October 26, 2006

Applied Analysis Corporation
P.O. Box 518
Shillington, PA 19607-0518

Subject: Regulatory Guide 1.183 - Containment Spray Aerosol Removal Models

Dear Mr. Cajigas,

During the U.S. Nuclear Regulatory Commission's (NRC's) June 2006 workshop on implementation of an alternative source term (AST), you commented on the staff's containment spray aerosol removal models and handed me additional information on this subject. This letter responds to your comments.

As I understand, your organization, Applied Analysis Corp. (AAC), perceives the NRC's regulatory guidance as being overly conservative. In particular, AAC interprets a footnote in Appendix A of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms For Evaluating Design Basis Accidents at Nuclear Power Reactors" as requiring no more than 10% uncertainty in the particulate removal parameters characterized by NUREG/CR 5966, "A Simplified Model of Aerosol Removal by Containment Sprays" (Powers' Model).

The staff's approval of the use of the Powers' Model in RG 1.183 does not require application of any particular level of uncertainty. Rather, the staff evaluates the soundness of engineering calculations commensurate with the plant- and scenario-specific characteristics. General acceptance of the 10% level of uncertainty reflects the fact that it is sufficiently conservative for all of the current reactor designs under any postulated design basis accident condition. Other spray removal rates may be found acceptable if appropriately justified.

In summary, the staff recognizes the existence of significant uncertainties associated with the implementation of AST. Given these uncertainties, the staff believes that use of the median statistical value can be justified on the basis of plant- and scenario-specific characteristics.

Enclosed is a discussion of some of the technical issues presented in your letter.

Sincerely,

/RA/

Margie Kotzalas, Chief
Accident Dose Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

Enclosure

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Enclosure

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Discussion of Technical Points

AAC states that the spray removal model, as presented in the Standard Review Plan (SRP) Chapter 6.5.2, is overly conservative (i.e., its application leads to an overestimation of the release from containment).

> The SRP formula was derived for a single droplet size spray (NUREG 0772, "Technical Bases for Estimating Fission Product Behavior During LWR Accidents," Appendix E). For a given spray flow, the calculated aerosol removal rate depends on the choice of a representative spray droplet size and an effective collision efficiency. The perceived conservatism is a result of the traditional practice of using a conservatively large spray droplet size (e.g., 1,000 microns) and conservatively low collision efficiency. For example, use of a 100 micron spray droplet would produce a spray removal rate 10 times higher than that of a 1,000 micron spray droplet, which may be overly optimistic. The staff recognizes, however, the difficulty with the choice of, and justification for, the representative spray droplet size and collision efficiency.

AAC states that the Powers' Model conservatively ignores diffusiophoretic deposition.

> The staff agrees with this statement. The diffusiophoretic, as well as thermophoretic, contributions are relatively small and well within the uncertainties accounted for in the statistical methodology applied in NUREG/CR 5966.

AAC states that in the staff rebaselining studies (SECY 98-154) all "MELCOR best estimate calculations produced lower dose estimates even when compared with the least conservative Powers' 90% model."

> This result does not invalidate the Appendix A footnote. The studies performed in support of SECY 98-154 indicate that the lower calculated doses may range "from a slight reduction up to an order of magnitude decrease," which is consistent with the use of removal rate distributions presented in the NUREG/CR 5966. In addition, the study points out that the use of different dose conversion factors also contribute to the dose reduction.

AAC refers to the approved AP 1000 design, where the use of Powers' 50% model was accepted.

> The AP 1000 design does not have a safety grade spray system, so its effect was <u>not</u> included in the design basis calculations. The approved dose calculations accounted for the design's passive features (i.e., the calculated aerosol removal rate was based on thermophoretic and diffusiophoretic phenomena). The staff evaluated the applicant's natural deposition model with a new study derived from the Powers' aerosol natural deposition model (NUREG/CR 6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments") in which the median statistical values of the study were used. The staff's discussion of use of the median values was given in the AP 1000 Safety Evaluation, Section 15.3.6. Therefore, in this particular case, the staff believes that the use of the median values is justified.

ENCLOSURE