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

March 20, 2013

Mr. R.W. Borchardt
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REGULATORY GUIDE 1.163, "PERFORMANCE-BASED CONTAINMENT LEAK-TEST PROGRAM," REVISION 1

Dear Mr. Borchardt:

During the 602nd meeting of the Advisory Committee on Reactor Safeguards, March 7, 2013, we reviewed proposed Revision 1 to Regulatory Guide (RG) 1.163, "Performance-Based Containment Leak-Test Program," dated August 2012. Our Regulatory Policies and Practices Subcommittee also reviewed this matter during a meeting on September 18, 2012. During these meetings, we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

RECOMMENDATION

The proposed revision of RG 1.163 should be issued.

BACKGROUND

Appendix J to 10 CFR Part 50 requires the following types of containment leakage tests:

- Type A Tests: Integrated leakage rate tests (ILRTs)
- Type B Tests: Leakage tests of penetration seals, gaskets, and expansion bellows
- Type C Tests: Leakage tests of containment isolation valves

Type B and C tests are referred to as local leakage-rate tests (LLRTs).

Maximum allowable leakage rates (L_a) are calculated in accordance with 10 CFR Part 100, "Reactor Site Criteria." Allowable leakage rates are about 0.1 percent containment volume per day for pressurized water reactors and about 1 percent containment volume per day for boiling water reactors. Sensitivity analyses in NUREG-1493 and other studies show that light water reactor accident risk is relatively insensitive to the containment leakage rate because the risk is dominated by accident sequences that result in failure or bypass of containment.

Appendix J has two options to determine test frequencies: Option A (Prescriptive) and Option B (Performance-Based). Under Option A, three Type A tests are to be performed at approximately equal intervals during each 10-year in-service inspection period. The Option B "Performance-Based Requirements," issued in 1995, allows licensees to replace prescriptive testing requirements with testing requirements based on leakage rate performance and a supporting plant-specific risk impact assessment. Option B also introduced a requirement for visual inspection of accessible portions of the containment. This requirement is usually met by the containment in-service inspection program in accordance with ASME Section XI, Subsections IWE/IWL required by 10 CFR Part 50.55a.

In 1995 the Nuclear Energy Institute (NEI) issued Topical Report 94-01, Revision 0, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J," which permitted extension of Type A test intervals from roughly 3 years to 10 years, extension of Type B intervals (except for airlocks) from 24 months to a maximum of 120 months, and extension of Type C intervals from 24 months to 60 months.

RG 1.163, issued in 1995, endorsed NEI 94-01, Revision 0, with limitations and conditions. The proposed revision of RG 1.163 endorses the guidance in NEI 94-01, Revision 3, for implementing Option B of Appendix J of 10 CFR Part 50, subject to the limitations and conditions in two safety evaluation reports (SERs): the SER for NEI 94-01, Revision 2, extending Type A test intervals up to 15 years and the SER for NEI 94-01, Revision 3, extending Type C test intervals up to 75 months.

Approximately 94 reactors have received one-time approval for 15 year Type A test intervals. RG 1.163, Revision 1, would permit licensees to request license amendments to implement an Option B program which would permit 15 year test intervals without case-by-case approval of the extended interval.

Extension of the test intervals is based on an acceptable performance history, and a plant-specific confirmatory risk assessment establishing that the risk increase associated with the extended intervals is small. Acceptable performance history is defined as successful completion of two consecutive tests where the leakage rate was acceptable.

Plants that rely on containment accident pressure for net positive suction head for emergency core coolant system injection for certain accident sequences must address this in the risk assessment. In the probabilistic risk assessment model, the failure rates for valves are assumed not to increase with time so that the likelihood of failure is simply proportional to the inspection interval, i.e., it assumes no new modes of failure are introduced. The likelihood of corrosion failures of the liner is assumed to increase with time of service. The base rate of corrosion failure is based on service experience, and sensitivity studies are used to estimate the impact of increased instances of corrosion failures.

DISCUSSION

The 10 CFR Part 50, Appendix J, Containment Leakage Testing Program (consisting of ILRTs and LLRTs) and the 10 CFR Part 50.55a Containment In-Service Inspection Program (in accordance with ASME Section XI, Subsections IWE/IWL) together are intended to ensure that containment structural and leakage integrity are maintained.

An important element of performance-based approaches to testing is monitoring of performance to ensure that expectations are met. In NUREG-1493, approximately 180 ILRT reports, performed under the original deterministic test intervals, were reviewed. Five ILRT failures were found which could not be detected by local leakage-rate testing. Tests under the extended intervals permitted by the performance-based approach show similar results. Of the 94 operating reactors that were given one-time 15-year ILRT interval approval, approximately 75 have completed 15-year Type A tests. No test failures have been reported. The instances of corrosion and fatigue failure of metallic liners and shells that have occurred, for example at North Anna, Brunswick, Beaver Valley, and Fitzpatrick, have been detected by visual examinations under the IWE program, not by ILRTs. An Electric Power Research Institute review of extended interval testing of Type C containment isolation valves shows that their performance has not degraded compared to the performance of Type C valves tested at the shorter intervals. Moreover, there does not appear to be an increase in the failure trend with service time.

The models used in the analyses that evaluate the change in risk from extending the test intervals are based on an assumption that the effects from incipient causes for equipment failures accumulate linearly over time. Large extensions of the surveillance intervals may not appropriately test for effects from unexpected failure modes or failure causes that behave nonlinearly with time. However, performance results from the extended test intervals that have been applied to date do not indicate that any new failure modes have been missed. Limiting the increase in the maximum test intervals to 15 years for Type A tests and 75 months for Type C tests is prudent. Continued monitoring of the performance will confirm this conclusion. The staggered performance of LLRT tests provides an opportunity to identify trends and correct deficiencies.

The proposed revision of RG 1.163 should be issued.

Sincerely,

/RA/

J. Sam Armijo
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission, RG 1.163, Rev. 1, “Performance-Based Containment Leak-Test Program,” August 2012. (ML12087A248)

2. Nuclear Energy Institute, NEI 94-01, Revision 3A, “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J,” July 31, 2012. (ML12221A202)

3. Electric Power Research Institute, EPRI Report 1009325, Revision 2A, “Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals,” October 2008.

4. U.S Nuclear Regulatory Commission, Safety Evaluation Input Regarding NEI Topical Report (TR) 94-01, Revision 3, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J,” April 5, 2012. (ML120810225)

5. U.S. Nuclear Regulatory Commission, Safety Evaluation for Nuclear Energy Institute (NEI) Topical Report (TR) 94-01, Revision 2, “Industry Guideline for Implementing Performance-based Option of 10 CFR Part 50, Appendix J,” and Electric Power Research Institute (EPRI) Report No. 100932, June 25, 2008. (ML081140105)

6. U.S. Nuclear Regulatory Commission, NUREG-1493, “Performance-Based Containment Leak-Test Program, Final Report,” September 1995. (9510200161)

7. Electric Power Research Institute, EPRI Report 1022599, “Type C Containment Isolation Valve Performance,” March 2011.

2. Nuclear Energy Institute, NEI 94-01, Revision 3A, “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J,” July 31, 2012. (ML12221A202)

3. Electric Power Research Institute, EPRI Report 1009325, Revision 2A, “Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals,” October 2008.

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5. U.S. Nuclear Regulatory Commission, Safety Evaluation for Nuclear Energy Institute (NEI) Topical Report (TR) 94-01, Revision 2, “Industry Guideline for Implementing Performance-based Option of 10 CFR Part 50, Appendix J,” and Electric Power Research Institute (EPRI) Report No. 100932, June 25, 2008. (ML081140105)

6. U.S. Nuclear Regulatory Commission, NUREG-1493, “Performance-Based Containment Leak-Test Program, Final Report,” September 1995. (9510200161)

7. Electric Power Research Institute, EPRI Report 1022599, “Type C Containment Isolation Valve Performance,” March 2011.

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