March 11, 2020

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: LIMERICK GENERATING STATION, UNITS 1 AND 2 − ISSUANCE OF AMENDMENT NOS. 241 AND 204 TO REVISE TECHNICAL SPECIFICATION 6.8.4.g, “PRIMARY CONTAINMENT LEAKAGE RATE TESTING PROGRAM,” TO EXTEND CONTAINMENT INTEGRATED LEAK RATE TEST FREQUENCY (EPID L-2019-LLA-0073)

Dear Mr. Hanson:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment Nos. 241 and 204 to Renewed Facility Operating License Nos. NPF-39 and NPF-85 for the Limerick Generating Station, Units 1 and 2, respectively, in response to your application dated April 9, 2019.

The amendments revise Technical Specification 6.8.4.g, “Primary Containment Leakage Rate Testing Program,” to adopt Nuclear Energy Institute (NEI) 94-01, Revisions 2-A and 3-A, “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J.” Specifically, the amendments allow the maximum interval for the integrated leakage rate test, also known as Type A test, to be extended permanently from once in 10 years to once in 15 years, and an administrative change to remove the exception under Technical Specification 6.8.4.g regarding the performance of the next Units 1 and 2 Type A test no later than May 15, 2013, and May 21, 2014, respectively, as these Type A tests have already occurred.

A copy of the related safety evaluation is also enclosed. Notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA James G. Danna for/

V. Sreenivas, Project Manager
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-352 and 50-353

Enclosures:
1. Amendment No. 241 to NPF-39
2. Amendment No. 204 to NPF-85
3. Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-352

LIMERICK GENERATING STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 241
Renewed License No. NPF-39

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Exelon Generation Company, LLC (the licensee) dated April 9, 2019, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Renewed Facility Operating License and Technical Specifications as indicated in the attachment to this license amendment.

3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility
Operating License and Technical
Specifications

Date of Issuance: March 11, 2020

ATTACHMENT TO LICENSE AMENDMENT NO. 241

LIMERICK GENERATING STATION, UNIT 1

RENEWED FACILITY OPERATING LICENSE NO. NPF-39

DOCKET NO. 50-352

Replace the following page of the Renewed Facility Operating License with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Page	Page
3	3

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Page	Page
6-14c	6-14c

(2) Pursuant to the Act and 10 CFR Part 70, to receive, possess and to use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(3) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility, and to receive and possess, but not separate, such source, byproduct, and special nuclear materials as contained in the fuel assemblies and fuel channels from the Shoreham Nuclear Power Station.

C. This renewed license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I (except as exempted from compliance in Section 2.D. below) and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Exelon Generation Company is authorized to operate the facility at reactor core power levels not in excess of 3515 megawatts thermal (100% rated power) in accordance with the conditions specified herein and in Attachment 1 to this license. The items identified in Attachment 1 to this renewed license shall be completed as specified. Attachment 1 is hereby incorporated into this renewed license.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 241, are hereby incorporated into this renewed license. Exelon Generation Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

g. Primary Containment Leakage Rate Testing Program

A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54 (o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions. This program shall be in accordance with the guidelines contained in NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR 50, Appendix J," Revision 3-A, dated July 2012, and the Limitations and Conditions specified in NEI 94-01, Revision 2-A, dated October 2008. The peak calculated containment internal pressure for the design basis loss of coolant accident, P_a, is 44.0 psig.

The maximum allowable primary containment leakage rate, L_a, at P_a, shall be 0.5% of primary containment air weight per day.

Leakage rate acceptance criteria are:

a. Primary Containment leakage rate acceptance criterion is less than or equal to 1.0 L_a. During the first unit startup following testing in accordance with this program, the leakage rate acceptance criteria are less than or equal to 0.60 L_a for the Type B and Type C tests and less than or equal to 0.75 L_a for Type A tests;

b. Air lock testing acceptance criteria are:

   1) Overall airlock leakage rate is less than or equal to 0.05 L_a when tested at greater than or equal to P_a.

   2) Seal leakage rate is less than or equal to 5 scf per hour when the gap between the door seals is pressurized to 10 psig.

The provisions of Specification 4.0.2 do not apply to the test frequencies specified in the Primary Containment Leakage Rate Testing Program.

The provisions of Specification 4.0.3 are applicable to the tests described in the Primary Containment Leakage Rate Testing Program.

h. Technical Specifications (TS) Bases Control Program

This program provides a means for processing changes to the Bases of these Technical Specifications.

a. Changes to the Bases of the TS shall be made under appropriate administrative controls and reviews.

b. Licensees may make changes to Bases without prior NRC approval provided the changes do not require either of the following:

A change in the TS incorporated in the license; or

A change to the UFSAR or Bases that requires NRC approval pursuant to 10 CFR 50.59.

c. The Bases Control Program shall contain provisions to ensure that the Bases are maintained consistent with the UFSAR.

d. Proposed changes that meet the criteria of b. above shall be reviewed and approved by the NRC prior to implementation. Changes to the Bases implemented without prior NRC approval shall be provided to the NRC on a frequency consistent with 10 CFR 50.71(e).

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-353

LIMERICK GENERATING STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 204
Renewed License No. NPF-85

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Exelon Generation Company, LLC (the licensee) dated April 9, 2019, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Renewed Facility Operating License and Technical Specifications as indicated in the attachment to this license amendment.

3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Renewed Facility
Operating License and Technical
Specifications

Date of Issuance: March 11, 2020

ATTACHMENT TO LICENSE AMENDMENT NO. 204

LIMERICK GENERATING STATION, UNIT 2

RENEWED FACILITY OPERATING LICENSE NO. NPF-85

DOCKET NO. 50-353

Replace the following page of the Renewed Facility Operating License with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Page	Page
3	3

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Pages	Pages
6-14c	6-14c

(2) Pursuant to the Act and 10 CFR Part 70, to receive, possess and to use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(3) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility, and to receive and possess, but not separate, such source, byproduct, and special nuclear materials as contained in the fuel assemblies and fuel channels from the Shoreham Nuclear Power Station.

C. This renewed license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I (except as exempted from compliance in Section 2.D. below) and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Exelon Generation Company is authorized to operate the facility at reactor core power levels of 3515 megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 204, are hereby incorporated into this renewed license. Exelon Generation Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

g. Primary Containment Leakage Rate Testing Program

A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54 (o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions. This program shall be in accordance with the guidelines contained in NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR 50, Appendix J," Revision 3-A, dated July 2012, and the Limitations and Conditions specified in NEI 94-01, Revision 2-A, dated October 2008.

The peak calculated containment internal pressure for the design basis loss of coolant accident, P_a, is 44.0 psig.

The maximum allowable primary containment leakage rate, L_a, at P_a, shall be 0.5% of primary containment air weight per day.

Leakage rate acceptance criteria are:

a. Primary Containment leakage rate acceptance criterion is less than or equal to 1.0 L_a. During the first unit startup following testing in accordance with this program, the leakage rate acceptance criteria are less than or equal to 0.60 L_a for the Type B and Type C tests and less than or equal to 0.75 L_a for Type A tests;

b. Air lock testing acceptance criteria are:

1) Overall airlock leakage rate is less than or equal to 0.05 L_a when tested at greater than or equal to P_a.

2) Seal leakage rate is less than or equal to 5 scf per hour when the gap between the door seals is pressurized to 10 psig.

The provisions of Specification 4.0.2 do not apply to the test frequencies specified in the Primary Containment Leakage Rate Testing Program.

The provisions of Specification 4.0.3 are applicable to the tests described in the Primary Containment Leakage Rate Testing Program.

h. Technical Specifications (TS) Bases Control Program

This program provides a means for processing changes to the Bases of these Technical Specifications.

a. Changes to the Bases of the TS shall be made under appropriate administrative controls and reviews.

b. Licensees may make changes to Bases without prior NRC approval provided the changes do not require either of the following:

A change in the TS incorporated in the license; or

A change to the UFSAR or Bases that requires NRC approval pursuant to 10 CFR 50.59.

c. The Bases Control Program shall contain provisions to ensure that the Bases are maintained consistent with the UFSAR.

d. Proposed changes that meet the criteria of b. above shall be reviewed and approved by the NRC prior to implementation. Changes to the Bases implemented without prior NRC approval shall be provided to the NRC on a frequency consistent with 10 CFR 50.71(e).

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 241 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-39 AND

AMENDMENT NO. 204 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-85

EXELON GENERATION COMPANY, LLC

LIMERICK GENERATING STATION, UNITS 1 AND 2

DOCKET NOS. 50-352 AND 50-353

1.0 INTRODUCTION

By application dated April 9, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19099A367), Exelon Generation Company, LLC (Exelon, the licensee) submitted a license amendment request (LAR) for the Limerick Generating Station (Limerick, LGS), Units 1 and 2. The amendments would revise Technical Specification (TS) TS 6.8.4.g, "Primary Containment Leakage Rate Testing Program," to adopt Nuclear Energy Institute (NEI) 94-01, Revisions 2-A and 3-A, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J" (ADAMS Accession Nos. ML100620847 and ML12221A202, respectively), as the guidance documents for the implementation of the performance-based Option B of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix J.

The amendments would allow the maximum interval for the integrated leakage rate test (ILRT), also known as Type A test, to be extended permanently from once in 10 years to once in 15 years in accordance with NEI 94-01, Revision 3-A, dated July 2012, and the conditions and limitations specified in Section 4.0 of the U.S. Nuclear Regulatory Commission (NRC, the Commission) safety evaluation (SE) on NEI 94-01, Revision 2-A, dated October 2008. In addition, the amendments would make an administrative change to remove the exception under TS 6.8.4.g regarding the performance of the next Units 1 and 2 Type A test no later than May 15, 2013, and May 21, 2014, respectively, as these Type A tests have already occurred. Lastly, the amendments would change the drywell-to-suppression chamber bypass leak rate test frequency required by Units 1 and 2 Surveillance Requirement (SR) 4.6.2.1.e from 10 years to 15 years to align with the proposed Type A test frequency.

2.0 REGULATORY EVALUATION

2.1 Regulatory Requirements and Guidance

The NRC's regulatory requirements related to the content of the TSs are set forth in 10 CFR 50.36, "Technical specifications." This regulation requires that the TSs include items in the following categories: (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation (LCOs); (3) SRs; (4) design features; and (5) administrative controls. The regulation does not specify the particular requirements to be included in plant TSs.

The regulations in 10 CFR 50.54(o) require that the primary reactor containments for water-cooled power reactors shall be subject to the requirements set forth in 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors." This appendix includes two options: "Option A − Prescriptive Requirements" and "Option B − Performance-Based Requirements," either of which can be chosen for meeting the requirements of Appendix J.

The testing requirements in 10 CFR Part 50, Appendix J, ensure that: (a) leakage through the containments or systems and components penetrating the containments does not exceed allowable leakage rates specified in the TSs, and (b) the integrity of the containment structure is maintained during its service life.

Option B of 10 CFR Part 50, Appendix J, specifies performance-based requirements and criteria for preoperational and subsequent leakage rate testing. These requirements are met by performing a Type A test to measure the containment system overall integrated leakage rate of the primary containments; a Type B test consisting of a pneumatic test to detect and measure local leakage rates across pressure-retaining leakage-limiting boundaries; and a Type C test consisting of a pneumatic test to measure containment isolation valve (CIV) leakage rates. After the preoperational tests, these tests are required to be conducted at periodic intervals based on the historical performance of the overall containment system (for Type A tests) and based on the safety significance and historical performance of each penetration boundary and isolation valve (for Types B and C tests) to ensure the integrity of the overall containment system as a barrier to fission product release.

The overall integrity (structural and leaktight integrity) of the primary containment is verified by a Type A ILRT, and the integrity of the penetrations and isolation valves is verified by Types B and C local leak rate tests (LLRT), as required by 10 CFR Part 50, Appendix J. These tests are performed to verify the essential leaktight characteristics of the containment structure at the design-basis accident pressure. The Type A test also provides a verification of structural integrity.

The leakage rate test results must not exceed the maximum allowable leakage rate (L_a) with margin, as specified in the TSs. Option B also requires that a general visual inspection of the accessible interior and exterior surfaces of the containment system for structural deterioration that may affect the containment leaktight integrity must be conducted prior to each Type A test, and at a periodic interval between tests.

Section V.B.3 of 10 CFR Part 50, Appendix J, Option B, requires that the regulatory guide (RG) or other implementation document used by a licensee to develop a performance-based leakage testing program must be included, by general reference, in the plant TSs. Further, the submittal for TS revisions must contain justification, including supporting analyses, if the licensee chooses to deviate from methods approved by the NRC and endorsed in an RG.

The NRC staff's final safety evaluation report (SER) for NEI 94-01, Revision 2, and Electric Power Research Institute (EPRI) Report No. 1009325, Revision 2, dated August 2007, "Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals," dated June 25, 2008 (ADAMS Accession No. ML081140105), was incorporated into NEI 94-01, Revision 2-A. NEI 94-01, Revision 2-A, describes an NRC-approved approach for implementing the optional performance-based requirements of Option B described in 10 CFR Part 50, Appendix J, which includes provisions for extending Type A ILRT intervals to up to 15 years, and incorporates the regulatory positions stated in RG 1.163, "Performance-Based Containment Leak-Test Program," dated September 1995 (ADAMS Accession No. ML003740058). NEI 94-01, Revision 2-A, delineates a performance-based approach for determining Types A, B, and C containment leakage rate surveillance testing frequencies. This method uses industry performance, plant-specific data, and risk insights in determining the appropriate testing frequency, and also discusses the performance factors that licensees must consider in determining test intervals.

The NRC staff's final SER dated June 8, 2012 (ADAMS Accession No. ML121030286), of NEI 94-01, Revision 3, was incorporated into NEI 94-01, Revision 3-A. NEI 94-01, Revision 3-A, documents the NRC staff's evaluation and acceptance of NEI 94-01, Revision 3.

The regulations in 10 CFR 50.55a contain the containment inservice inspection (CISI) program requirements that, in conjunction with the requirements of 10 CFR Part 50, Appendix J, ensure the continued leaktight and structural integrity of the containment during its service life.

The regulations in 10 CFR 50.65(a) state, in part, that the licensee:

> …shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components, as defined in paragraph (b) of this section, are capable of fulfilling their intended functions. These goals shall be established commensurate with safety and, where practical, take into account industrywide operating experience.

EPRI Report No. 1009325, Revision 2-A, provides a risk impact assessment for optimized ILRT intervals up to 15 years, utilizing current industry performance data and risk-informed guidance. NEI 94-01, Revision 3-A, Section 9.2.3.1, states that Type A ILRT intervals of up to 15 years are allowed by this guideline. The risk impact assessment of extended integrated leak rate testing intervals, EPRI Report No. 1018243,[1] "Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals" (i.e., formerly Report No. 1009325, Revision 2-A), indicates that, in general, the risk impact associated with ILRT interval extensions for intervals up to 15 years is small. However, plant-specific confirmatory analyses are required.

The NRC staff reviewed NEI 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2. For NEI 94-01, Revision 2, the NRC staff determined that it described an acceptable approach for implementing the optional performance-based requirements of Option B to 10 CFR Part 50, Appendix J. This guidance includes provisions for extending Type A ILRT intervals up to 15 years and incorporates the regulatory positions stated in RG 1.163. The NRC staff found

[1] EPRI Report No. 1018243 is also identified as EPRI Report No. 1009325, Revision 2-A. This report is publicly available and can be found at www.epri.com by typing "1018243" in the search field box.

that the Type A testing methodology as described in American National Standards Institute/American Nuclear Society (ANSI/ANS) 56.8-2002, "Containment System Leakage Testing Requirements," and the modified testing frequencies recommended by NEI 94-01, Revision 2, serve to ensure the continued leakage integrity of the containment structure. Types B and C testing ensures that individual penetrations are essentially leaktight. In addition, aggregate Types B and C leakage rates support the leakage tightness of the primary containment by minimizing potential leakage paths.

For EPRI Report No. 1009325, Revision 2, a risk-informed methodology using plant-specific risk insights and industry ILRT performance data to revise ILRT surveillance frequencies, the NRC staff found that the proposed methodology satisfies the key principles of risk-informed decisionmaking applied to changes to TSs as delineated in RG 1.177, Revision 1, "An Approach to Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications" (ADAMS Accession No. ML100910008) and RG 1.174, Revision 3, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" (ADAMS Accession No. ML17317A256). The NRC staff found that this guidance was acceptable for referencing by licensees proposing to amend their TSs regarding containment leakage rate testing subject to the limitations and conditions noted in Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2.

In 2012, NEI 94-01, Revision 3, was issued. The NRC staff reviewed NEI 94-01, Revision 3, and determined that it described an acceptable approach for implementing the optional performance-based requirements of Option B to 10 CFR Part 50, Appendix J, as modified by the conditions and limitations summarized in Section 4.0 of the associated SER. This guidance included provisions for extending Type C LLRT intervals up to 75 months. Type C testing ensures that individual CIVs are essentially leaktight. In addition, aggregate Type C leakage rates support the leakage tightness of the primary containment by minimizing potential leakage paths. The NRC staff, therefore, found that this guidance, as modified to include two limitations and conditions, was acceptable for referencing by licensees proposing to amend their TSs regarding containment leakage rate testing. Any applicant may reference NEI 94-01, Revision 3-A, as modified by the associated SER and approved by the NRC, and the conditions and limitations specified in NEI 94-01, Revision 2-A, in a licensing action to satisfy the requirements of Option B to 10 CFR Part 50, Appendix J. Since the licensee proposes to invoke NEI 94-01, Revision 3-A, along with the limitations and conditions of NEI 94-01, Revision 2-A, as the Option B implementation documents for Limerick, the licensee is effectively also requesting the authority to extend the frequencies of the Type C performance-based test intervals beyond 60 months, even though it evaluated the additional extension of Type C intervals afforded by NEI 94-01, Revision 3-A, and chose not to implement these extensions at this time. Additionally, the risk assessment performed to permanently extend the currently allowed containment Type A ILRT to 15 years used the methodology currently endorsed by NEI 94-01, Revision 3-A, for the required confirmatory risk impact assessment, as this is the most up-to-date guidance available.

3.0 TECHNICAL EVALUATION

3.1 Background

The NRC issued Amendment Nos. 190 and 151 on February 20, 2008, for Limerick, Units 1 and 2, respectively (ADAMS Accession No. ML080310769), which revised TS 6.8.4.g to allow a one-time extension of the Type A leak rate test. Specifically, the containment ILRTs were moved to May 15, 2013, for Unit 1 and May 21, 2014, for Unit 2. The changes reflected a one-time extension of the test interval for each unit from 10 to 15 years. The ILRT interval for Limerick, Units 1 and 2, reverted back to 10 years after completion of the ILRTs of May 2013 and May 2014, respectively.

3.2 Licensee's Proposed Changes

The proposed changes would revise portions of TS 6.8.4.g by replacing the reference to RG 1.163 (September 1995) with a reference to NEI 94-01, Revision 3-A (July 2012), and the limitations and conditions specified in NEI 94-01, Revision 2-A (October 2008), as the documents used by Limerick, Units 1 and 2, to implement the performance-based leakage rate testing program in accordance with Option B of 10 CFR Part 50, Appendix J. By invoking these two NEI 94-01 topical reports as the Option B implementation documents for TS 6.8.4.g, the licensee would be allowed to:

- Permanently extend the 10-year frequency of the Type A ILRT to 15 years.
- Permanently extend the CIVs leakage test interval (i.e., Type C tests) from its current 60-month frequency to 75 months, in accordance with NEI 94-01, Revision 3-A.
- Adopt ANSI/ANS 56.8-2002.
- Adopt a more conservative allowable test interval extension of nine months, for Types A, B, and C leakage rate tests in accordance with NEI 94-01, Revision 3-A.
- Permanently extend the existing drywell-to-suppression chamber bypass leak rate test (DWBT) frequency from 120 months (10 years) to 180 months (15 years) to align this test frequency with the proposed Type A test frequency. The LAR does not propose any changes to the Units 1 and 2 SR 4.6.2.1.e, as the current wording meets the intent of the change to the DWBT interval of 15 years.

With respect to the proposed deletion of the two exceptions "a" currently contained in TS 6.8.4.g, as indicated in LAR Attachment 1, Table 3.3.4-1, "LGS Unit 1 Type A Testing History," the first Unit 1 Type A test after the May 13, 1998 ILRT was completed in March 2012, during Unit 1 Refueling Outage (RFO) Li1R13, and Table 3.3.4-2, "LGS Unit 2 Type A Test History," the first Unit 2 Type A test after the May 21, 1999 ILRT was completed in April 2013, during Unit 2 RFO Li2R12.

The DWBT test results are described in Section 3.2.3 of this SE.

3.2.1 Type A ILRT History

Limerick, Unit 1

Per TS 6.8.4.g, the Unit 1 primary containment has a maximum allowable leakage rate, L_a, at the peak calculated containment internal pressure for the design-basis loss-of-coolant accident (LOCA), P_a, of 0.5 percent of primary containment air weight per day (wt.%/day). Per TS 6.8.4.g, P_a is 44.0 pounds per square inch gauge (psig).

Since 1984, a total of four ILRTs have been performed on the Unit 1 containment. All four ILRTs had satisfactory leakage rate results. These four ILRT results were documented in LAR Attachment 1, Table 3.3.4-1 and are reflected in Table 3.1.1-1 below:

Table 3.1.1-1
Limerick, Unit 1, Type A ILRT History

Test Date	95% Upper Confidence Limit (wt.%/day)	As-Found Leak Rate (wt.%/day)	Acceptance Criteria (L_a) (wt.%/day)	As-Left Leakage (wt.%/day)	Acceptance Criteria (0.75 L_a) (wt.%/day)
August 1987	0.131	Note 2	0.5	0.1469	0.375
November 1990	0.252	Note 5	0.5	0.287	0.375
May 1998	0.263	0.3751	0.5	0.307	0.375
March 2012	0.139	0.2688	0.5	0.2318	0.375

Table 3.1.1-1 Notes

Note 2: The AF [as-found] test results failed to meet the acceptance criteria of 0.500wt.%/day.

Note 5: LGS does not maintain records of Types B and C leak rate summations for RFOs earlier than 1996. Therefore, leakage savings are not known and the AF leak rate cannot be calculated.

The NRC staff notes that the last sentence of Section 9.2.3, "Extended Test Intervals," of NEI 94-01, Revision 3-A, reads:

> In the event where previous Type A tests were performed at reduced pressure (as described in 10 CFR [Part] 50, Appendix J, Option A), at least one of the two consecutive periodic Type A tests shall be performed at peak accident pressure (P_a).

The Appendix J, Option B current licensing basis for TS 6.8.4.g references RG 1.163, dated September 1995. Regulatory Position C of RG 1.163 in turn states that NEI 94-01, Revision 0 (ADAMS Accession No. ML11327A025), "provides methods acceptable to the NRC staff for complying with the provisions of Option B in Appendix J to 10 CFR Part 50." The third paragraph of Section 9.2.3, "Extended Test Intervals," of NEI 94-01, Revision 0, reads, in part:

> In reviewing past performance history, Type A test results may have been calculated and reported using computational techniques other than the Mass Point method from ANSI/ANS 56.8–1994 (e.g., Total Time or Point-to-Point). Reported test results from these previously acceptable Type A tests can be used to establish the performance history. Additionally, a licensee may recalculate past Type A UCL [upper confidence limit] (using the same test intervals as reported) in accordance with ANSI/ANS 56.8–1994 Mass Point methodology and its adjoining Termination criteria in order to determine acceptable performance history.

NEI 94-01, Revision 3-A, Section 9.2.3, reads nearly identical, except that the test standard invoked is ANSI/ANS 56.8–2002 versus ANSI/ANS 56.8–1994.

The NRC staff notes that NEI 94-01, Section 9.2.3, does not mandate that a licensee recalculate past Type A test results to demonstrate conformance with the definition of "performance leakage rate" contained in NEI 94-01, Revision 3-A. The staff also notes that the Unit 1 ILRT results since May 1998 demonstrated ample margin (i.e., approximately 25 percent margin in 1998 and approximately 46 percent margin in 2012) between each as-found leakage rate value and L_a.

TS 6.8.4.g states that the allowable primary containment leakage rate, L_a, at P_a (44.0 psig) shall be 0.5 percent of primary containment air weight per day.

The past two Unit 1 ILRT results dating back to 1998 have confirmed that the containment leakage rates are acceptable with respect to the allowable leakage criterion of containment air weight (L_a) per day. Since the last two Type A tests for Limerick, Unit 1, had as-found leakage rate test results of less than 1.0 L_a at the peak design containment internal accident pressure (P_a), a test frequency of 15 years in accordance with NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A, would be acceptable for Unit 1.

Therefore, based on the last two Unit 1 ILRT results, the NRC staff concludes that the requirements of Sections 9.1.2 and 9.2.3 of NEI 94-01, Revision 3-A, have been satisfied.

Limerick, Unit 2

Per TS 6.8.4.g, the Unit 2 primary containment has a maximum allowable leakage rate, L_a, at P_a of 0.5 percent of primary containment air weight per day. Per TS 6.8.4.g, P_a is 44.0 psig.

Since 1989, a total of three ILRTs have been performed on the Unit 2 containment. All three ILRTs had satisfactory leakage rate results. These three ILRT results were documented in LAR Attachment 1, Table 3.3.4-2 and are reflected in Table 3.1.1-2 below:

Table 3.1.1-2
Limerick, Unit 2, Type A ILRT History

Test Date	**95% UCL (wt.%/day)**	**As-Found Leak Rate (wt.%/day)**	**Acceptance Criteria (L_a) (wt.%/day)**	**As-Left Leakage (wt.%/day)**	**Acceptance Criteria (0.75 L_a) (wt.%/day)**
March 1993	0.215	Note 5	0.5	0.2586	0.375
May 1999 Note 3	0.2965	0.3584	0.5	0.3272	0.375
April 2013	0.252	0.3643	0.5	0.3643	0.375

Table 3.1.1-2 Notes

Note 3: The test method used was the Total Time Method, as described in ANSI N45.4-1972, "Leakage-Rate Testing of Containment Structures for Nuclear Reactors" and Bechtel Topical Report BN-TOP-1, Revision 1, "Testing Criteria for Integrated Leak Rate Testing of Primary Containment Structures for Nuclear Power Plants."

Note 5: LGS does not maintain records of Types B and C leak rate summations for RFOs earlier than 1996. Therefore, leakage savings are not known and the AF leak rate cannot be calculated.

The Appendix J, Option B current licensing basis for TS 6.8.4.g references RG 1.163, dated September 1995. Regulatory Position C of RG 1.163 in turn states that NEI 94-01, Revision 0, "provides methods acceptable to the NRC staff for complying with the provisions of Option B in Appendix J to 10 CFR Part 50." The third paragraph of Section 9.2.3, "Extended Test Intervals," of NEI 94-01, Revision 0, reads, in part:

> In reviewing past performance history, Type A test results may have been calculated and reported using computational techniques other than the Mass Point method from ANSI/ANS 56.8–1994 (e.g., Total Time or Point-to-Point). Reported test results from these previously acceptable Type A tests can be used to establish the performance history. Additionally, a licensee may recalculate past Type A UCL [upper confidence limit] (using the same test intervals as reported) in accordance with ANSI/ANS 56.8–1994 Mass Point methodology and its adjoining Termination criteria in order to determine acceptable performance history.

NEI 94-01, Revision 3-A, Section 9.2.3, reads nearly identical, except that the test standard invoked is ANSI/ANS 56.8–2002 versus ANSI/ANS 56.8–1994.

The NRC staff notes that NEI 94-01, Section 9.2.3, does not mandate that a licensee recalculate past Type A test results to demonstrate conformance with the definition of "performance leakage rate" contained in NEI 94-01, Revision 3-A. The staff also notes that the Unit 2 ILRT results since May 1999 demonstrated ample margin (i.e., approximately 28 percent margin in 1999 and approximately 27 percent margin in 2013) between each as-found leakage rate value and L_a.

TS 6.8.4.g states that the allowable primary containment leakage rate, L_a, at P_a (44.0 psig) shall be 0.5 percent of primary containment air weight per day.

The past two Unit 2 ILRT results dating back to 1999 have confirmed that the containment leakage rates are acceptable with respect to the allowable leakage criterion of containment air weight (L_a) per day. Since the last two Type A tests for Limerick, Unit 2, had as-found leakage rate test results of less than 1.0 L_a at the peak design containment internal accident pressure (P_a), a test frequency of 15 years in accordance with NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A, would be acceptable for Unit 2.

Therefore, based on the last two Unit 2 ILRT results, the NRC staff concludes that the requirements of Sections 9.1.2 and 9.2.3 of NEI 94-01, Revision 3-A, have been satisfied.

3.2.2 <u>Types B and C Leak Rate Test History</u>

<u>Limerick, Unit 1</u>

TS 6.8.4.g reads, in part:

> Leakage rate acceptance criteria are:

a. Primary Containment leakage rate acceptance criterion is less than or equal to 1.0 L_a. During the first unit startup following testing in accordance with this program, the leakage rate acceptance criteria are less than or equal to 0.60 L_a for the Type B and Type C tests and less than or equal to 0.75 L_a for Type A tests;

b. Air lock testing acceptance criteria are:

   1) Overall airlock leakage rate is less than or equal to 0.05 L_a when tested at greater than or equal to P_a.

   2) Seal leakage rate is less than or equal to 5 scf [standard cubic feet] per hour when the gap between the door seals is pressurized to 10 psig."

The NRC staff reviewed the local leak rate summaries listed in LAR Attachment 1, Section 3.5.5, "Primary Containment Leakage Rate Testing Program - Type B and Type C Testing Program."

The licensee indicated that L_a at 44.0 psig is 158,273 standard cubic centimeters per minute (sccm); therefore, 0.6 L_a is 94,964 sccm. Using these L_a values and the data contained in LAR Attachment 1, Table 3.5.5-1, "LGS, Unit 1 Types B and C LLRT Combined As-Found/As-Left Trend Summary," the NRC staff confirmed the accuracy of the "Fraction of 0.6 L_a" values contained in the table and concluded that:

- Limerick, Unit 1, as-found minimum pathway leak rate (years 2008-2018) shows an average of 36.34 percent of 0.6 L_a with a high of 52.59 percent (2010) of 0.6 L_a.

- Limerick, Unit 1, as-left maximum pathway leak rate (years 2008-2018) shows an average of 58.07 percent of 0. 6 L_a with a high of 68.31 percent (2008) of 0.6 L_a.

Limerick, Unit 1, Summary

Based on its review of the historical information provided in LAR Attachment 1, Section 3.5.5, the NRC staff observes that there was no indication of the licensee's failure to adequately implement the requirements of its 10 CFR Part 50, Appendix J, Option B, performance-based testing program.

Based on its review of LAR Attachment 1, Table 3.5.5-1, the NRC staff concludes that the aggregate results of the as-found minimum pathway for all Unit 1 Types B and C tests from 2008 through 2018 demonstrate a history of adequate maintenance, since the aggregate test results at the end of each operating cycle were all well below (i.e., approximately 47 percent margin in 2010) the Type B and Type C test TS leakage rate acceptance criteria of ≤ 0.60 L_a contained in TS 6.8.4.g.

From its review of the information contained in LAR Attachment 1, Section 3.5.5, the NRC staff has reasonable assurance that the licensee has been compliant with the NEI 94-01, Revision 3-A, guidance of Section 10.2.1, "Type B Test Intervals," and Section 10.2.3, "Type C Test Interval."

Based on the information discussed above, the NRC staff concludes that the licensee has a demonstrated history of adherence to the requirements of 10 CFR Part 50, Appendix J, Option B. Therefore, the staff finds it acceptable to allow an extended test interval of up to 75 months for the Unit 1 Type C tested CIVs in accordance with the guidance of NEI 94-01, Revision 3-A.

Limerick, Unit 2

TS 6.8.4.g reads, in part:

> Leakage rate acceptance criteria are:
>
> a. Primary Containment leakage rate acceptance criterion is less than or equal to 1.0 L_a. During the first unit startup following testing in accordance with this program, the leakage rate acceptance criteria are less than or equal to 0.60 L_a for the Type B and Type C tests and less than or equal to 0.75 L_a for Type A tests;
>
> b. Air lock testing acceptance criteria are:
>
> 1) Overall airlock leakage rate is less than or equal to 0.05 L_a when tested at greater than or equal to P_a.
>
> 2) Seal leakage rate is less than or equal to 5 scf per hour when the gap between the door seals is pressurized to 10 psig.

The NRC staff reviewed the local leak rate summaries listed in LAR Attachment 1, Section 3.5.5.

The licensee indicated that L_a at 44.0 psig is 158,273 sccm; therefore, 0.6 L_a equals 94,964 sccm. Using these L_a values and the data contained in LAR Attachment 1, Table 3.5.5-2, "LGS, Unit 2 Types B and C LLRT Combined As-Found/As-Left Trend Summary," the NRC staff confirmed the accuracy of the "Fraction of 0.6 L_a" values contained in the table and concluded that:

- Limerick, Unit 2, as-found minimum pathway leak rate (years 2007-2017) shows an average of 23.25 percent of 0.6 L_a with a high of 31.55 percent (2015) of 0.6 L_a.

- Limerick, Unit 2, as-left maximum pathway leak rate (years 2007-2017) shows an average of 42.23 percent of 0.6 L_a with a high of 51.87 percent (2013) of 0.6 L_a.

Limerick, Unit 2, Summary

Based on its review of the historical information provided in LAR Attachment 1, Section 3.5.5, the NRC staff observes that there was no indication of the licensee's failure to adequately implement the requirements of its 10 CFR Part 50, Appendix J, Option B, performance-based testing program.

Based on its review of LAR Attachment 1, Table 3.5.5-2, the NRC staff concludes that the aggregate results of the as-found minimum pathway for all Unit 2 Types B and C tests from 2007 through 2017 demonstrate a history of adequate maintenance, since the aggregate test results at the end of each operating cycle were all well below (i.e., approximately 68 percent margin in 2015) the Type B and Type C test TS leakage rate acceptance criteria of ≤ 0.60 L_a contained in TS 6.8.4.g.

From its review of the information contained in LAR Attachment 1, Section 3.5.5, the NRC staff has reasonable assurance that the licensee has been compliant with the NEI 94-01, Revision 3-A guidance of Section 10.2.1, "Type B Test Intervals," and Section 10.2.3, "Type C Test Interval."

Based on the information discussed above, the NRC staff concludes that the licensee has a demonstrated history of adherence to the requirements of 10 CFR Part 50, Appendix J, Option B. Therefore, the staff finds it acceptable to allow an extended test interval of up to 75 months for the Unit 2 Type C tested CIVs in accordance with the guidance of NEI 94-01, Revision 3-A.

3.2.3 Drywell-to-Suppression Chamber Bypass Leak Rate Test (DWBT)

3.2.3.1 Drywell-to-Suppression Chamber Bypass Leak Rate Test Justification

In LAR Attachment 1, Section 3.3.5.3, "Qualitative Justification for DWBT Interval Extension," the licensee describes the drywell-to-suppression chamber bypass leakage pathways, which are:

- Leakage through the diaphragm floor penetrations (SRV) discharge line (downcomers),
- Cracks in the diaphragm floor/liner plate,
- Cracks in the downcomers that pass through the suppression pool airspace,
- Valve seat leakage in the four sets of drywell-to-suppression chamber containment vacuum breakers, and
- Seat leakage of isolation valves in piping connecting the drywell and the suppression chamber air space.

3.2.3.2 Drywell-to-Suppression Chamber Bypass Leak Rate Test History

LAR Attachment 1, Section 3.3.5.2, "Historical Test Results," provides past test history for the DWBT and identifies no failures. Tables 3.2-1 and 3.2-2 below provide the historical DWBT test results at Limerick, Units 1 and 2, respectively:

Table 3.2-1
Limerick, Unit 1, DWBT History

Year	Measured Leakage (ft^2)	Acceptance Criteria (ft^2)
1984	0.00026	0.005
1987	0.00005133	0.005
1990	0.000278	0.005
1998	0.000075	0.005
2012	0.000151	0.005

Table 3.2-2
Limerick, Unit 2, DWBT History

Year	Measured Leakage (ft^2)	Acceptance Criteria (ft^2)
1989	0.000069	0.005
1993	0.000076	0.005
1999	0.000012	0.005
2013	0.000137	0.005

By letter dated January 24, 1997 (ADAMS Accession No. ML011560583), the NRC issued Amendment Nos. 118 and 81 for Limerick, Units 1 and 2, respectively, approving the use of 10 CFR Part 50, Appendix J, Option B, along with the corresponding frequency change to the DWBT. As a result of these amendments, SR 4.6.2.1.e was revised to include wording to conduct the DWBT to "coincide with the Type A test."

The proposed change of the frequency of both the Type A test and DWBT to a maximum test interval of 15 years does not change SR 4.6.2.1.e, as the current wording meets the intent of the change to the DWBT interval to 15 years to align with the proposed Type A test frequency.

The licensee reviewed the historical test results for the DWBT and reported them in LAR Attachment 3, Appendix B, Section B.2. The licensee identified no failures of the historical test results. The history of the test results indicates that the typical leakage is about an order of magnitude, or more, below the acceptance criteria of 0.005 ft^2, which is itself set below the design-basis limit of 0.050 ft^2.

3.2.4 Containment Inservice Inspection Program

As discussed in LAR Attachment 1, Section 3.1.1, the Limerick primary containment is in the form of a truncated cone over a cylindrical section with the drywell being the upper conical section, and the suppression chamber being the lower cylindrical section comprising a structurally integrated, reinforced concrete pressure vessel lined with welded steel plate and provided with a steel domed head for closure at the top of the drywell. The diaphragm slab is a reinforced concrete slab structurally connected to the containment wall. The steel liner plate is anchored to the concrete slab by structural steel beams embedded in the concrete and welded to the plate. The primary containment is discussed in Section 3.8.1.1 of the Limerick Updated Final Safety Analysis Report.

In LAR Attachment 1, Section 3.5.3, the licensee stated that it is implementing its CISI program in accordance with the applicable edition/addenda of Subsections IWE/IWL of Section XI of the American Society of Mechanical Engineers (ASME) Code. The CISI plan for ASME Class MC (metal containment) and CC (concrete containment) components and structures for the third 10-year CISI interval has been developed in accordance with the requirements of 10 CFR 50.55a and the 2007 Edition with the 2008 Addenda of the ASME Code, Section XI, subject to the limitations and modifications contained in paragraph (b) of the regulation. The CISI plan addresses Subsections IWE and IWL, mandatory appendices of ASME Code, Section XI, approved IWE code cases, and approved alternatives through relief requests and SEs. The Limerick, Units 1 and 2, third CISI interval is effective from February 1, 2017, through January 31, 2027.

Subsection IWL provides the rules and requirements for inservice inspection (ISI) of Class CC components, and Subsection IWE provides the rules and requirements for ISI of Class MC pressure-retaining components. Metal containment surface areas subject to accelerated degradation and aging require augmented examination in accordance with Examination Category E-C and paragraph IWE-1240. Similarly, concrete surfaces may be subject to detailed visual examination in accordance with item number L1.12 and paragraph IWL-2310(b) if declared to be "suspect areas."

During the first 10-year CISI interval, no significant conditions were identified by the licensee; however, significant conditions were identified during the second 10-year CISI interval (ending January 2017) requiring application of augmented examination requirements pursuant to paragraph IWE-1240 or IWL-2310. Specifically, the submerged portion of the suppression pool is required to receive a Subsection IWE examination during each ISI period not to exceed a maximum interval of 4 years (two refueling cycles). As a result of a Limerick license renewal commitment in 2014, the ASME Code, Section XI, Subsection IWE Aging Management Program (AMP) was enhanced in certain areas to manage suppression pool liner and coating system, perform ultrasonic thickness measurements on certain areas of the submerged suppression pool liner when IWE examinations are conducted, and provide guidance to prevent or mitigate degradation and failure of structural bolting. As a result, Augmented Examination Program AUG-32 was developed by implementing examinations at an increased frequency or requiring additional examinations. The results of the examination will be used to determine when recoating of the suppression pool liner or downcomers is necessary, and when to require augmented inspection in accordance with IWE, Category E-C. LAR Attachment 1 Table 3.5.3-1 for Unit 1 and Table 3.5.3-2 for Unit 2 identify components included in the Limerick CISI AUG-32 program.

In LAR Attachment 1, Section 3.5.2, the licensee provided a discussion of the Service Level I Protective Coatings Program. The program provides a common approach in controlling, applying, maintaining, and periodically assessing Service Level I coatings used in areas inside the Limerick reactor containments where the coating failure could adversely affect the operation of post-accident fluid systems and thereby impair safe shutdown.

In LAR Attachment 1, Section 3.6.7, the licensee provided a discussion of the results of recent walkdowns related to the Unit 1 drywell head performed during RFO 1R15 (Spring 2014) and RFO 1R16 (Spring 2016). Areas examined included reassessment based on general visual examination of the drywell head assembly, which included evaluating the condition of the drywell head coating previously identified during the 1R14 walkdown and impact damage to the drywell bolting support. The head assembly consists of a semi-ellipsoidal head and a cylindrical lower flange supported on the top of the drywell wall. The head is constructed of thick plate steel and is secured with 80 bolts at the thick mating flange. No evidence of cracking, blistering, flaking, scaling, peeling, discoloration, embrittlement, or mechanical damage was observed on the interior surfaces of the drywell head. The examination concluded that the drywell head flange is acceptable as-is with no repairs necessary, and that the coating degradation on the interior surface of the drywell head will not adversely impact the operability of primary containment (drywell) and was acceptable as is for an additional cycle.

During the walkdown of the Unit 2 drywell during RFO 2R13 (Spring 2015), several areas of minor degradation were noted on the mild carbon steel metal containment liner, which is coated with Amercoat 90N in accordance with Limerick specifications. The coating is classified as a safety-related Service Level I coating for Limerick due to the coating detaching and affecting emergency core cooling system (ECCS) pump suction strainer function during a LOCA. The drywell head interior surface indications were reassessed and found acceptable based on a general visual examination of the areas surrounding the interior surfaces of the drywell head, with no additional deterioration or coating failure identified.

The licensee recently performed technical evaluations to ensure that the structural integrity of the primary containment was maintained during Service Level I Protective Coatings Program evaluations for RFOs in 2014 and 2016 for Unit 1, and 2015 and 2017 for Unit 2. Light surface corrosion was observed on the interior surfaces of the drywell head along with exterior surface impact damage between bolt supports. For Unit 2, several areas of minor degradation were noted on the 1/4-inch mild carbon steel containment liner. Limerick determined by evaluation that due to available margin, the liner will continue to perform its design function for the next operating cycle, and the coating issues were dispositioned as acceptable with no adverse impact on the operability of the primary containment.

Results of visual examinations of containment vessels and internals performed in 2012 and 2016 for Unit 1, and 2013 and 2017 for Unit 2, identified white crystalline deposits on the Unit 1 bio-shield, areas of flaking concrete, and paint and linear concrete indications inside the reactor building, coating damage on exterior containment wall, and missing caulking. For Unit 2, coating damage was identified above the drywell head, concrete surface cracks in Room 174, missing coating above penetration x-7C with no apparent substrate degradation, mechanical damage on seal plate to drywell head flange, and drywell equipment access hatch, and personnel airlock and drywell head penetration X-4 access manway bolting issues. The Limerick evaluations concluded that no actions were required and that the issues identified did not compromise the structural integrity of the containment to perform its intended function with no impact on station operation.

In LAR Attachment 1, Section 3.7.1, the licensee also identified several license renewal AMPs for the Limerick, Units 1 and 2, primary containments. As part of the license renewal effort, the licensee demonstrated that commitments related to the aging effects applicable for the systems, structures, and components within the scope of license renewal would be adequately managed during the period of extended operation. The renewed operating licenses for Limerick, Units 1 and 2, were issued on October 20, 2014, extending the original licensed operating terms by 20 years.

The following AMPs, consistent with the corresponding programs described in NUREG-1801, Revision 2, “Generic Aging Lessons Learned (GALL) Report, Final Report” (ADAMS Accession No. ML103490041), and related activities, are credited with the aging management of the primary containment:

- 10 CFR Part 50, Appendix J Program, which monitors leakage rates through the containment pressure boundary, including penetrations and access openings;
- ISI-IWE Program, which manages aging effects for the containment liners and its integral attachments, including connecting penetrations and parts forming the leaktight boundary;
- ISI-IWL Program, which manages the reinforced concrete of the primary containment structure;
- Structures Monitoring Program, which was developed and implemented to meet the regulatory requirements of 10 CFR 50.65 (Maintenance Rule) using the guidance in RG 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and NUMARC 93-01, “Nuclear Energy Institute, Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and which is implemented by

procedures that require periodic visual inspections by personnel qualified to monitor structures and components for aging effects such as those described in the American Concrete Institute (ACI) Standards 349.3R and 201.1R; and

- Protective Coating Monitoring and Maintenance Program, which provides for aging management of Service Level I coatings inside the Limerick primary containment, the failure of which could adversely affect the operation of the ECCS by clogging the ECCS suction strainers.

Based on the above, the NRC staff finds that the licensee has an adequate CISI program in place as demonstrated by the implementation of overlapping inspection activities performed as part of the CISI programs (IWE/IWL), inspections of Service Level 1 protective coatings, and the Maintenance Rule Structural Monitoring Program. These programs periodically examine, monitor, and manage structural deterioration and aging degradation of the Limerick containment pressure boundary such that the primary containment can perform its intended function as a leaktight barrier consistent with the guidance contained in NEI 94-01.

Conclusion

The NRC staff finds that the licensee is satisfactorily monitoring and managing the primary containments at Limerick, Units 1 and 2, and performing supplemental inspections to periodically examine and monitor aging degradation, thereby providing reasonable assurance that the containment structural and leaktight integrity will continue to be maintained. The licensee justified the proposed change to extend the performance-based Type A ILRT test interval by demonstrating adequate performance of the containment based on plant-specific Type A ILRT test program results. Therefore, based on the review, the staff finds that the requested permanent extension for the Type A ILRT leakage rate test frequency from 10 years to 15 years is acceptable.

3.2.5 NRC Conditions in NEI 94-01, Revision 2-A

As required by 10 CFR 50.54(o), both Limerick containments are subject to the requirements set forth in 10 CFR Part 50, Appendix J. Option B of Appendix J requires that test intervals for Types A, B, and C testing be determined by using a performance-based approach. Currently, the Limerick 10 CFR Part 50, Appendix J, containment leakage rate testing program invokes RG 1.163 as the plan implementation document. The LAR proposes to revise the Limerick 10 CFR Part 50, Appendix J, containment leakage rate testing program by replacing this implementation document with the guidance contained in NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A.

In the letter dated June 25, 2008, the NRC published the SER, with limitations and conditions, for NEI 94-01, Revision 2. In the SER, the NRC staff concluded that NEI 94-01, Revision 2, describes an acceptable approach for implementing the optional performance-based requirements of 10 CFR Part 50, Appendix J, and is acceptable for referencing by licensees proposing to amend their TSs pertaining to containment leakage rate testing, subject to the six limitations and conditions pertaining to deterministic requirements in Section 4.1 and the four limitations and conditions pertaining to the plant's probabilistic risk assessment (PRA) analysis in Section 4.2. The accepted version of NEI 94-01, Revision 2, was issued as Revision 2-A on November 19, 2008 to incorporate the June 25, 2008 NRC final SER and its limitations and conditions.

The NRC staff review of LAR Attachment 1, Section 3.8.1, “Limitations and Conditions Applicable to NEI 94-01, Revision 2-A,” which contains Table 3.8.1-1, “NEI 94-01 Revision 2-A Limitations and Conditions,” indicates that the licensee intends to satisfy the six limitations and conditions of Section 4.1. Accordingly, as previously noted, the licensee intends to adopt the testing methodology of ANSI/ANS 56.8–2002 in place of the methodology of ANSI/ANS 56.8-1994.

The leakage rate testing requirements of 10 CFR Part 50, Appendix J, Option B (Types A, B, and C Tests) and the CISI requirements mandated by 10 CFR 50.55a, together, ensure the continued leaktight and structural integrity of both containments during their service lives.

Type B testing ensures that the leakage rate of individual containment penetration components is acceptable. Type C testing ensures that individual CIVs are essentially leaktight. In addition, aggregate Types B and C leakage rates support the leakage tightness of both containments by minimizing potential leakage paths.

The licensee proposes to invoke NEI 94-01, Revision 3-A, along with the limitations and conditions of NEI 94-01, Revision 2-A, as the reference documents for the Limerick “Primary Containment Leakage Rate Testing Program” in TS 6.8.4.g. Therefore, the licensee is also requesting the authority to extend the frequencies of the Type C performance-based test intervals beyond 60 months.

The NRC staff has found that the use of NEI 94-01, Revision 2-A, is acceptable for referencing by licensees proposing to amend their TSs to permanently extend the ILRT surveillance interval to 15 years, provided that the following applicable limitations and conditions are satisfied.

3.2.5.1 NRC Condition 1

The SER dated June 25, 2008 states as Condition 1:

> For calculating the Type A leakage rate, the licensee should use the definition in the NEI TR [Topical Report] 94-01, Revision 2, in lieu of that in ANSI/ANS-56.8-2002.

Limerick Response to NRC Condition 1

In the LAR, the licensee states:

> LGS will utilize the definition in NEI 94-01, Revision 3-A, Section 5.0. This definition has remained unchanged from Revision 2-A to Revision 3-A of NEI 94-01.

Staff Assessment

Section 3.2.9, “Type A Test Performance Criterion,” of ANSI/ANS 56.8-2002 defines the “performance leakage rate” and reads, in part:

> The performance criterion for a Type A test is met if the performance leakage rate is less than L_a. The performance leakage rate is equal to the sum of the measured Type A test UCL [upper confidence level] and the total as-left MNPLR [minimum pathway leakage rate] of all Type B or Type C pathways isolated during performance of the Type A test.

Section 3.1.1.1 of the NRC staff SER for NEI 94-01, Revision 2, reads, in part:

> Section 5.0 of NEI TR 94-01, Revision 2, uses a definition of "performance leakage rate" for Type A tests that is different from that of ANSI/ANS-56.8-2002…. The definition contained in NEI TR 94-01, Revision 2, is more inclusive because it considers excessive leakage in the performance determination. In defining the minimum pathway leakage rate, NEI TR 94-01, Revision 2, includes the leakage rate for all Type B and Type C pathways that were in service, isolated, or not lined up in their test position prior to the performance of the Type A test. Additionally, the NEI TR 94-01, Revision 2, definition of performance leakage rate requires consideration of the leakage pathways that were isolated during performance of the test because of excessive leakage in the performance determination. The NRC staff finds this modification of the definition of "performance leakage rate" used for Type A tests to be acceptable.

Section 5.0, "Definitions," of NEI 94-01, Revision 3-A, reads, in part:

> The performance leakage rate is calculated as the sum of the Type A upper confidence limit (UCL) and as-left minimum pathway leakage rate (MNPLR) leakage rate for all Type B and Type C pathways that were in service, isolated, or not lined up in their test position (i.e., drained and vented to containment atmosphere) prior to performing the Type A test. In addition, leakage pathways that were isolated during performance of the test because of excessive leakage must be factored into the performance determination. The performance criterion for Type A tests is a performance leak rate of less than $1.0L_a$.

The NRC staff reviewed the definitions of "performance leakage rate" contained in NEI 94-01, Revisions 2 and 3-A. The staff determined that the definitions contained in both documents are identical. Therefore, the staff concludes that Limerick will use the definition found in Section 5.0 of NEI 94-01, Revision 2, for calculating the Type A leakage rate in the Limerick Primary Containment Leakage Rate Testing Program. Based on the above review, the staff finds that the licensee has adequately addressed Condition 1.

3.2.5.2 NRC Condition 2

The SER dated June 25, 2008 states as Condition 2:

> The licensee submits a schedule of containment inspections to be performed prior to and between Type A tests.

<u>Limerick Response to NRC Condition 2</u>

LAR Attachment 1, Section 3.5.3, "Containment Inservice Inspection Program," states, in part:

> The LGS Containment ISI (CISI) Plan includes ASME Section CISI Class MC pressure retaining components and their integral attachments (including metal liner), and CISI Class CC components and structures that meet the criteria of Subarticle IWA-1300. This CISI Plan also includes information related to augmented examination areas, component accessibility, and examination review.

LAR Attachment 1, Section 3.5.4, "Supplemental Inspection Requirements," states, in part:

> With the implementation of the proposed change, Units 1 and 2 TS 6.8.4.g will be revised by replacing the reference to RG 1.163 … with reference to NEI 94-01, Revision 3-A…. This will require that a general visual examination of accessible interior and exterior surfaces of the containment for structural deterioration that may affect the containment leak-tight integrity be conducted. This inspection must be conducted prior to each Type A test and during at least three other outages before the next Type A test, if the interval for the Type A test has been extended to 15 years in accordance with the following sections of NEI 94-01, Revision 3-A:
>
> - Section 9.2.1, "Pretest Inspection and Test Methodology"
> - Section 9.2.3.2, "Supplemental Inspection Requirements"

<u>Staff Assessment</u>

Section 3.1.1.3 of the NRC staff SER for NEI 94-01, Revision 2, reads, in part:

> NEI TR 94-01, Revision 2, Section 9.2.3.2, states that: "To provide continuing supplemental means of identifying potential containment degradation, a general visual examination of accessible interior and exterior surfaces of the containment for structural deterioration that may affect the containment leak-tight integrity must be conducted prior to each Type A test and during at least three other outages before the next Type A test if the interval for the Type A test has been extended to 15 years." NEI TR 94-01, Revision 2, recommends that these inspections be performed in conjunction or coordinated with the examinations required by ASME Code, Section XI, Subsections IWE and IWL. The NRC staff finds that these visual examination provisions, which are consistent with the provisions of regulatory position C.3 of RG 1.163, are acceptable considering the longer 15 year interval. Regulatory Position C.3 of RG 1.163 recommends that such examination be performed at least two more times in the period of 10 years. The NRC staff agrees that as the Type A test interval is changed to 15 years, the schedule of visual inspections should also be revised. Section 9.2.3.2 in NEI TR 94-01, Revision 2, addresses the supplemental inspection requirements that are acceptable to the NRC staff.

Section 9.2.3.2, "Supplemental Inspection Requirements," of NEI 94-01, Revisions 2 and 3-A, both read:

> To provide continuing supplemental means of identifying potential containment degradation, a general visual examination of accessible interior and exterior surfaces of the containment for structural deterioration that may affect the containment leak-tight integrity must be conducted prior to each Type A test and during at least three other outages before the next Type A test if the interval for the Type A test has been extended to 15 years. It is recommended that these inspections be performed in conjunction or coordinated with the ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWE/IWL required examinations.

Section 9.2.1, “Pretest Inspection and Test Methodology,” of NEI 94-01, Revision 3-A, reads, in part:

> Prior to initiating a Type A test, a visual examination shall be conducted of accessible interior and exterior surfaces of the containment system for structural problems that may affect either the containment structure leakage integrity or the performance of the Type A test. This inspection should be a general visual inspection of accessible interior and exterior surfaces of the primary containment and components. It is recommended that these inspections be performed in conjunction or coordinated with the ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWE/IWL required examinations.

LAR Attachment 1, Section 3.5.3, “Containment Inservice Inspection Program,” indicates that the Limerick CISI plan includes ASME Section CISI Class MC pressure retaining components and their integral attachments (including metal liner), and CISI Class CC components and structures that meet the criteria of Subarticle IWA-1300. This CISI plan also includes information related to augmented examination areas, component accessibility, and examination review.

The Limerick second interval CISI program was developed in accordance with the requirements of 10 CFR 50.55a and the 2001 Edition with the 2003 Addenda of ASME Code Section XI, subject to the limitations and modifications contained in paragraph (b) of the regulation. With the update to the ISI program for the fourth ISI interval for Class 1, 2, and 3 components, including their supports, the CISI program was updated to its third CISI interval for ISI Class MC and CC components. This update will enable all of the ISI and CISI program components/piping structural elements (elements) to be based on the same effective edition and addenda of the ASME Code, Section XI, as well as share a common interval start and end date. The third interval CISI program plan addresses Subsections IWE and IWL, Mandatory Appendices of ASME Code Section XI, approved IWE code cases, and approved alternatives through relief requests and SEs, and utilizes the inspection program as defined therein. The Limerick third interval CISI program plan was developed in accordance with the requirements of 10 CFR 50.55a and the 2007 Edition with the 2008 Addenda of ASME Code Section XI, subject to the limitations and modifications contained in paragraph (b) of the regulation. The Limerick, Units 1 and 2, third CISI interval is effective from February 1, 2017, through January 31, 2027.

Based on its review of LAR Attachment 1, Sections 3.5.3 and 3.5.4, the NRC staff concludes that the requirements of Section 3.1.1.3 of the SER for NEI 94-01 Revision 2, can be satisfied.

Conclusion

Based on the foregoing discussion, the NRC staff concludes that the licensee intends to comply with the guidance contained in NEI 94-01, Revision 3-A, Sections 9.2.1 and 9.2.3.2, and intends to satisfy the provisions contained in Section 3.1.1.3 of the SER for NEI 94-01 Revision 2.

Accordingly, the staff finds that the licensee has adequately addressed Condition 2.

3.2.5.3 NRC Condition 3

The SER dated June 25, 2008 states as Condition 3:

> The licensee addresses the areas of the containment structure potentially subjected to degradation.

Limerick Response to NRC Condition 3

LAR Attachment 1, Section 3.5.3, “Containment Inservice Inspection Program,” states, in part:

> The LGS Containment ISI (CISI) Plan includes ASME Section CISI Class MC pressure retaining components and their integral attachments (including metal liner), and CISI Class CC components and structures that meet the criteria of Subarticle IWA-1300. This CISI Plan also includes information related to augmented examination areas, component accessibility, and examination review.

LAR Attachment 1, Section 3.6.7, “Primary Containment OE [Operating Experience] Since Completion of Last ILRTs,” states, in part:

> Service Level I Protective Coatings Program
>
> The majority of the deficiencies discovered related to the Service Level I protective coatings have been identified and dispositioned in the containment ISI reports. The following items were technical evaluations found outside of the containment ISI examinations.

Staff Assessment

Section 3.1.3 of the NRC staff SER for NEI 94-01, Revision 2, reads, in part:

> In approving for Type A tests the one-time extension from 10 years to 15 years, the NRC staff has identified areas that need to be specifically addressed during the IWE and IWL inspections including a number of containment pressure-retaining boundary components (e.g., seals and gaskets of mechanical and electrical penetrations, bolting, penetration bellows) and a number of the accessible and inaccessible areas of the containment structures (e.g., moisture barriers, steel shells, and liners backed by concrete, inaccessible areas of ice-condenser containments that are potentially subject to corrosion).

The Limerick second interval CISI program plan was developed in accordance with the requirements of 10 CFR 50.55a and the 2001 Edition with the 2003 Addenda of ASME Code Section XI, subject to the limitations and modifications contained in paragraph (b) of the regulation. With the update to the ISI program for the fourth ISI interval for ISI Class 1, 2, and 3 components, including their supports, the CISI program was updated to its third CISI Interval for ISI Class MC and CC components. This update will enable all of the ISI and CISI program components/piping structural elements (elements) to be based on the same effective Edition and Addenda of ASME Code, Section XI, as well as share a common interval start and end date. The third interval CISI program plan addresses Subsections IWE and IWL, Mandatory Appendices of ASME Code Section XI, approved IWE Code cases, and approved alternatives through relief requests and SEs, and utilizes the inspection program as defined therein. The Limerick third interval CISI program plan was developed in accordance with the requirements of 10 CFR 50.55a and the 2007 Edition with the 2008 Addenda of ASME Code Section XI, subject to the limitations and modifications contained in paragraph (b) of the regulation. The Limerick, Units 1 and 2, third CISI interval is effective from February 1, 2017, through January 31, 2027.

Inaccessible Areas/Augmented Examinations

The programmatic requirements for Class MC application inaccessible areas as specified in 10 CFR 50.55a(b)(2)(ix)(A) are:

> (2) For each inaccessible area identified for evaluation, the applicant or licensee must provide the following in the ISI Summary Report as required by IWA-6000:
>
> (i) A description of the type and estimated extent of degradation, and the conditions that led to the degradation;
>
> (ii) An evaluation of each area, and the result of the evaluation; and
>
> (iii) A description of necessary corrective actions.

Based on the information provided in the LAR, the NRC staff finds that the licensee has adequately addressed Condition 3.

3.2.5.4 NRC Condition 4

The SER dated June 25, 2008 states as Condition 4:

> The licensee addresses any tests and inspections performed following major modifications to the containment structure, as applicable.

Limerick Response to NRC Condition 4

In the LAR, the licensee states that there are no major modifications planned that would require the performance of a Type A ILRT or a structural integrity test.

Staff Assessment

Section 3.1.4, "Major and Minor Containment Repairs and Modifications," of the NRC staff SER for NEI 94-01, Revision 2, states, in part:

> Section 9.2.4 of NEI TR 94-01, Revision 2, states that: "Repairs and modifications that affect the containment leakage integrity require LLRT or short duration structural tests as appropriate to provide assurance of containment integrity following the modification or repair. This testing shall be performed prior to returning the containment to operation." Article IWE-5000 of the ASME Code, Section XI, Subsection IWE (up to the 2001 Edition and the 2003 Addenda), would require a Type A test after major repair or modifications to the containment. In general, the NRC staff considers the cutting of a large hole in the containment for replacement of steam generators or reactor vessel heads, replacement of large penetrations, as major repair or modifications to the containment structure.

This condition is intended to verify that any major modification or maintenance repair of the containment since the last ILRT has been appropriately accompanied by either a structural integrity test or an ILRT and that any plans for such major modification also include appropriate pressure testing.

As stated in the licensee response to Condition 4, no major modifications are planned for the Limerick containment structures. Therefore, the NRC staff finds that the licensee has adequately addressed Condition 4.

3.2.5.5 NRC Condition 5

The SER dated June 25, 2008 states as Condition 5:

> The normal Type A test interval should be less than 15 years. If a licensee has to utilize the provision of Section 9.1 of NEI TR 94-01, Revision 2, related to extending the ILRT interval beyond 15 years, the licensee must demonstrate to the NRC staff that it is an unforeseen emergent condition.

Limerick Response to NRC Condition 5

> LGS will follow the requirements of NEI 94-01, Revision 3-A, Section 9.1. This requirement has remained unchanged from Revision 2-A to Revision 3-A of NEI 94-01.
>
> In accordance with the requirements of NEI 94-01, Revision 2-A, SER Section 3.1.1.2, LGS will also demonstrate to the NRC staff that an unforeseen emergent condition exists in the event an extension beyond the 15-year interval is required.

Staff Assessment

Section 3.1.1.2, "Deferral of Tests Beyond The 15-Year Interval," of the NRC staff SER for NEI 94-01 Revision 2, reads:

> As noted above, Section 9.2.3, NEI TR 94-01, Revision 2, states, "Type A testing shall be performed during a period of reactor shutdown at a frequency of at least once per 15 years based on acceptable performance history." However, Section 9.1 states that the "required surveillance intervals for recommended Type A testing given in this section may be extended by up to 9 months to accommodate unforeseen emergent conditions but should not be used for routine scheduling and planning purposes." The NRC staff believes that extensions of the performance-based Type A test interval beyond the required 15 years should be infrequent and used only for compelling reasons. Therefore, if a licensee wants to use the provisions of Section 9.1 in TR NEI 94-01, Revision 2, the licensee will have to demonstrate to the NRC staff that an unforeseen emergent condition exists.

As stated in the licensee response to Condition 5, "LGS will follow the requirements of NEI 94-01 Revision 3-A, Section 9.1." The NRC staff notes that NEI 94-01, Revision 3-A, Section 9.1, "Introduction," contains the relevant passage from the NRC staff SER for NEI 94-01, Revision 2, and states, in part:

> Required surveillance intervals for recommended Type A testing given in this section may be extended by up to 9 months to accommodate unforeseen emergent conditions, but should not be used for routine scheduling and planning purposes.

Therefore, the licensee has demonstrated its understanding that any extension of the Type A test interval beyond the upper-bound performance-based limit of 15 years should be infrequent and that any requested permission (i.e., for such an extension) will demonstrate to the NRC staff that an unforeseen emergent condition exists.

Based on the above review, the NRC staff finds that the licensee has adequately addressed Condition 5.

3.5.2.6 NRC Condition 6

The SER dated June 25, 2008 states as Condition 6:

> For plants licensed under 10 CFR Part 52, applications requesting a permanent extension of the ILRT surveillance interval to 15 years should be deferred until after the construction and testing of containments for that design have been completed and applicants have confirmed the applicability of NEI 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2, including the use of past containment ILRT data.

<u>Limerick Response to NRC Condition 6</u>

> Not applicable. LGS was not licensed under 10 CFR Part 52.

<u>Staff Assessment</u>

> Condition 6 does not apply to Limerick.

<u>Summary</u>

Based on the above evaluations of each condition, the NRC staff determined that the licensee has adequately addressed the six conditions identified in Section 4.1 of the NRC SER for NEI 94-01, Revision 2-A. Therefore, the staff concludes that it is acceptable for the licensee to adopt the "limitations and conditions" of NEI 94-01, Revision 2-A, as part of the implementation documents in the Limerick, Units 1 and 2, TS 6.8.4.g.

3.2.6 <u>NRC Conditions in NEI 94-01, Revision 3-A</u>

As required by 10 CFR 50.54(o), the Limerick containments are subject to the requirements set forth in 10 CFR Part 50, Appendix J. Option B of Appendix J allows the intervals for Types A, B, and C testing be determined by using a performance-based approach. Currently, Limerick TS 6.8.4.g is implemented in accordance with the guidelines contained in RG 1.163, as modified by exception (a). The LAR proposes to revise Limerick TS 6.8.4.g by replacing Option B implementation document RG 1.163 with NEI 94-01, Revision 3-A, along with the limitations and conditions of NEI 94-01, Revision 2-A, to govern the test frequencies and the grace periods for Types A, B, and C tests.

In its letter dated June 8, 2012, the NRC published an SER with limitations and conditions for NEI 94-01, Revision 3. In the SER, the NRC staff concluded that NEI 94-01, Revision 3, describes an acceptable approach for implementing the optional performance-based requirements of 10 CFR Part 50, Appendix J, and is acceptable for referencing by licensees proposing to amend their TSs regarding containment leakage rate testing, subject to the limitations and conditions identified in Section 4.0 and summarized in Section 5.0. The accepted version of NEI 94-01, Revision 3, was issued as Revision 3-A on July 31, 2012, to incorporate the June 8, 2012 NRC final SER and its limitations and conditions.

The licensee indicated in LAR Attachment 1, Section 3.8.2, "Limitation and Conditions Applicable to NEI 94-01, Revision 3-A," that Limerick will meet the limitations and conditions of the NRC staff SER for NEI 94-01, Revision 3-A. Accordingly, both Units 1 and 2 will be adopting, in part, the testing criteria ANSI/ANS 56.8–2002 as part of their licensing basis.

As stated in Section 2.0, "Purpose and Scope," of NEI 94-01, Revision 3-A:

> This guideline delineates the basis for a performance–based approach for determining Type A, Type B, and Type C containment leakage rate surveillance testing frequencies. It does not address how to perform the tests because these details can be found in existing documents (e.g., ANSI/ANS-56.8–2002) that are endorsed for use. However, some differences exist between ANSI/ANS-56.8-2002, and this document, NEI 94-01. Where differences exist, NEI 94-01, Revision 3-A takes precedence.

In the LAR, the licensee proposes to invoke NEI 94-01, Revision 3-A, as the implementation document for Limerick TS 6.8.4.g to govern its Types B and C LLRT programs. The NRC staff has found that NEI 94-01, Revision 3, is an acceptable reference for use in licensee TSs to extend the Option B to 10 CFR Part 50, Appendix J, Types B and C test intervals beyond 60 months, provided that the following two conditions are satisfied.

3.2.6.1 NRC Condition 1

The SER dated June 8, 2012 states as Condition 1:

> NEI TR 94-01, Revision 3, is requesting that the allowable extended interval for Type C LLRTs be increased to 75 months, with a permissible extension (for non-routine emergent conditions) of nine months (84 months total). The staff is allowing the extended interval for Type C LLRTs be increased to 75 months with the requirement that a licensee's post-outage report include the margin between the Type B and Type C leakage rate summation and its regulatory limit. In addition, a corrective action plan shall be developed to restore the margin to an acceptable level. The staff is also allowing the non-routine emergent extension out to 84-months as applied to Type C valves at a site, with some exceptions that must be detailed in NEI 94-01, Revision 3. At no time shall an extension be allowed for Type C valves that are restricted categorically (e.g. BWR MSIVs [boiling water reactor main steam isolation valves]), and those valves with a history of leakage, or any valves held to either a less than maximum interval or to the base refueling cycle interval. Only non-routine emergent conditions allow an extension to 84 months.

Condition 1 presents three separate issues that are required to be addressed:

Condition 1, Issue 1

> The allowance of an extended interval for Type C LLRTs of 75 months carries the requirement that a licensee's post-outage report include the margin between the Type B and Type C leakage rate summation and its regulatory limit.

The licensee's response to Condition 1, Issue 1, is reflected in LAR Attachment 1, Section 3.8.2, "Limitations and Conditions Applicable to NEI 94-01, Revision 3," which states, in part:

> The post-outage report shall include the margin between the Type B and Type C Minimum Pathway Leak Rate (MNPLR) summation value, as adjusted to include the estimate of applicable Type C leakage understatement, and its regulatory limit of 0.60 L_a.

Condition 1, Issue 2

> A corrective action plan shall be developed to restore the margin to an acceptable level.

The licensee's response to Condition 1, Issue 2, is reflected in LAR Attachment 1, Section 3.8.2, "Limitations and Conditions Applicable to NEI 94-01, Revision 3," which states, in part:

> When the potential leakage understatement adjusted Types B and C MNPLR total is greater than the LGS administrative leakage summation limit of 0.50 L_a, but less than the regulatory limit of 0.6 L_a, then an analysis and determination of a corrective action plan shall be prepared to restore the leakage summation margin to less than the LGS leakage limit. The corrective action plan shall focus on those components which have contributed the most to the increase in the leakage summation value and the manner of timely corrective action, as deemed appropriate, that best focuses on the prevention of future component leakage performance issues so as to maintain an acceptable level of margin.

Condition 1, Issue 3

> Use of the allowed 9-month extension for eligible Type C valves is only authorized for non-routine emergent conditions.

The licensee's response to Condition 1, Issue 3, is reflected in LAR Attachment 1, Section 3.8.2, "Limitations and Conditions Applicable to NEI 94-01, Revision 3," which states, in part:

> LGS will only apply the 9-month extension period to eligible Type C components for non-routine emergent conditions. Such occurrences will be documented in the record of tests.

Staff Assessment

The NRC staff has reviewed the requirements of NEI 94-01, Revision 3-A, against the licensee's responses to Condition 1, Issues 1, 2, and 3. Based on this review, the staff finds that the licensee acknowledged all the requirements of Condition 1 and that the licensee has established its intent for Limerick to comply with these requirements. Therefore, the staff finds that the licensee has adequately addressed Condition 1.

3.2.6.2 NRC Condition 2

The SER dated June 8, 2012 states as Condition 2:

> The basis for acceptability of extending the ILRT interval out to once per 15 years was the enhanced and robust primary containment inspection program and the local leakage rate testing of penetrations. Most of the primary containment leakage experienced has been attributed to penetration leakage and penetrations are thought to be the most likely location of most containment leakage at any time. The containment leakage condition monitoring regime involves a portion of the penetrations being tested each refueling outage, nearly all LLRT's being performed during plant outages. For the purposes of assessing and monitoring or trending overall containment leakage potential, the as-found minimum pathway leakage rates for the just tested penetrations are summed with the as-left minimum pathway leakage rates for penetrations tested during the previous 1 or 2 or even 3 refueling outages. Type C tests involve valves which, in the aggregate, will show increasing leakage potential due to normal wear and tear, some predictable and some not so predictable. Routine and appropriate maintenance may extend this increasing leakage potential. Allowing for longer intervals between LLRTs means that more leakage rate test results from farther back in time are summed with fewer just tested penetrations and that total used to assess the current containment leakage potential. This leads to the possibility that the LLRT totals calculated understate the actual leakage potential of the penetrations. Given the required margin included with the performance criterion and the considerable extra margin most plants consistently show with their testing, any understatement of the LLRT total using a 5-year test frequency is thought to be conservatively accounted for. Extending the LLRT intervals beyond 5 years to a 75-month interval should be similarly conservative provided an estimate is made of the potential understatement and its acceptability determined as part of the trending specified in NEI 94-01, Revision 3, Section 12.1.
>
> When routinely scheduling any LLRT valve interval beyond 60 months and up to 75-months, the primary containment leakage rate testing program trending or monitoring must include an estimate of the amount of understatement in the Type B & C total, and must be included in a licensee's post-outage report. The report must include the reasoning and determination of the acceptability of the extension, demonstrating that the LLRT totals calculated represent the actual leakage potential of the penetrations.

Condition 2 presents two separate issues that are required to be addressed:

<u>Condition 2, Issue 1</u>

> Extending the Type C, LLRT intervals beyond 5 years to a 75-month interval should be similarly conservative provided an estimate is made of the potential understatement and its acceptability determined as part of the trending specified in NEI 94-01, Revision 3, Section 12.1.

The licensee's response to Condition 2, Issue 1, is reflected in LAR Attachment 1, Section 3.8.2, "Limitations and Conditions Applicable to NEI 94-01, Revision 3," which states, in part:

> The change in going from a 60-month extended test interval for Type C tested components to a 75-month interval, as authorized under NEI 94-01, Revision 3-A, represents an increase of 25% in the LLRT periodicity. As such, LGS, Units 1 and 2 will conservatively apply a potential leakage understatement adjustment factor of 1.25 to the actual As-Left leak rate, which will increase the As-Left leakage total for each Type C component currently on greater than a 60-month test interval up to the 75-month extended test interval. This will result in a combined conservative Type C total for all 75-month LLRTs being "carried forward" and will be included whenever the total leakage summation is required to be updated (either while on line or following an outage).
>
> When the potential leakage understatement adjusted leak rate total for those Type C components being tested on greater than a 60-month test interval up to the 75-month extended test interval, is summed with the non-adjusted total of those Type C components being tested at less than or equal to a 60-month test interval, and the total of the Type B tested components, results in the MNPLR being greater than the LGS leakage summation limit of $0.50L_a$, but less than the regulatory limit of $0.6\ L_a$, then an analysis and corrective action plan shall be prepared to restore the leakage summation value to less than the LGS leakage limit. The corrective action plan shall focus on those components which have contributed the most to the increase in the leakage summation value and what manner of timely corrective action, as deemed appropriate, best focuses on the prevention of future component leakage performance issues.

<u>Condition 2, Issue 2</u>

> When routinely scheduling any LLRT valve interval beyond 60 months and up to 75 months, the primary containment leakage rate testing program trending or monitoring must include an estimate of the amount of understatement in the Type B & C total, and must be included in a licensee's post-outage report. The report must include the reasoning and determination of the acceptability of the extension, demonstrating that the LLRT totals calculated represent the actual leakage potential of the penetrations.

The licensee's response to Condition 2, Issue 2, is reflected in LAR Attachment 1, Section 3.8.2, "Limitations and Conditions Applicable to NEI 94-01, Revision 3," which states, in part:

> If the potential leakage understatement adjusted leak rate MNPLR is less than the LGS leakage summation limit of $0.50\ L_a$, then the acceptability of the greater than a 60-month test interval up to the 75-month LLRT extension for all affected Type C components has been adequately demonstrated and the calculated local leak rate total represents the actual leakage potential of the penetrations.
>
> In addition to Condition 1, Issues 1 and 2, which deal with the MNPLR Types B and C summation margin, NEI 94-01, Revision 3-A also has a margin related requirement as contained in Section 12.1, Report Requirements.

A post-outage report shall be prepared presenting results of the previous cycle's Type B and Type C tests, and Type A, Type B and Type C tests, if performed during that outage. The technical contents of the report are generally described in ANSI/ANS-56.8-2002 and shall be available on-site for NRC review. The report shall show that the applicable performance criteria are met and serve as a record that continuing performance is acceptable. The report shall also include the combined Type B and Type C leakage summation, and the margin between the Type B and Type C leakage rate summation and its regulatory limit. Adverse trends in the Type B and Type C leakage rate summation shall be identified in the report and a corrective action plan developed to restore the margin to an acceptable level.

At LGS, in the event an adverse trend in the aforementioned potential leakage understatement adjusted Type B and C summation is identified, then an analysis and determination of a corrective action plan shall be prepared to restore the trend and associated margin to an acceptable level. The corrective action plan shall focus on those components which have contributed the most to the adverse trend in the leakage summation value and the manner of timely corrective action, as deemed appropriate, that best focuses on the prevention of future component leakage performance issues.

At LGS, an adverse trend is defined as three (3) consecutive increases in the final pre-Opcon Mode Change Types B and C MNPLR leakage summation values, as adjusted to include the estimate of applicable Type C leakage understatement, as expressed in terms of L_a.

Staff Assessment

The NRC staff has reviewed the requirements of NEI 94-01, Revision 3-A, against the licensee's responses to Condition 2, Issues 1 and 2. Based on this review, the staff finds that the licensee acknowledged all the requirements of Condition 2 and that the licensee has established its intent for Limerick to comply with these requirements. Therefore, the staff finds that the licensee has adequately addressed Condition 2.

Summary

Based on the above evaluations of each condition, the NRC staff determined that the licensee has adequately addressed both conditions in Section 4.0 of the NRC SER for NEI 94-01, Revision 3-A. Therefore, the staff concludes that it is acceptable for the licensee to adopt NEI 94-01, Revision 3-A, as the implementation document in the Limerick, Units 1 and 2, TS 6.8.4.g.

3.2.7 Overall Evaluation of the Proposed Extension of ILRT and LLRT Test Intervals

The NRC staff reviewed the Types A, B, and C leakage test results related to the licensee's proposal to extend 10 CFR Part 50, Appendix J test intervals.

As described below, for each Limerick unit, the staff finds that the licensee is effectively implementing the Limerick Types B and C performance-based leakage rate test programs, as required by 10 CFR Part 50, Appendix J, Option B. Accordingly, the staff concludes that the performance history of Types B and C tests supports extending the current Type C test interval to 75 months, as permitted by NEI 94-01, Revision 3-A, for Limerick.

Limerick, Unit 1

The ILRT results provided in Table 3.1.1-1 of this SE indicate that the previous two consecutive Type A tests for Unit 1 (1998 and 2012) were successful with containment performance leakage rates less than the maximum allowable (i.e., L_a at P_a , of 0.5 percent (%) of primary containment air weight per day) contained in the leakage rate acceptance criteria of TS 6.8.4.g. Therefore, the NRC staff finds that the performance history of the Unit 1 Type A tests supports extending the current ILRT interval on a permanent basis to 15 years as permitted by NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A.

The NRC staff reviewed the Unit 1 as-found minimum path and as-left maximum path local leak rates listed in Section 3.2.2 of this SE. The staff notes that the results of the as-found minimum path and as-left maximum path for recent (i.e., refueling outages in 2008-2018) Types B and C tests are substantially less than the Types B and C test TS limit of ≤ 0.60 L_a contained in TS 6.8.4.g. The Limerick, Unit 1 as-found minimum pathway leak rate shows an average of 36.34 percent of 0.6 L_a with a high of 52.59 percent of 0.6 L_a, and the Unit 1 as-left maximum pathway leak rate shows an average of 58.07 percent of 0.6 L_a with a high of 68.31 percent of 0.6 L_a. Therefore, the staff finds that the Unit 1 LLRT combined leakage results support extension of Types A and C test intervals, while the ILRT results support extending the Type A test interval. Specifically, LLRT results support both ILRT interval extension since they show penetration leakage is being well controlled, leaving more margin for non-penetration leakage, and Type C testing interval extension since margin to the combined Types B and C performance criteria is being well controlled.

Limerick, Unit 2

The ILRT results provided in Table 3.1.1-2 of this SE indicate that the previous two consecutive Type A tests for Unit 2 (1999 and 2013) were successful with containment performance leakage rates less than the maximum allowable (i.e., L_a at P_a, of 0.5 percent (%) of primary containment air weight per day) contained in the leakage rate acceptance criteria of TS 6.8.4.g. Therefore, the NRC staff finds that the performance history of the Unit 2 Type A tests supports extending the current ILRT interval on a permanent basis to 15 years as permitted by NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A.

The NRC staff reviewed the Unit 2 as-found minimum path and as-left maximum path local leak rates listed Section 3.2.2 of this SE. The staff notes that the results of the as-found minimum path and as-left maximum path for recent (i.e., refueling outages in 2007-2017) Types B and C tests are substantially less than the Types B and C test TS limit of ≤ 0.60 L_a contained in TS 6.8.4.g. The Limerick, Unit 2 as-found minimum pathway leak rate shows an average of 23.25 percent of 0.6 L_a with a high of 31.55 percent of 0.6 L_a, and the Unit 2 as-left maximum pathway leak rate shows an average of 42.23 percent of 0.6 L_a with a high of 51.87 percent of 0.6 L_a. Therefore, the staff finds that the Unit 2 LLRT combined leakage results support extension of Types A and C test intervals, while the ILRT results support extending the Type A test interval. Specifically, LLRT results support both ILRT interval extension since they show penetration leakage is being well controlled, leaving more margin for non-penetration leakage, and Type C testing interval extension since margin to the combined Types B and C performance criteria is being well controlled.

3.2.8 Overall Evaluation of the Proposed Extension of Units 1 and 2 DWBT

The NRC staff reviewed the Units 1 and 2 DWBT historical test results as described in Section 3.2.3 of this SE. The licensee has shown measured leakage margin (Table 3.2-1 of this SE) to the acceptance criterion. The vacuum breakers are where most drywell bypass leakage potential is expected, and local leakage tests of these components are performed on a refuel outage frequency. Therefore, the staff finds that performing the DWBT on the requested extended interval to align this test with the proposed Type A test frequency provides reasonable assurance that bypass leakage potential will be adequately monitored and controlled.

3.3 Probabilistic Risk Assessment (PRA)

3.3.1 Background

Section 9.2.3.1, “General Requirements for ILRT Interval Extensions beyond Ten Years,” of NEI 94-01, Revision 3-A, discusses how plant-specific confirmatory analyses are required when extending the Type A ILRT interval beyond 10 years. Section 9.2.3.4, “Plant-Specific Confirmatory Analyses,” of NEI 94-01, Revision 3-A, states that the assessment should be performed using the approach and methodology described in EPRI Report No. 1018243 and that the analysis is to be performed by the licensee and retained in the plant documentation and records as part of the basis for extending the ILRT interval.

In the SER dated June 25, 2008, the NRC staff found the methodology in NEI 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2, to be acceptable for referencing by licensees proposing to amend their TSs to permanently extend the ILRT interval to 15 years, provided that certain conditions are satisfied. These conditions, set forth in Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2, provide that:

1. The licensee submits documentation indicating that the technical adequacy of its PRA is consistent with the requirements of RG 1.200 relevant to the ILRT extension application. Additional application-specific guidance on the technical adequacy of a PRA used to extend ILRT intervals is provided in the SER for EPRI Report No. 1009325, Revision 2.

2. The licensee submits documentation indicating that the estimated risk increase associated with permanently extending the ILRT surveillance interval to 15 years is small and consistent with the clarification provided in Section 3.2.4.6[2] of the SER for EPRI Report No. 1009325, Revision 2.

3. The methodology in EPRI Report No. 1009325, Revision 2, is acceptable, provided the average leak rate for the preexisting containment large leak accident case (i.e., accident case 3b) used by licensees is assigned a value of 100 times the maximum allowable leakage rate (L_a) instead of 35 L_a.

4. An LAR is required in instances where containment overpressure is relied upon for ECCS performance. According to the clarification provided in Section 3.2.4.6 of the SER for NEI 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2, plants that rely on containment overpressure (or containment accident pressure) net

[2] Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2, indicates that the clarification regarding small increases in risk is provided in Section 3.2.4.5; however, the clarification is actually provided in Section 3.2.4.6.

positive suction head (NPSH) for ECCS injection must also consider core damage frequency (CDF) in the ILRT evaluation.

3.3.2 Plant-Specific Risk Evaluation

The licensee provided a plant-specific risk assessment for permanently extending the currently allowed containment Type A ILRT interval from 10 years to 15 years in Attachment 3 to the LAR dated April 9, 2019.

The licensee states that the plant-specific risk assessment follows the guidance in NEI 94-01, Revision 3-A; the methodology described in EPRI Report No. 1018243 (also identified as EPRI Report No. 1009325, Revision 2-A); and the NRC guidance outlined in RG 1.174. Additionally, the licensee applied the methodology from the Calvert Cliffs Nuclear Power Plant to estimate the likelihood and risk implications of corrosion-induced leakage of steel liners going undetected during extended test interval.[3]

The analysis also provides a risk assessment of extending the plant's drywell-to-suppression chamber bypass leak test interval from 3 years to 15 years. The drywell-to-suppression chamber bypass leak test risk assessment is performed in Appendix B, separate from the Type A Test assessment, in the main body of the calculation. The drywell-to-suppression chamber bypass leak test risk assessment is performed in accordance with the guidelines set forth in NEI 94-01, the methodology used in EPRI Report No. 1018243, and RG 1.174.

The licensee addressed each of the four conditions for the use of EPRI Report No. 1009325, Revision 2, which are listed in Section 4.2 of the SER. A summary of how each condition is met is provided in Sections 3.3.2.1 through 3.3.2.4 below.

3.3.2.1 Condition 1 – PRA Quality

The first condition in Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2, states that the licensee submits documentation indicating that the technical adequacy of its PRA is consistent with the requirements of RG 1.200 relevant to the ILRT extension application. This RG describes one acceptable approach for determining whether the technical adequacy of the PRA, in total, or the parts that are used to support an application, is sufficient to provide confidence in the results such that the PRA can be used in regulatory decisionmaking for light-water reactors.

Consistent with the information provided in Regulatory Issue Summary 2007-06, "Regulatory Guide 1.200 Implementation,"[4] the NRC staff will use Revision 2 of RG 1.200 to assess the technical adequacy of the PRA used to support risk-informed applications received after March 2010.[5] In Section 3.2.4.1 of the SER for NEI 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2, the NRC staff states that Capability Category (CC) I of the ASME PRA standard shall be applied as the standard for assessing PRA quality for ILRT extension applications, since approximate values of CDF and large early release frequency (LERF) and their distribution among release categories are sufficient to support the evaluation of changes to ILRT frequencies.

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[3] ADAMS Accession No. ML020920100.
[4] ADAMS Accession No. ML070650428.
[5] ADAMS Accession No. ML090410014.

The licensee addresses the Limerick PRA technical adequacy in LAR Attachment 1, Section 3.4.2, and Attachment 3. As discussed in Appendix A of Attachment 3 to the LAR, the Limerick risk assessment performed to support the ILRT application utilized the current Limerick Levels 1 and 2 internal events PRA model of record, which the licensee completed in 2017. The 2017 versions of the Limerick PRA models are the most recent risk profile evaluations at Limerick for internal events. The licensee explains its approach to establishing and maintaining the technical adequacy and plant fidelity of the PRA models. This approach includes both a proceduralized PRA maintenance and update process and the use of self-assessments and independent peer reviews.

The Limerick PRA model for internal events received a formal industry peer review in November 1998. The model was updated in 2001 to address the significant findings from that review. Following that update, Limerick was one of five nuclear plants that piloted application of RG 1.200; thus, a site PRA gap analysis, which compared the Limerick PRA to the requirements of the NRC-endorsed ASME PRA standard, was completed in 2003 in support of the Limerick pilot for risk-informed activities. Additionally, the Limerick PRA model was subject to an RG 1.200 pilot assessment in July 2004. Following the completion of the PRA model update in 2005 to strategically address the identified gaps, a peer review against draft Addendum B of the ASME PRA standard was performed in October 2005. The full power internal events peer review performed in 2005 found that 97 percent of the supporting requirements evaluated "met" CC II or better. There were seven supporting requirements that were assessed as "not met," and two supporting requirements that were assessed as meeting CC 1. In May 2008, a focused peer review against Addendum B of the ASME PRA standard of the updated internal flooding analysis was performed. The internal flooding peer review encompassed a review of the internal flood at-power PRA, consistent with the scope of the ASME PRA standard RA-Sb-2005, as endorsed and clarified at the time by the NRC in RG 1.200, Revision 1.

The 2005 full power internal events peer review findings and the 2008 internal flood peer review findings were addressed in the Limerick PRA. In July 2016, a review of the peer review findings and the resolutions was performed by an independent review team. The independent review team concluded that, for the full power internal events, three findings were not resolved, and one open item was not reviewed. Two of the four findings were documentation-related, and one of the findings could be addressed by a minor model change. For the internal flood findings, the review team concluded that two findings were resolved, one finding was not resolved, and eight findings were partially resolved. The nine unresolved internal flood findings were mostly related to minor model enhancements and documentation issues.

Lastly, a gap assessment to the current standard, ASME/ANS Ra-Sa-2009, and RG 1.200, Revision 2, was performed. The gap assessment did not identify any deficiencies that were not identified by the peer reviews or were not previously self-identified with respect to the new standard, and the remaining open items are consistent with the 2016 independent review team conclusions. The remaining set of open or partially resolved findings and observations from the independent review team assessment are described in Table A-1 of the LAR for internal events and internal flooding, with their impact on the application noted. The status reflects what has been completed following the 2017 model update, where most of the remaining findings have been addressed. A staff review of these findings and observations found that there is no material, if any, impact on the application.

With respect to external events, RG 1.174 provides that established acceptance guidelines are intended for comparison with a full-scope assessment of the change in the applicable risk metrics and recognizes that many PRAs are not full scope, and that PRA information of less than full scope may be acceptable. The methodology described in EPRI Report No. 1009325, Revision 2-A, which the NRC staff found satisfies the key principles of risk-informed decisionmaking of RG 1.174, discusses that if the external event analysis is not of sufficient quality or detail to allow direct application of the methodology, the quality or detail will be increased, or a suitable estimate of the risk impact from the external events should be performed. This assessment can be taken from existing, previously submitted and approved analyses or another alternate method of assessing an order-of-magnitude estimate for contribution of the external event to the impact of the changed interval. Based on this, the licensee performed a bounding, order-of-magnitude analysis of the potential impacts from external events. This analysis references the currently available information for external events models and information to develop an "external events multiplier" to be applied to the internal events results.

The Limerick fire PRA peer review was performed in November 2011 using the NEI 07-12, Revision 1, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," dated June 2010 (ADMAS Accession No. ML102230070), fire PRA peer review process; the ASME PRA standard, ASME/ANS RA-Sa-2009; and RG 1.200, Revision 2. The purpose of this review was to establish the technical adequacy of the fire PRA for the spectrum of potential risk-informed plant licensing applications for which the fire PRA may be used. The 2011 Limerick fire PRA peer review was a full-scope review of all the technical elements of the Limerick at-power fire PRA against all technical elements in Part 4 of the ASME/ANS PRA standard, including the referenced internal events supporting requirements. The peer review noted a few facts and observations. The findings were addressed in the Limerick fire PRA, and in July 2016, an independent review team performed a review of the fire PRA peer review findings and resolutions. The independent review team concluded that 14 of the findings were either partially resolved or still open. The independent review team did not assess an additional five findings since they were assessed as being open prior to the independent review. The remaining set of open or partially resolved findings from the independent review team assessment is described in Table A-2 of Attachment 3 for the internal fire hazard group and its impact on this application is noted. A staff review of these findings and observations found that there is no material, if any, impact on the application.

The licensee does not maintain a seismic PRA model for Limerick. NRC Generic Issue (GI) 199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern U.S. for Existing Plants," "Appendix D: Seismic Core-Damage Frequencies," provides the seismic CDF estimates developed in the safety/risk Assessment.[6] Table D-1 provides seismic CDFs using 2008 USGS seismic hazard curves. The weakest link model using the curve for Limerick resulted in a CDF of 5.3E-05/year (yr) based on a peak ground motion fragility high confidence of low probability of failure (HCLPF) value of 0.15g, as noted in Table C-2 of GI-199. The licensee explained that a more realistic limiting HCLPF value would be 0.30g peak ground acceleration, which is based on the staff's SER associated with the Limerick individual plant examination of external events (IPEEE). The licensee further indicated that using the 0.30g value would result in an estimated seismic CDF on an order of magnitude less than that reported in GI-199. The staff noted that the estimated seismic CDF would be in the order of E-06/yr. Also, as indicated in the SER associated with the Limerick IPEEE, the licensee had provided additional information which, upon review, indicated that all structures, systems, and components on the seismic margin assessment success path component list have

[6] ADAMS Accession No. ML100270756.

a capacity of at least 0.3g peak ground acceleration (PGA) or are acceptable as-is. The staff notes that the more realistic limiting HCLPF value of 0.30g PGA is appropriate.

As a bounding estimate for the ILRT external events risk impact assessment, the licensee chose to apply half of the reported GI-199 seismic CDF value, which is 2.65E-05/yr; this is a factor of 8.4 higher than the full power internal events CDF. By assuming the ratio of the seismic LERF to the full power internal events LERF is the same as the ratio of the CDF values, the seismic LERF is approximated by multiplying the full power internal events LERF of 2.07E-07/yr by 8.4. The result of 1.75E-06/yr was used by the licensee in its analysis to represent the seismic LERF.

The chosen seismic CDF is judged to be sufficient to support an order of magnitude Limerick ILRT external events risk impact assessment because the licensee demonstrated that the chosen seismic CDF bounded the estimated seismic CDF, and the estimated seismic CDF is calculated based on an HCLPF value of 0.30g PGA, which was found to be appropriate based on the NRC staff's SER associated with the Limerick IPEEE.

Based on its review of the above information, the NRC staff finds that the licensee has addressed the relevant findings and gaps from the peer reviews and that they have no impact on the results of this application. Therefore, the NRC staff concludes that the internal events PRA model used by the licensee is of sufficient quality to support the evaluation of changes to ILRT frequencies. Accordingly, Condition 1 is met.

3.3.2.2 Condition 2 – Estimated Risk Increase

The second condition in Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2, states that the licensee submits documentation indicating that the estimated risk increase associated with permanently extending the ILRT interval to 15 years is small, and consistent with the clarification provided in Section 3.2.4.5 of the SER for NEI 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2. Specifically, a small increase in population dose should be defined as an increase in population dose of less than or equal to either 1.0 person-Roentgen equivalent man (rem) per year or 1 percent of the total population dose, whichever is less restrictive. In addition, a small increase in conditional containment failure probability (CCFP) should be defined as a value marginally greater than that accepted in previous one-time 15-year ILRT extension requests. This would require that the increase in CCFP be less than or equal to 1.5 percentage points. Lastly, for plants that rely on containment overpressure for NPSH for ECCS injection, both CDF and LERF will be considered in the ILRT evaluation and compared with the risk acceptance guidelines in RG 1.174. RG 1.174 defines very small changes in risk as resulting in increases of CDF and LERF of less than 1.0E-6/yr and 1.0E-07/yr, respectively. Thus, the associated risk metrics include LERF, population dose, CCFP, delta CDF, and delta LERF.

The licensee reported the results of the plant-specific risk assessment in Section 5.6 of Appendix A to the LAR. External events are considered in Section 5.7, and the impact of containment overpressure is assessed in Section 5.8. The reported risk impacts are based on a change in the Type A containment ILRT frequency from three tests in ten years (the test frequency under 10 CFR Part 50, Appendix J, Option A) to one test in fifteen years and account for the risk from undetected containment leaks due to steel liner corrosion. The following conclusions can be drawn from the licensee's analysis associated with extending the Type A ILRT frequency:

1. RG 1.174 defines very small changes in risk as resulting in increases of CDF less than 1.0E-6/yr. The Limerick design conservatively assumes 0 psig containment pressure and maximum expected temperatures of the pumped fluids. Thus, no reliance is placed on pressure and/or temperature transients to ensure adequate NPSH. Since Limerick does not rely on containment accident pressure for ECCS NPSH during certain design-basis accidents, extending the ILRT interval does not impact CDF. Thus, the estimated risk increase associated with permanently extending the ILRT surveillance interval to 15 years is small using the acceptance guidelines of RG 1.174.

   RG 1.174 defines very small changes in risk as resulting in increases in LERF less than 1.0E-07/yr. The increase in LERF resulting from a change in the Type A ILRT test interval from 3-in-10 years to 1-in-15 years with corrosion included is estimated as 3.23E-08/yr using the EPRI guidance. As such, the estimated change in LERF is determined to be very small using the acceptance guidelines of RG 1.174. When external event risk is included, the increase in LERF resulting from a change in the Type A ILRT test interval from 3-in-10 years to 1-in-15 years is estimated as 4.12E-07/yr using the EPRI guidance, and total estimated upper bound LERF is 2.72E-06/yr. As such, the estimated change in LERF is determined to be small using the acceptance guidelines of RG 1.174. The risk change resulting from a change in the Type A ILRT test interval from 3-in-10 years to 1-in-15 years bounds the 1-in-10 years to 1-in-15 years risk change.

2. The effect resulting from changing the Type A test frequency to 1-in-15 years measured as an increase to the total integrated plant risk for those accident sequences influenced by Type A testing is 6.60E-02 person-rem/yr. NEI 94-01 states that a small total population dose is defined as an increase of ≤ 1.0 person-rem/yr, or ≤ 1 percent of the total population dose, whichever is less restrictive for the risk impact assessment of the extended ILRT intervals. The reported increase in total population dose is below the acceptance criteria provided in EPRI Report No. 1009325, Revision 2-A, and defined in Section 3.2.4.6 of the SER for NEI 94-01, Revision 2. Thus, the increase in the total integrated plant risk for the proposed change is considered small and supportive of the proposed change.

3. The increase in the CCFP due to the change in test frequency from 3-in-10 years to 1-in-15 years is 1.02. NEI 94-01 states that an increase in CCFP of ≤ 1.5 is small. This value is below the acceptance guidelines in Section 3.2.4.6 of the SER for NEI 94-01, Revision 2, and supportive of the proposed change.

Based on the risk assessment results, the NRC staff concludes that the increase in LERF is small and consistent with the acceptance guidelines of RG 1.174, and that the increase in the total population dose and the magnitude of the change in the CCFP for the proposed change are small. The defense-in-depth philosophy is maintained, as the independence of barriers will not be degraded because of the requested change, and the use of the quantitative risk metrics collectively ensures that the balance between prevention of core damage, prevention of containment failure, and consequence mitigation is preserved. Accordingly, Condition 2 is met.

3.3.2.3 Condition 3 – Leak Rate for the Large Preexisting Containment Leak Rate Case

The third condition in Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2, states that to make the methodology in EPRI Report No. 1009325, Revision 2, acceptable, the average leak rate for the preexisting containment large leak rate accident case (i.e., accident case 3b) used by the licensee shall be 100 L_a instead of 35 L_a. As noted by the licensee in Section 3.5.1 of Enclosure 1 to the LAR, the methodology in EPRI Report No. 1009325, Revision 2-A, incorporated the use of 100 L_a as the average leak rate for the preexisting containment large leak rate accident case (accident case 3b), and this value has been used in the Limerick plant-specific risk assessment. Accordingly, Condition 3 is met.

3.3.2.4 Condition 4 – Containment Overpressure is Relied Upon for ECCS Performance

The fourth condition in Section 4.2 of the SER for EPRI Report No. 1009325, Revision 2, states that in instances where containment overpressure is relied upon for ECCS performance, an LAR is required to be submitted. In Section 3.3.6 of Attachment 1 of the LAR, the licensee stated that the Limerick BWR design conservatively assumes 0 psig containment pressure and maximum expected temperatures of the pumped fluids. Thus, for Limerick, no reliance is placed on pressure and/or temperature transients to ensure adequate net positive suction head. Accordingly, Condition 4 is not applicable.

3.3.3 Drywell Bypass Leak Rate Test Risk Assessment

Limerick incorporates a Mark II containment with the drywell located over the suppression chamber and separated by a diaphragm slab. The suppression chamber contains a pool of water having a depth that varies between 22 feet and 24 feet, 3 inches, during normal operation. There are 87 downcomers and 14 main steam safety/relief valve discharge lines that penetrate the diaphragm slab and terminate at a pre-designed submergence within the pool.

During a postulated LOCA inside containment, the drywell is pressurized with steam and air. The resulting large pressure difference between the drywell and the wetwell forces the steam through the suppression pool where it is condensed, resulting in a lower containment pressure. If the steam were to bypass the suppression pool and pressurize the wetwell, containment design pressure may be exceeded. Consequently, a test is performed to ensure that the leakage between the drywell and the wetwell is less than a specified amount. The leakage is specified as $A/\sqrt{K}$, where A is the flow area of the leakage path and K is the geometric and frictional loss coefficient.

The design value for leakage area is determined by analyzing a spectrum of LOCA break sizes. For each break size, there is a limiting leakage area. In determining the limiting leakage area, credit is taken for the capability of operators to initiate drywell and suppression pool sprays after a period of time sufficient for them to realize that there is a significant suppression pool bypass flow. The effect of suppression pool bypass on containment pressure response is greatest with small breaks. The design value of 0.050 square feet (ft^2) for Limerick represents the maximum leakage area that can be tolerated for that break size that is most limiting with respect to suppression pool bypass. Therefore, the Limerick TS requirements conservatively specify a maximum allowable bypass area of 10 percent of the design value of 0.050 ft^2. The TS limit provides an additional factor of ten safety margin above the conservatisms taken in the steam bypass analysis. The drywell-to-suppression chamber bypass leak rate test verifies that the actual bypass flow area is less than or equal to the TS limit.

The most probable leakage paths between the drywell and the wetwell of a BWR Mark II containment are through the four sets of vacuum breakers. The other leakage paths are diaphragm floor penetrations such as the downcomer and main steam safety/relief valve discharge line penetrations, cracks in the diaphragm floor and liner plate, and cracks in the downcomers and safety/relief valve discharge lines that pass through the suppression chamber air space. Isolation valves in lines that are cross-connected between the drywell and the wetwell are another possible leakage path.

The licensee reviewed the historical test results for the drywell-to-suppression chamber bypass leak rate tests and reported them in Attachment 3, Appendix B, Section B.2 of the LAR. The licensee identified no failures of the historical test results. The history of test results indicates that the typical leakage is about an order of magnitude, or more, below the acceptance criterion of 0.005 ft^2, which is set below the design-basis limit of 0.050 ft^2.

As part of the drywell-to-suppression chamber bypass leak rate test risk assessment, the licensee performed a set of deterministic thermal hydraulic analyses using the MAAP code and the Limerick plant-specific model. The purpose of the analyses was to identify the impact of increased drywell-to-suppression chamber leakage on the risk spectrum. The focus was to understand the containment response from pressurization of water and steam LOCA events as a function of the drywell-to-suppression chamber bypass leakage. The licensee concluded, for a full range of water LOCAs, variations in the drywell-to-suppression chamber bypass leakage, from zero to many times TS leakage, do not impact the vapor suppression capability of the Limerick containment and, therefore, do not significantly impact the calculated CDF or radionuclide release frequency for these accident scenarios. For the medium and large steam LOCAs, the results indicate that the containment pressure approaches the ultimate containment pressure within a few hours. For small steam LOCAs, the containment pressure approaches the ultimate containment pressure within the 24-hour mission time. For simplicity, an operator action to initiate containment sprays or perform an emergency depressurization is assumed to be required to prevent containment overpressure failure for a leakage of this magnitude. These conditions regarding the impact of the potential for increased drywell-to-suppression chamber leakage are factored into the risk assessment.

The licensee performed a risk impact assessment that includes the impact of extending the duration of the drywell-to-suppression chamber bypass leak rate test to match that of the ILRT. The consideration of the drywell-to-suppression chamber bypass leak rate test extension in the risk assessment uses the methodology presented in EPRI Report No. 1009325, Revision 2, for the ILRT extension with a few additional assumptions and considerations. Consistent with the ILRT assessment, the relevant figures of merit are changes in LERF, population dose, and CCFP. Additionally, the drywell-to-suppression chamber bypass leak rate test extension will also lead to a change in CDF.

The primary difference in the methodology used to evaluate the drywell-to-suppression chamber bypass leak rate test extension is in the determination of the probability of a large undetected drywell leak and in the assignment of various drywell and containment leakage combinations to appropriate containment failure categories. For consistency with the EPRI guidance, the change in the probability of a large undetected bypass increases by a factor of 3.33 for a 10-year interval, and an extension to a 15-year interval can be estimated to lead to a factor increase of 5.0 in the non-detection probability of a leak. Additionally, the licensee assumed that the base case potential for a large drywell-to-suppression chamber bypass leak is 100 L_a, which is consistent with the ILRT analysis.

Based on the results of the deterministic studies and their PRA implications, the licensee provided the following findings:

- Increasing the drywell-to-suppression chamber bypass leak rate test interval is assumed to increase the probability of increased bypass leakage.

- There is a change in the CDF associated with the possibility that a steam LOCA occurs with the increased drywell to wetwell bypass leakage, and the containment pressurization is not mitigated. The licensee notes that this is conservatively assumed to lead to containment failure and consequential loss of reactor pressure vessel makeup and results in core damage.
- There is a change in the LERF associated with the possibility that previous early wetwell region failures that were not considered LERF due to the fission product scrubbing effects of the suppression pool would be LERF if sufficient bypass leakage area exists.
- The overall change in population dose is small.
- There is a change in the conditional containment failure probability with an increase in CDF. The increase in LERF is only from cases that were already containment failure cases.

The risk metric changes to be compared are then:

- Δ CDF = 7.86E-10/yr
- Δ LERF = 3.60E-09/yr
- Δ Person-rem dose rate = 0.015 person-rem/yr
- Δ CCFP = 0.003 percent

The changes in CDF and LERF meet the RG 1.174 acceptance guidelines for very small risk change. The change in population dose rate is well below the acceptance criteria of ≤ 1.0 person-rem/yr or < 1 percent person-rem/yr defined in the EPRI guidance. The change in CCFP of 0.003 percent is approximately two orders of magnitude below the EPRI guidance document acceptance criteria of < 1.5 percent. It is noted that the licensee's methodology to include the impact of the drywell-to-suppression chamber bypass leak rate test frequency extension in the risk assessment is similar to prior ILRT/drywell-to-suppression chamber bypass leak rate test extension risk assessments for Grand Gulf Nuclear Station, River Bend Station, and Clinton Power Station. As such, the NRC staff has reviewed the risk impact of the drywell-to-suppression chamber bypass leak rate test frequency extension provided by the licensee and concludes that it is technically acceptable for this application.

4.0 CONCLUSION

In the LAR, the licensee proposed to extend the Limerick current performance-based Type A test interval to no longer than 15 years by adopting NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A, as the implementation documents in TS 6.8.4.g.

This change would allow the licensee to conduct the next Unit 1 Type A test no later than March 2027 in lieu of the current requirement of no later than March 2022 and conduct the next Unit 2 Type A test no later than April 2028 in lieu of the current requirement of no later than April 2023.

Consistent with the guidance in NEI 94-01, Revision 3-A, and the limitations and conditions of NEI 94-01, Revision 2-A, the licensee justified the proposed change by demonstrating adequate performance of the Limerick containments based on: (a) plant-specific containment leakage testing program results, (b) CISI results, and (c) a plant-specific risk assessment.

Based on its review of the licensee's LAR dated April 9, 2019, and the regulatory and technical evaluations above, the NRC staff finds that there is reasonable assurance that the licensee has addressed the NRC conditions to demonstrate the acceptability of adopting NEI 94-01, Revision 3-A, and the limitations and conditions specified in NEI 94-01, Revision 2-A, as the 10 CFR Part 50, Appendix J, Option B implementation documents for Limerick, Units 1 and 2.

The NRC staff also finds that the licensee has adequately implemented its Primary Containment Leakage Rate Testing Program (i.e., Types A, B, and C leakage tests) for the Limerick containments. The results of past ILRTs and recent LLRTs demonstrate acceptable performance of the Limerick containments and demonstrate that the structural and leaktight integrity of the containment structures are being adequately maintained. The staff also finds that the structural and leaktight integrity of the Limerick containments will continue to be monitored and maintained if Limerick adopts NEI 94-01, Revision 3-A, and the limitations and conditions specified in NEI 94-01, Revision 2-A, as the 10 CFR Part 50, Appendix J, Option B implementation documents for both Units 1 and 2. Accordingly, the staff concludes that there is reasonable assurance that the structural and leaktight integrity for the Limerick containments will continue to be maintained, without undue risk to public health and safety, if the current Type A test intervals are extended to 15 years and if the current Type C test intervals for qualifying CIVs are extended to 75 months.

Therefore, the NRC staff concludes that it is acceptable for Limerick, Units 1 and 2, to:

- Permanently extend the existing Type A ILRT program test interval from 10 years to 15 years in accordance with NEI 94-01, Revision 3-A, and the limitations and conditions specified in NEI 94-01, Revision 2-A.

- Permanently extend the CIV leakage rate testing (Type C) frequency from the 60 months currently permitted by 10 CFR Part 50, Appendix J, Option B, to a maximum 75-month frequency for Type C leakage rate testing of selected components, in accordance with NEI 94-01, Revision 3-A.

- Adopt ANSI/ANS 56.8-2002.

- Adopt a more conservative allowable test interval extension of 9 months for Types A, B, and C leakage rate tests in accordance with NEI 94-01, Revision 3-A.

- Permanently extend the existing DWBT frequency from 120 months (10 years) to 180 months (15 years).

- Delete TS 6.8.4.g, Unit 1 exceptions: “a. Section 9.2.3: The first Type A test performed after May 15, 1998 shall be performed no later than May 15, 2013.”

- Delete TS 6.8.4.g, Unit 2 exceptions: “a. Section 9.2.3: The first Type A test performed after May 21, 1999 shall be performed no later than May 21, 2014.”

5.0 STATE CONSULTATION

In accordance with the Commission’s regulations, the NRC staff notified the Pennsylvania State official of the proposed issuance of the amendments on December 11, 2019. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The amendments change requirements with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20 and change SRs. The NRC staff has determined that the amendments involve no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on June 4, 2019 (84 FR 25837). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

7.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

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Date: March 11, 2020

SUBJECT: LIMERICK GENERATING STATION, UNITS 1 AND 2 − ISSUANCE OF AMENDMENT NOS. 241 AND 204 TO REVISE TECHNICAL SPECIFICATION 6.8.4.g, "PRIMARY CONTAINMENT LEAKAGE RATE TESTING PROGRAM," TO EXTEND CONTAINMENT INTEGRATED LEAK RATE TEST FREQUENCY (EPID L-2019-LLA-0073) DATED MARCH 11, 2020

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