XI.M25 BWR REACTOR WATER CLEANUP SYSTEM

Program Description

This program provides inspection to manage the aging effects of cracking due to stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC) on the intended function of austenitic stainless steel (SS) piping outboard of the second primary containment isolation valves in the reactor water cleanup (RWCU) system. Based on the Nuclear Regulatory Commission (NRC) criteria related to inspection guidelines for RWCU piping welds outboard of the second isolation valve, the program includes the measures delineated in NUREG-0313, Rev. 2, and in NRC Generic Letter (GL) 88-01 and its Supplement 1. The aging management review (AMR) Item in the GALL Report that credits this program also credits AMP XI.M2, "Water Chemistry," to provide mitigation of the aging effects. Reactor coolant water chemistry is monitored and maintained in accordance with the Water Chemistry program.

NRC GL 88-01 applies to all boiling water reactor (BWR) piping made of austenitic SS that is 4 inches or larger in nominal diameter and contains reactor coolant at a temperature above 93.3^{o} C (200^{o} F) during power operation regardless of code classification. NRC GL 88-01 requests, in part, that affected licensees implement an ISI program conforming to staff positions for austenitic SS piping covered under the scope of the letter. In response to NRC GL 88-01, affected licensees undertook ISI in accordance with the scope and schedules described in the letter and included affected portions of RWCU piping outboard of the second isolation valves in their ISI programs.

The NRC issued GL 88-01, Supplement 1, to provide acceptable alternatives to staff positions delineated in NRC GL 88-01. In NRC GL 88-01, Supplement 1, the staff noted, in part, that the position stated in NRC GL 88-01 on inspection sample size of RWCU system welds outboard of the second isolation valves had created an unnecessary hardship for affected licensees because of the very high radiation levels associated with this portion of RWCU piping. The staff also noted that affected licensees had requested that they be exempted from NRC GL 88-01 with regard to inspection of this piping of the RWCU system. Although NRC GL 88-01, Supplement 1, does not provide explicit generic guidance with regard to staff criteria for reduction or elimination of RWCU weld inspections, it does suggest that the staff would be receptive to modifications to a licensee's original docketed NRC GL 88-01 response for RWCU weld inspections, provided all issues of reactor safety were adequately addressed. The staff has subsequently allowed individual licensees to modify their docketed responses to GL-88-01 to reduce or eliminate their ISI of RWCU welds in the piping outboard of the second isolation valves. This AMP is based on the staff-approved screening criteria for the inspection.

Evaluation and Technical Basis

1. ***Scope of Program:*** This program provides ISI to manage the aging effects of cracking due to SCC or IGSCC in austenitic SS piping outboard of the second containment isolation valves in the RWCU system.

   The components included in this program are the welds in piping that have a nominal diameter of 4 inches or larger and that contain reactor coolant at a temperature above 93°C (200°F) during power operation, regardless of code classification.

2. ***Preventive Actions:*** The comprehensive program outlined in NUREG-0313 and NRC GL 88-01 addresses improvements in all three elements that, in combination, cause

SCC or IGSCC. These elements are a susceptible (sensitized) material, a significant tensile stress, and an aggressive environment. The program delineated in NUREG-0313 and NRC GL 88-01 includes recommendations regarding selection of materials that are resistant to sensitization, use of special processes that reduce residual tensile stresses, and monitoring and maintenance of coolant chemistry. The resistant materials are used for new and replacement components and include low-carbon grades of austenitic SS and weld metal, with a maximum carbon of 0.035 wt.% and a minimum ferrite of 7.5% in weld metal and cast austenitic stainless steel (CASS). Special processes are used for existing as well as new and replacement components. These processes include solution heat treatment, heat sink welding, induction heating, and mechanical stress improvement.

3. ***Parameters Monitored/Inspected:*** The aging management program (AMP) monitors SCC or IGSCC of austenitic SS piping by detecting and sizing cracks in accordance with the requirements of American Society of Mechanical Engineers (ASME) Code, Section XI; the guidelines of NUREG-0313, NRC GL 88-01, and NRC GL 88-01, Supplement 1; and the NRC screening criteria as described in Element 4 for the RWCU piping outboard of the second isolation valves.

4. ***Detection of Aging Effects:*** The extent, method, and schedule of the inspection and test techniques delineated in the NRC inspection criteria for RWCU piping and NRC GL 88-01 are designed to maintain structural integrity and to detect aging effects before the loss of intended function of austenitic SS piping and fittings. Guidelines for the inspection schedule, methods, personnel, sample expansion, and leak detection guidelines are based on the guidelines of NRC GL 88-01 and GL 88-01, Supplement 1, and subsequent licensing correspondence. Consistent with the NRC guidelines and with licensees' completion of all actions requested in NRC GL 89-10, no inspection of the outboard piping is required for (a) piping systems that are made of IGSCC-resistant piping materials or (b) piping with no IGSCC detected inboard of the second isolation valves (ongoing GL 88-01 inspection) and outboard of the second isolation valves (after inspecting a minimum of 10% of susceptible piping welds). For piping that includes a non-resistant base or weld material in the scope of the program or piping that has experienced IGSCC, either inboard or outboard of the second isolation valves, an inspection of at least 2% of the welds or two welds, whichever is greater, is performed on the portions of the RWCU system outboard of the second isolation valves every refueling outage.

5. ***Monitoring and Trending:*** The extent and schedule for inspection in accordance with the recommendations of NRC GL 88-01 provide timely detection of cracks and leakage of coolant. Based on inspection results, NRC GL 88-01 provides guidelines for additional samples of welds to be inspected when one or more cracked welds are found in a weld category.

6. ***Acceptance Criteria:*** NRC GL 88-01 recommends that any indication detected be evaluated in accordance with the requirements of ASME Code, Section XI, Subsection IWB-3640.[15]

7. ***Corrective Actions*****:** The guidance for weld overlay repair, stress improvement, or replacement is provided in NRC GL 88-01. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

[15] Refer to the GALL Report, Chapter I, for applicability of other editions of the ASME Code, Section XI.

8. ***Confirmation Process:*** Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of 10 CFR Part 50, Appendix B. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process and administrative controls.

9. ***Administrative Controls:*** As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the administrative controls.

10. ***Operating Experience:*** The IGSCC has occurred in small- and large-diameter boiling water reactor (BWR) piping made of austenitic stainless steels. The comprehensive program outlined in NRC GL 88-01 and NUREG-0313 addresses improvements in all elements that cause SCC or IGSCC (e.g., susceptible material, significant tensile stress, and an aggressive environment) and is effective in managing IGSCC in austenitic SS piping in the RWCU system.

References

10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2009.

ASME Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components*, The ASME Boiler and Pressure Vessel Code, 2004 edition as approved in 10 CFR 50.55a The American Society of Mechanical Engineers, New York, NY.

Letter from Joseph W. Shea, U.S. Nuclear Regulatory Commission, to George A. Hunger, Jr., PECO Energy Company, *Reactor Water Cleanup (RWCU) System Weld Inspections at Peach Bottom Atomic Power Station*, *Units 2 and 3 (TAC Nos. M92442 and M92443)*, September 15, 1995. (ADAMS Accession Number ML090930466)

Letter from Robert M. Pulsifer, U.S. Nuclear Regulatory Commission, to Michael A Balduzzi, Vermont Yankee Nuclear Power Corporation, *Review of Request to Discontinue Intergranular Stress Corrosion Cracking Inspection of RWCU Piping Welds Outboard of the Second Containment Isolation Valves (TAC No. MB0468),* March 27, 2001. (ADAMS Accession Number ML010780094)

NRC Generic Letter 88-01, *NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping,* U.S. Nuclear Regulatory Commission, January 25, 1988.

NRC Generic Letter 88-01, Supplement 1, *NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping,* U.S. Nuclear Regulatory Commission, February 4, 1992.

NRC Generic Letter 89-10, *Safety-related Motor Operated Valve Testing and Surveillance,* U.S. Nuclear Regulatory Commission, June 28, 1989; through Supplement 7, January 24, 1996.

NUREG-0313, Rev. 2, *Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping,* W. S. Hazelton and W. H. Koo, U.S. Nuclear Regulatory Commission, 1988.