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

December 10, 2004

Mr. Luis A. Reyes
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SAFETY EVALUATION OF THE INDUSTRY GUIDELINES RELATED TO PRESSURIZED WATER REACTOR SUMP PERFORMANCE

Dear Mr. Reyes:

Thank you for your letter of November 26, 2004, which responded to our letter of October 18, 2004, on the staff safety evaluation (SE) of the Industry Guidelines Related to Pressurized Water Reactor Sump Performance.

We appreciate the staff's desire to move ahead to resolve Generic Safety Issue-191, "Assessment of Debris Accumulation on Pressurized Water Reactor (PWR) Sump Performance." As licensees attempt to use the guidance, we anticipate that they will have to cope with several technical problems due to errors in the suggested methods. We disagree with your statement that the knowledge limitations are clearly identified and addressed in the SE. In our letter, we identified a number of these limitations. The purpose of this letter is to restate several of the limitations, and to respond to some of the staff's replies.

The head loss correlation in NUREG/CR-6224 (Ref. 1) is not entirely empirical, as claimed by the staff, but rests in part on the theoretical representation of two physical phenomena: the mechanical compression of the bed and the limit of this compression. The theoretical models for these phenomena are erroneous. Although some results may be predicted with apparent adequacy, the faulty models lead to some conclusions that are obviously at odds with reality. For example, correlating bed compression with the pressure gradient is inconsistent with standard methods in the literature and cannot explain the compression of a fiber bed by the imposed pressure from a superposed particulate bed, as in the "thin bed effect." In addition, the NUREG/CR-6224 equation for the compression limit would predict that a fiber bed could be compressed up to the limiting particulate bed density even when there are no particles present, which makes no sense. The foundation of the correlation of data must be theoretically sound if the user of the guidance is to extrapolate a very limited range of data to real plant conditions.

The Committee commented in its letter that the effect on coatings of a two-phase jet is not well understood. The staff agreed "that the nature and effects of a two-phase LOCA jet on coatings are not well understood and that there is a lack of data on coatings." However, the staff still believes that the guidance is acceptable because of "precedents set by past applications approved by the staff and accepted by the ACRS or based on the staff approach of applying conservative assumptions to bound the unknowns." Unfortunately, because the phenomena are not well known, the uncertainties are also not well known, so the staff's "conservative assumptions" are only engineering judgment, without any technical basis.

We are pleased that the staff has alerted the American Nuclear Society to our technical comments on the 1988 ANSI/ANS standard (Ref. 2). However, the claim that Appendix I of the SE contains a "detailed evaluation" of this model is incorrect. Appendix I explains how to use the model, but repeats the technical errors contained in the model, such as the assumption of an "asymptotic plane" beyond which there are no supersonic effects, and the use of a stagnation density to describe a high-velocity stream. As a result, we have not seen convincing arguments that it is conservative to use the ANSI/ANS standard to determine the size of the zone of influence.

The staff claims that it is appropriate to assume that the debris bed is homogeneous, with the particles uniformly distributed through it. The staff also claims to supply guidance about the "thin bed effect," which is the extreme case where all the particles concentrate in a single layer. These two arrangements of the debris are limiting situations of the general case in which various degrees of inhomogeneity occur; they cannot be true simultaneously. The guidance should address a wider range of possible inhomogeneities. It should allow the user to predict how much inhomogeneity occurs and the resulting head loss. There also needs to be better guidance on how the head loss evolves with time (as observed in experiments documented by NRC contractors), apparently because of the development of inhomogeneities, and on how extreme inhomogeneity can give rise to anomalously high head loss.

The guidance is also inadequate for evaluating downstream effects. It merely lists issues to be considered. It does not explain how to determine whether the issues are resolved, or how to perform an "integrated evaluation". Licensees will have to derive the acceptance criteria themselves.

There is also no useful guidance on chemical effects. The staff has only told the industry not to get caught by unexpected results from the ongoing experimental program.

We continue to believe that both the SE and the Nuclear Energy Institute guidance document contain technical faults and limitations that will have to be corrected at some stage in order for the methods to be sufficiently robust and durable to support sound regulatory decisions.

Sincerely

/RA/

Mario V. Bonaca
Chairman

References:

1. NUREG/CR-6224, "Parametric Study of the Potential for BWR WCCS Strainer Blockage Due to LOCA Generated Debris," G. Zigler et.al., October 1995.
2. ANSI/ANS-58.2-1988, "Design Basis for Protection of Light-Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture," American Nuclear Society, October 6, 1988.