U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

BRANCH TECHNICAL POSITION 5-1

MONITORING OF SECONDARY SIDE WATER CHEMISTRY IN PWR STEAM GENERATORS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of component integrity issues related to steam generator tubes

Secondary - None

A. BACKGROUND

Effective long-term reliable operation of pressurized-water reactor (PWR) steam generators requires that the design and operation of the steam generator are such that the barrier between the primary and secondary fluids maintains its integrity under operating (including design-basis accidents), maintenance, and testing conditions, as stated in GDC 1, 4, 14, 15, 30, and 31 of Appendix A to 10 CFR Part 50.

To provide assurance that these requirements are met, various measures have been taken, including (1) treating the secondary side water to remove impurities, (2) implementing operating procedures for removing accumulated corrosion products (including sludge and deposits) and other insoluble impurities and chemical contaminants from the steam generators, (3) designing SSCs to prevent impurities from entering the steam generator with makeup water, and (4) designing the steam generator to prevent the impurities from concentrating and forming sludges or deposits, especially in crevices.

Revision 3 - March 2007

Less than thoroughly effective water treatment, operational procedures, and design factors have led to the degradation of steam generator tubing, as documented by an extensive history of stress-corrosion cracking, wastage, and denting of steam generator tubing in operating PWRs. Therefore, the staff recommends the criteria below.

Industry water chemistry guidelines (e.g., the Electric Power Research Institute (EPRI) Secondary Water Chemistry Guidelines) continue to evolve to include more recent research and operating experience. Although the staff does not review or evaluate these guidelines, there is an expectation that plant water chemistry programs will be periodically reviewed and updated to reflect more recent information and trends in water chemistry management.

B. BRANCH TECHNICAL POSITION

1. The applicant's final safety analysis report (FSAR) should describe the implementation of a secondary water chemistry monitoring and control program in accordance with the supplier's recommended procedure to inhibit steam generator corrosion and tube degradation. The applicant should address how its program meets industry guidelines (e.g., EPRI's secondary water chemistry guidelines and Nuclear Energy Institute (NEI) 97-06). In addition, this program should cover all operational modes.

   Each of the modes should be defined with regard to percent rated thermal power and approximate temperature range.

2. The secondary water chemistry monitoring and control program should identify a sampling schedule for critical parameters during each mode of operation, as well as the acceptance control criteria for these parameters. At a minimum, the program should control pH, cation conductivity, sodium, and dissolved oxygen. However, other parameters merit consideration, such as specific conductivity, chloride, fluoride, suspended solids, silica, total iron, copper, sulfate, lead, ammonia, and residual hydrazine. Additives to each steam generator should be controlled separately.

3. The reviewer will evaluate the secondary water chemistry control and monitoring program of each individual plant. Significant deviations from the industry guidelines should be noted and justified technically.

   Records should be made of the monitored item values and should be made available for audit and inspection when deemed necessary.

4. Routine changes to the secondary water chemistry control and monitoring program should be reported as part of the biannual FSAR update, as required by 10 CFR 50.71. Changes shall be evaluated in accordance with the requirements of 10 CFR 50

C. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."

2. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."

3. 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary."

4. 10 CFR Part 50, Appendix A, General Design Criterion 15, “Reactor Coolant System Design.”

5. 10 CFR Part 50, Appendix A, General Design Criterion 30, “Quality of Reactor Coolant Pressure Boundary.”

6. 10 CFR Part 50, Appendix A, General Design Criterion 31, “Fracture Prevention of the Reactor Coolant Pressure Boundary.”

7. 10 CFR 50.59, “Changes, Tests, and Experiments.”

8. 10 CFR Part 50.71, “Maintenance of Records, Making of Reports.”

9. Electric Power Research Institute, “Pressurized Water Reactor Secondary Water Chemistry Guidelines.”

10. Nuclear Energy Institute, NEI 97-06, “Steam Generator Program Guidelines.”