ACRSR-1966

October 18, 2001

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

Subject: NRC ACTION PLAN TO ADDRESS THE DIFFERING PROFESSIONAL OPINION ISSUES ON STEAM GENERATOR TUBE INTEGRITY

Dear Chairman Meserve:

During the 486th meeting of the Advisory Committee on Reactor Safeguards, October 4-6, 2001, we reviewed the Action Plan developed by the NRC staff to address the differing professional opinion (DPO) issues on steam generator tube integrity. Our Subcommittee on Materials and Metallurgy had reviewed this Action Plan during its meeting on September 26, 2001. The purpose of our review was to determine whether the Action Plan adequately and appropriately responded to our recommendations included in NUREG-1740, "Voltage-Based Alternative Repair Criteria." During our review, we had the benefit of discussions with representatives of the NRC staff and of the documents referenced.

CONCLUSION

The Action Plan appropriately and adequately responds to our recommendations concerning the DPO on Steam Generator Tube Integrity. In the discussion that follows, we provide detailed comments on elements of the Action Plan that might help to refine and improve the efforts.

BACKGROUND

In February 2001, we sent to the Executive Director for Operations (EDO) an assessment of the technical issues raised in the DPO concerning alternative repair criteria for steam generator tubes in pressurized water reactors. We concluded that alternative repair criteria were needed and that general features of the criteria and the condition monitoring program the staff had endorsed provide such criteria that could adequately protect public health and safety. We did find that the DPO raised substantive technical issues that merited consideration. We made several recommendations to the EDO. Some were directly applicable to the details of the alternative repair criteria. Others related to the general risk status of plants with degrading steam generator tubes regardless of whether these plants had adopted the alternative repair criteria. Of the various recommendations, seven deserve to be highlighted:

1. Evaluate the potential for propagating steam generator tube damage during rapid depressurization caused by a main steamline break.

2. Monitor performance in search for systematic deviations from the linear bound on the nonlinear processes of crack initiation and growth through steam generator tube walls.

3. Improve the database for the correlation of tube leakage with voltage used in the condition monitoring program for 7/8" tubes.

4. Improve the analysis and understanding of radioactive iodine behavior during design-basis accidents.

5. Use improved risk assessments to support analyses of exemptions from the alternative repair criteria.

6. Develop a description of the probability of detection of steam generator tube flaws that will accommodate improvements in instrumentation and techniques.

7. Develop better understanding of the behavior of degraded steam generator tubes under severe accident conditions.

We concluded that the research that would be required to address our recommendations could be prioritized and pursued within the existing NRC research program augmented as necessary with additional resources.

DISCUSSION

The Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Regulatory Research have jointly developed the Action Plan to address our recommendations contained in NUREG-1740. This Action Plan, which has been incorporated into NRR's existing Steam Generator Action Plan, consists of eleven major activities:

1. Investigate the effects of depressurization during a main steamline break on steam generator tube integrity.

2. Complete investigation of jet penetration of adjacent tubes.

3. Develop experimental information on source term attenuation on the secondary side of steam generators (ARTIST tests).

4. Develop a better understanding of steam generator tube behavior under severe accident conditions.

5. Develop improved methods of assessing risk associated with steam generator tubes under accident conditions.

6. Assess the technical basis for improving the probability of crack detection in steam generator tubes.

7. Assess the need for better leakage correlations as a function of voltage for 7/8" steam generator tubes.

8. Monitor the predictions of flaw growth for systematic deviations from expectations.

9. Assess the need for a more technically defensible treatment of radionuclide release to be used in safety analyses of design-basis events.

10. Develop a better mechanistic understanding of tube cracking processes
.
11. Resolve Generic Safety Issue 163, “Multiple Steam Generator Tube Leakage.”

The Action Plan does, indeed, address our recommendations included in NUREG-1740. Time scales envisaged for the work are consistent with expectations we had when we formulated our recommendations. Although the proposed work has been well integrated with ongoing work on steam generator tube integrity, we do have comments on some of the specific activities of the Action Plan:

- The efforts to understand threats to tube integrity posed by depressurization during main steamline breaks (Item 1, above) depend heavily on computer code analyses. In the absence of defensible, conservative load predictions, there is a need to validate predictions of computer codes with experimental data on modes of motion of steam generator tube support plates and stresses that these motions place on steam generator tubes. As noted in NUREG-1740, extant experimental data on thermal hydraulics and forces on tube support plates during depressurization are suspect because of poor scaling of the experimental facilities.

- The NRC staff should actively participate in formulating and conducting the ARTIST tests to investigate decontamination on the secondary side of steam generators (Item 3, above) rather than simply waiting for the data from the tests to become available. Activities necessary to use and understand the data from the planned tests should be defined and included in the Action Plan.

- Plans for examining steam generator tube behavior under severe accident conditions (Item 4, above) are quite detailed. These plans should be augmented to include a detailed assessment of the understanding of loop-seal clearing and the subsequent behavior in the reactor coolant system.

- We are impressed by the progress that has been made in the modeling of mixing and flow in the steam generator input plenum using computational fluid dynamics (CFD) models. We believe that this work will serve as a good example of how the NRC can use CFD models to resolve complicated regulatory issues.

- The lack of a correlation between leakage and voltage for 7/8" tubes (Item 7, above) is perplexing, in view of the good correlation for the 3/4" tubes. The staff should investigate the reason for this.

- The proposed work in connection with developing a better understanding of radioactive iodine behavior under design-basis accident conditions (Item 9, above) suggests that the staff does not accept our recommendation. Certainly, the staff has not committed to develop further the existing, mechanistic models of the iodine spiking phenomenon.

- The effort to develop a mechanistic understanding of stress corrosion cracking and its relationship to voltage signals (Item 10, above), is very long-term in nature as would be expected. This work will be conducted under a continuing cooperative international research program on steam generator tube integrity.

Results of the research on the effects of jet impingement on adjacent tubes (Item 2, above) have shown that the probability of damage progression is low enough that it can be neglected in the accident analyses.

The Action Plan should provide valuable input on risk assessment, inspection processes, and periodicity to the evolving life management strategy for steam generators.

We look forward to continued interaction with the staff as results are obtained from its planned work to refine and improve the technical bases for the alternative repair criteria.

Dr. William J. Shack did not participate in the Committee's deliberations regarding this matter.

Sincerely,

/RA/

George E. Apostolakis
Chairman

References:
1. Memorandum dated June 1, 2001, from William D. Travers, Executive Director for Operations, NRC, to George Apostolakis, Chairman, ACRS, Subject: Steam Generator Action Plan Revision to Address Differing Professional Opinion (DPO) on Steam Generator Tube Integrity Issues.
2. U.S. Nuclear Regulatory Commission, NUREG-1740, "Voltage-Based Alternative Repair Criteria," Advisory Committee on Reactor Safeguards, March 2001.