ACRSR-2003

July 18, 2002

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

Dear Dr. Travers:

SUBJECT: DRAFT ADVANCED REACTOR RESEARCH PLAN

During the 494th meeting of the Advisory Committee on Reactor Safeguards, July 10-12, 2002, and a meeting of our Subcommittee on Future Plant Designs on July 8, 2002, we were briefed by representatives of the NRC's Office of Nuclear Regulatory Research (RES) on the subject Plan. We also had the benefit of the document referenced.

The draft Advanced Reactor Research Plan appears to us to be a very competent effort by the staff. It is comprehensive and reflects a high level of understanding of the issues, existing state of the art, and past and ongoing research results and activities. We commend the RES staff on its effort to date. The Plan is not yet complete in the sense that it does not establish resources, schedules, and milestones. Nevertheless, we believe that addressing the research needs already identified in the Plan is very important.

COMMENTS

1. We agree that research on High Temperature Gas Cooled Reactors (HTGRs) should continue. However, given the current uncertain status of the Pebble Bed Modular Reactor (PBMR), the research for HTGRs should focus on generic issues and the Gas Turbine-Modular Helium Reactor (GT-MHR) concept.

2. We consider the development of fission product release models for TRISO fuels to be the key research need for the gas-cooled reactor concepts. All the current models for fission product release in the MELCOR computer code are empirical and based on data obtained from light water reactor (LWR) fuel at burnup levels less than 45 GWd/t. To extend these models to HTGRs will require research on fission product release from highly irradiated HTGR fuel. Even the form of the empirical models (diffusive in nature) may not be appropriate to TRISO fuel for which the release of fission products is primarily related to the failure rate of the coatings, which is not well-described by a diffusive-like correlation.

3. A viable research plan can be developed in the absence of a well-defined framework for risk-informed regulations. However, such a framework can help prioritize the research and is important for other reasons. The work on the framework should be given higher priority.

4. Plans should be developed for experiments to investigate degradation and fission product release characteristics of the advanced LWR's core with very high-burnup fuel [particularly International Reactor Innovative and Secure (IRIS) design].

5. A risk-informed approach for selecting design-basis events and choosing acceptance criteria for the new designs needs to be developed.

6. The use of Phenomena Identification and Ranking Table (PIRT) is an essential ingredient of the Plan and should be developed early in the process. Because we have doubts that a "super-PIRT" that encompasses the entire program would be effective, the PIRTs should be focused on specific research areas.

7. Consideration should be given to research to determine whether the buildup and characteristics of radioactivity in the coolant system during the operating phase of the HTGRs could be used to infer whether the as-installed fuel quality meets the required (licensing-basis) quality.

8. The Plan should include an element to maintain cognizance of the international near-term deployment and GEN IV concepts, with anticipation that research eventually may be needed to address issues associated with technology concepts that are significantly different than those of the Plan's focus.

9. If in-vessel retention via external flooding of the reactor vessel is anticipated as an accident management strategy for AP1000 (and perhaps IRIS), we believe this reopens the need for additional consideration of fuel coolant interactions (steam explosions). The state of the art for fuel coolant interactions is not yet sufficiently advanced to predict the occurrence and energetics of steam explosions.

10. Because there is a general need for large-scale integral testing of new concepts, the staff should evaluate the utility of the proposed concept of "licensing by test."

Additional comments by ACRS Members Dana A. Powers, Stephen L. Rosen, and Graham B. Wallis are provided below.

Sincerely

/RA/

George E. Apostolakis
Chairman

Additional Comments by ACRS Members Dana A. Powers, Stephen L. Rosen, and Graham B. Wallis

Design-basis accidents are prominent features of the regulatory process for existing reactors. The design-basis accident concept, which originated in the 1950s, was an important element of reactor safety analysis in an era when comprehensive, integrated analyses involving wide ranges of accident initiators and the possibility of multiple systems failures were not practical undertakings. It can be argued that design-basis accidents have served the safety regulation of the current generation of nuclear power plants well. It must also be acknowledged that the

accident at Three Mile Island revealed deficiencies of the design-basis accident concept. Design-basis accidents divert safety focus toward stylized accidents that, by definition, have exceptionally low probabilities at the expense of ensuring plants have capabilities of coping with more likely events.

The conduct of comprehensive, integrated plant analyses is now well-developed and, indeed, such analyses are essential features of the regulatory process for advanced reactors. These analyses supplant the need for design-basis accidents in the regulatory process for advanced reactors. Specialized attention to a few, low probability accidents does not add to plant safety if integrated, comprehensive accident analyses are done well. Design-basis accidents do create unnecessary burdens for both licensees and regulators. Design-basis accidents, then, should not be considered in the Advanced Reactor Research Plan.

Reference:

U. S. Nuclear Regulatory Commission, Advanced Reactor Research Plan (Draft), Revision 1, Office of Nuclear Regulatory Research, June 2002.