



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

June 13, 2008

The Honorable Dale E. Klein  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

SUBJECT: ARTIST TEST PROGRAM

Dear Chairman Klein:

During the 553<sup>rd</sup> meeting of the Advisory Committee on Reactor Safeguards, June 4-6, 2008, we reviewed the results of the tests conducted by the Paul Scherrer Institut (PSI) at the Aerosol Trapping in a Steam Generator Test (ARTIST) facility in Switzerland. During this review, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

### **CONCLUSION**

The ARTIST test program has provided sufficient experimental data to close out Item 3.3a, "Development of Experimental Information on Aerosol Source Term Attenuation on the Secondary Side of Steam Generators," of the NRC Steam Generator Action Plan.

### **BACKGROUND**

The ARTIST test program was sponsored by an international consortium, including the NRC. This was a four-year program and was completed in 2007. The program investigated the retention of aerosols representative of those produced during severe core damage accidents as they pass through a ruptured steam generator tube and are transported through the secondary side of the steam generator. This retention is measured by the decontamination factor which is the ratio of the aerosol mass entering the primary side of the steam generator to that exiting the secondary side.

During this four-year program, a number of separate effects tests as well as large-scale integral tests were performed. Several important variables were investigated, including: aerosol particle size, composition and concentration, break location, break geometry, and carrier gas velocity. The aerosols used in the program included 0.3 - 0.7  $\mu\text{m}$  diameter  $\text{TiO}_2$  particles, and 1.4 - 3.7  $\mu\text{m}$  diameter  $\text{SiO}_2$  particles.

The scaled steam generator at the ARTIST test facility was 10.5 meters in height and contained prototypic steam generator tubing, a separator, and a dryer. The tube bundle consisted of 276, 3.8 meters long U-tubes, which were welded to a tube sheet and supported by near-prototypic support plates. The number of tubes in the bundle was selected to ensure dissipation of

momentum in the horizontal direction before the flow escaped the tube bundle. Vertical flow was similar to what would be expected in a full-size steam generator. The test program evaluated aerosol deposition inside the steam generator tubes, on the tubes adjacent to the break, along the secondary side of the steam generator tubes and shell, as well as on the steam separator and dryer.

The decontamination factors measured in the program are consistent with earlier expert panel recommendations made for NUREG-1150. The staff plans to use the test data obtained from the ARTIST program to refine the MELCOR code. We concur with the staff that the ARTIST test program has provided sufficient information to close out Item 3.3.a of the Steam Generator Action Plan.

Dr. Dana A. Powers did not participate in the Committee's deliberation regarding this matter.

Sincerely,

*/RA/*

William J. Shack  
Chairman

## REFERENCES

1. S. Guntay, D. Suckow, A. Dehbi, R. Kapulla, "ARTIST: Introduction and First Results," Paul Scherrer Institut, Nuclear Engineering and Design Vol. 231, pp 109-120, February 2004.
2. Memorandum to Mark A. Cunningham, Director, Division of Risk Assessment, Office of Nuclear Reactor Regulation, from Farouk Eltawila, Director, Division of Systems Analysis, Office of Nuclear Regulatory Research, "Steam Generator Action Plan (SGAP) Item 3.3a – Develop Experimental Information on Source Term Attenuation on the Secondary Side of Steam Generators (ARTIST Separate and Integral Tests)," November 8, 2007 (ML073040474 and ML073040435).
3. U.S. Nuclear Regulatory Commission "Steam Generator Action Plan," July 31, 2007 (ML072690547).
4. U.S. Nuclear Regulatory Commission, NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," December 1990.

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