ACRSR-1917

November 8, 2000

The Honorable Richard A. Meserve
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Chairman Meserve:

SUBJECT: DRAFT FINAL TECHNICAL STUDY OF SPENT FUEL POOL ACCIDENT RISK AT DECOMMISSIONING NUCLEAR POWER PLANTS

During the 477th meeting of the Advisory Committee on Reactor Safeguards, November 2-4, 2000, we discussed the draft final technical study of spent fuel pool accident risk at decommissioning nuclear power plants. The ACRS Reactor Fuels Subcommittee also met on October 18, 2000, to discuss this matter. During these meetings, we had the benefit of discussions with the staff and with representatives from NEI and the Institute for Resource and Security Studies. We also had the benefit of the documents referenced.

OBSERVATIONS AND RECOMMENDATIONS

1. This revised technical study provides an adequate basis for decisions on emergency preparedness (EP) requirements at decommissioning plants. The study has addressed concerns expressed in our report dated April 13, 2000.

2. Although the information is not needed for the decision on EP, the final report should include the calculated consequences for total deaths, injuries, and land contamination to provide input to decisions concerning insurance and safety at decommissioning plants.

3. The ACRS and stakeholders who appeared at our meetings on this subject agree that the staff needs to develop a better phenomenological understanding of the thermal hydraulics, chemical reactions, source terms, and physical phenomena associated with spent fuel pool fires as a basis for future risk-informed decisions concerning safety during plant decommissionings.

4. While not necessary for the intended use of this study, there is a need to reconcile the Lawrence Livermore National Laboratory (LLNL) seismic hazard curves and the Electric Power Research Institute (EPRI) seismic hazard curves so that the agency will have a consistent basis for its future seismic-related regulatory decisions.

DISCUSSION

In our April 13, 2000, report on an earlier draft of this study, we identified a number of concerns, including:

1. The inappropriate use of the Regulatory Guide (RG) 1.174 risk acceptance criterion for large early release frequency (LERF) in view of the expected differences in source terms for air-oxidation accidents and steam-oxidation accidents.

2. The use of an ignition temperature based on data from fresh (nonhydrided) cladding.

3. The lack of consideration of uncertainties in plume dispersion parameters.

4. The initial plume energy used in the atmospheric dispersion assessment could be substantially greater in a spent fuel fire than in an operating reactor accident.

5. The assessment of the seismic risk.

We are pleased that the revised technical study has addressed each of these concerns as follows.

LERF Acceptance Criterion and the Source Term

The revised technical study carried out the risk analysis for a representative site and included atmospheric transport and consequence determination. Instead of relying on a LERF surrogate, the results can be directly compared with the prompt and latent fatality Safety Goals. Based on sensitivity studies, the staff adopted a revised source term with a ruthenium release fraction of 0.75 and an actinide release fraction of 0.035. These values appear defensible for an air-oxidation source term based on the experimental data currently available.

Ignition Time for a Zirconium (Zr) Fire

Because of the lack of prototypic data and the large uncertainty associated with the requisite heat transfer analyses, particularly under obstructed air flow conditions, the study concluded that ignition of the Zr clad could not be precluded for any specific time period. We believe this to be an appropriately conservative approach until additional data and better analyses are available.

Atmospheric Dispersion Uncertainty

To estimate the uncertainty in the consequences as a result of atmospheric dispersion of released radioactivity, a total of 300 MELCOR Accident Consequence Code System (MACCS) calculations were performed using distributions of the dispersion parameters, s_y and s_z. This is a credible way to deal with these uncertainties and provides a better basis for decisionmaking.

Plume Energy

The staff performed a sensitivity calculation in which the plume energy dissipation rate for spent fuel pool fires was selected at three values covering the plausible range. This, too, provides technical input needed for the decisionmaking process.

Seismic Risk Assessment

The revised technical study used a less conservative (than the earlier draft study) but still simplified method that made use of a typical high confidence of low probability of failure (HCLPF)

for a plant. The simplified method then combined the HCLPF with both the LLNL and the EPRI seismic hazard curves to estimate the seismic risk. We found this to be an acceptable approach for the purpose of comparing prompt fatalities and latent cancers with the Safety Goals.

For the cases using the more conservative LLNL seismic hazard curves, high ruthenium release, and significant actinide release, the overall individual risk of prompt fatalities is about a factor of 4 lower than the Safety Goal and the individual risk of latent cancer fatality is about an order of magnitude less than the Safety Goal. Emergency response measures had negligible effect on these results. Since severe seismic events dominated the risk of spent fuel fires at decommissioning plants, the staff argued that emergency response would be hindered by the collateral seismic damage to the transportation and communications infrastructure. Thus, the emergency response was equivalent to "late evacuation" (i.e., the population in the emergency response zone was modeled as being outdoors for the first 24 hours and then evacuated). Emergency response would be effective only for other-than-seismic accident sequences. Because these sequences develop slowly, there is time for effective *ad hoc* measures. These sequences, however, make a smaller contribution to risk, and therefore, emergency response planning is of marginal value. We agree with the staff's arguments and find that the technical study provides an adequate basis for decisions on potential relaxation of the EP requirements at decommissioning plants.

Regulatory decisions related to spent fuel pools should not be based solely on individual risk of prompt fatalities and the individual cancer risk. The large amounts of cesium and strontium, which have long half-lives, coupled with the higher plume energy and the larger values of the dispersion parameters recommended by experts, increase the relative importance of societal risk (total deaths), injuries, and land contamination. These may become more important consequences than individual prompt and latent fatalities if compared on the basis of equivalent cost or other appropriate metrics. For decisions concerning safety at decommissioning plants, all of the projected consequences calculated by MACCS should be included in the technical study report. These results, however, may underestimate these consequences because they are calculated only out to 100 miles. It should be possible to derive acceptance limits for these consequences from the Safety Goals based on concepts like equivalent cost.

The technical study used the LLNL and EPRI seismic hazard curves in assessing the seismic risks. The staff had no basis for excluding either of these sets of curves. Given this situation, future regulatory decisions involving seismic issues will have to be based on the most conservative of these whenever it matters to the decisionmaking process. This amounts to an inappropriate exclusion of the EPRI curves and a built-in bias toward use of the LLNL curves. The NRC cosponsored a study that proposes a process for the development of a single set of hazard curves (Reference 3). The agency should proceed with the development of such a combined set of curves for its future decision making needs.

Sincerely,

/RA/

Dana A. Powers
Chairman

References:

1. Letter dated October 12, 2000, from G. M. Holahan, NRR, to John T. Larkins, ACRS, Subject: Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants.
2. Report dated April 13, 2000, from Dana A. Powers, Chairman, ACRS, to Richard A. Meserve, Chairman, NRC, Subject: Draft Final Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants.
3. U.S. Nuclear Regulatory Commission, NUREG/CR-6372, “Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts,” prepared by R.J. Budnitz, G. Apostolakis, D.M. Boore, L.S. Cluff, K.J. Coppersmith, C.A. Cornell, and P.A. Morris, April 1997.