluation of Spent Fuel Pool Seismic Failure Frequency in Support of Risk Informed Decommissioning Emergency Planning," prepared by Duke Engineering & Services.
4. Letter dated September 3, 1999, from Mr. David A. Lochbaum, Union of Concerned Scientists, to NRC Commissioners, Subject: Inadequately Monitored Spent Fuel Pool Temperature and Operator Response Times at Permanently Closed Plants.
5. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," July 1998.
6. ACRS report dated December 16, 1997, from R. L. Seale, Chairman, ACRS, to Shirley Ann Jackson, Chairman, NRC, Subject: Treatment of Uncertainties Versus Point Values in the PRA-Related Decisionmaking Process."
7. ACRS report dated May 19, 1999, from Dana A. Powers, Chairman, ACRS to Shirley Ann Jackson, Chairman, NRC, Subject: The Role of Defense in Depth in a Risk-Informed Regulatory System.