Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-3110

Kevin T. Walsh
Vice President, Operations
Arkansas Nuclear One

2CAN061003

June 17, 2010

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: License Amendment Request
Technical Specification Change to Extend the
Type A Test Frequency to 15 Years
Arkansas Nuclear One, Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) hereby requests the following amendment for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed change would allow for the extension to the ten-year frequency of the ANO-2 Type A or Integrated Leak Rate Test (ILRT) that is required by Technical Specification (TS) 6.5.16 to be extended to 15 years on a permanent basis.

The proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c) and it has been determined that the changes involve no significant hazards consideration. The bases for these determinations are included in the attached submittal.

A similar TS change was approved for the Nine Mile Point Unit 2 on March 30, 2010 (ADAMS Accession Number ML100730032).

The proposed change includes one new commitment. These commitments are summarized in Attachment 4.

Entergy requests approval of the proposed amendment by February 20, 2011. Once approved, the amendment shall be implemented within 30 days.

If you have any questions or require additional information, please contact David Bice at 479-858-5338.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 17, 2010.

Sincerely,

Original signed by Kevin T. Walsh

KTW/rwc

Attachments:

1. Analysis of Proposed Technical Specification Change
2. Proposed Technical Specification Changes (mark-up)
3. Details of Risk Assessment
4. List of Regulatory Commitments

cc: Mr. Elmo E. Collins
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
Arkansas Nuclear One
P. O. Box 310
London, AR 72847

U. S. Nuclear Regulatory Commission
Attn: Mr. Kaly Kalyanam
MS O-8 B1
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Mr. Bernard R. Bevill
Arkansas Department of Health
Radiation Control Section
4815 West Markham Street
Slot #30
Little Rock, AR 72205

Attachment 1

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Analysis of Proposed Technical Specification Change

1.0 DESCRIPTION

This letter is a request to amend Operating License NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2).

The proposed amendment revises ANO-2 Technical Specification (TS) 6.5.16, "Containment Leakage Rate Testing Program," by replacing the reference to Regulatory Guide (RG) 1.163 with a reference to Nuclear Energy Institute (NEI) topical report NEI 94-01, Revision 2-A, as the implementation document used by Entergy Operations, Inc. (Entergy) to develop the ANO-2 performance-based leakage testing program in accordance with Option B of 10 CFR 50, Appendix J.

Revision 2-A of NEI 94-01 describes an approach for implementing the optional performance-based requirements of Option B, including provisions for extending primary containment integrated leak rate test (ILRT) intervals to 15 years, and incorporates the regulatory positions stated in RG 1.163. In the safety evaluation (SE) issued by NRC letter dated June 25, 2008, the NRC concluded that NEI 94-01, Revision 2, describes an acceptable approach for implementing the optional performance-based requirements of Option B of 10 CFR 50, Appendix J, and found that NEI 94-01, Revision 2, is acceptable for referencing by licensees proposing to amend their TS in regards to containment leakage rate testing, subject to the limitations and conditions noted in Section 4.0 of the SE.

In accordance with the guidance in NEI 94-01, Revision 2-A, ANO-2 proposes to extend the interval for the primary containment ILRT, which is currently required to be performed at ten year intervals to no longer than 15 years from the last ILRT. The next ILRT is currently due no later than February 29, 2012. This is approximately 11.3 years since the last ILRT. This schedule is acceptable based on a one-time extension of the frequency that was requested in Entergy letter dated August 21, 2008, and approved in NRC letter dated July 20, 2009. The current frequency would require the next ILRT to be performed during the spring 2011 refueling outage. The proposed amendment would allow the next ILRT for ANO-2 to be performed within 15 years from the last ILRT (i.e., November 30, 2015), as opposed to the current ten-year interval. This would allow successive ILRTs to be performed at 15-year intervals (assuming acceptable performance history). The performance of fewer ILRTs will result in significant savings in radiation exposure to personnel, cost, and critical path time during future refueling outages. In addition, the proposed change supports tying an ILRT to the potential breach in containment for a reactor head replacement at ANO-2, should the current head replacement projected schedule continue as planned.

2.0 PROPOSED CHANGE

ANO-2 TS 6.5.16, "Containment Leakage Rate Testing Program," currently states in part,

> 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 Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," dated September 1995, except that the next Type A test performed after the November 30, 2000, Type A test shall be performed no later than February 29, 2012.

The proposed change would revise this portion of TS 6.5.16 by replacing the reference to RG 1.163 with a reference to NEI 94-01, Revision 2-A. The date for the next ILRT is also revised. The changes are underlined.

> 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, Revision 2-A, “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J,” dated October 2008, except that the next Type A test performed after the November 30, 2000, Type A test shall be performed no later than November 30, 2015.

Attachment 2 contains the existing TS page 6-18 marked-up to show the proposed changes to TS 6.5.16.

3.0 BACKGROUND

The testing requirements of 10 CFR 50, Appendix J, provide assurance that leakage from the containment, including systems and components that penetrate the containment, does not exceed the allowable leakage values specified in the TS, and that periodic surveillance of containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of the containment and the systems and components penetrating containment. The limitation on containment leakage provides assurance that the containment would perform its design function following an accident up to and including the plant design basis accident. Appendix J identifies three types of required tests: (1) Type A tests, intended to measure the containment overall integrated leakage rate; (2) Type B tests, intended to detect local leaks and to measure leakage across pressure-containing or leakage limiting boundaries (other than valves) for containment penetrations; and (3) Type C tests, intended to measure containment isolation valve leakage. Type B and C tests identify the vast majority of potential containment leakage paths. Type A tests identify the overall (integrated) containment leakage rate and serve to ensure continued leakage integrity of the containment structure by evaluating those structural parts of the containment not covered by Type B and C testing.

In 1995, 10 CFR 50, Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,” was amended to provide a performance-based Option B for the containment leakage testing requirements. Option B requires that test intervals for Type A, Type B, and Type C testing be determined by using a performance-based approach. Performance-based test intervals are based on consideration of the operating history of the component and resulting risk from its failure. The use of the term “performance-based” in 10 CFR 50, Appendix J refers to both the performance history necessary to extend test intervals as well as to the criteria necessary to meet the requirements of Option B.

Also in 1995, RG 1.163 was issued. The RG endorsed NEI 94-01, Revision 0, “Industry Guideline for Implementing Performance-Based Option of 10 CFR 50, Appendix J,” with certain modifications and additions. Option B, in concert with RG 1.163 and NEI 94-01, Revision 0, allows licensees with a satisfactory ILRT performance history (i.e., two consecutive, successful Type A tests) to reduce the test frequency from the containment Type A (ILRT) test from three tests in ten years to one test in ten years. This relaxation was based on an NRC risk assessment contained in NUREG-1493, “Performance-Based Containment Leak-Test Program”, and Electric Power Research Institute (EPRI) TR-104285, “Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals, both of which illustrated that the risk increase associated with extending the ILRT surveillance interval was very small.

By letter dated April 11, 1996, Entergy Operations, Inc. (Entergy) submitted a TS change request concerning the implementation of 10 CFR 50, Appendix J, Option B. In the SE approving this request (letter dated October 3, 1996), the NRC noted the proposed TS changes were in compliance with the requirements of 10 CFR 50, Appendix J, Option B, and are consistent with the guidance in RG 1.163. Despite the different format of the ANO-2 TSs, all of the important elements of the guidance provided in the Staff’s letter to NEI dated November 2, 1995, are included in the proposed TS.

With the approval of the TS change request, ANO-2 transitioned to a performance-based ten year frequency for the Type A tests.

Entergy submitted a TS change to extend the ILRT interval from ten years (120 months) to approximately 135 months via letter dated August 21, 2008. This one-time extension was approved by the NRC in letter dated July 20, 2009.

By letter dated August 31, 2007, NEI submitted Revision 2 of NEI 94-01 and EPRI TR-1009325, Revision 2, “Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals,” to the NRC Staff for review.

NEI 94-01, Revision 2, describes an approach for implementing the optional performance-based requirements of Option B described in 10 CFR 50, Appendix J, which includes provisions for extending Type A intervals to up to 15 years and incorporates the regulatory positions stated in RG 1.163. It delineates a performance-based approach for determining Type A, Type B, and Type C containment leakage rate surveillance testing frequencies. This method uses industry performance data, plant-specific performance data, and risk insights in determining the appropriate testing frequency. NEI 94-01, Revision 2, also discusses the performance factors that licensees must consider in determining test intervals. However, it does not address how to perform the tests because these details are included in existing documents (e.g., American National Standards Institute / American Nuclear Society [ANSI / ANS]-56.8-2002). The NRC final SE issued by letter dated June 25, 2008, documents the NRC’s evaluation and acceptance of NEI 94-01, Revision 2, subject to the specific limitations and conditions listed in Section 4.1 of the SE. The accepted version of NEI 94-01 has subsequently been issued as Revision 2-A dated October 2008.

EPRI TR-1009325, Revision 2, provides a risk impact assessment for optimized ILRT intervals of up to 15 years, utilizing current industry performance data and risk-informed guidance, primarily Revision 1 of RG 1.174, “An Approach for using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Bases.” The NRC’s final SE issued by letter dated June 25, 2008, documents the NRC’s evaluation and acceptance of EPRI TR-1009325, Revision 2, subject to the specific limitations and conditions listed in Section 4.2 of the SE. An accepted version of EPRI TR-1009325 has subsequently been issued as Revision 2-A (also identified as TR-1018243) dated October 2008.

4.0 TECHNICAL ANALYSIS

As required by 10 CFR 50.54(o), the ANO-2 containment is subject to the requirements set forth in 10 CFR 50, Appendix J. Option B of Appendix J requires that test intervals for Type A, Type B, and Type C testing be determined by using a performance-based approach. Currently, the ANO-2 10 CFR 50 Appendix J Testing Program Plan is based on RG 1.163, which endorses NEI 94-01, Revision 0. This license amendment request proposes to revise the ANO-2 10 CFR 50, Appendix J Testing Program Plan by implementing the guidance in NEI 94-01, Revision 2-A.

In the SE issued by the NRC dated June 25, 2008, the NRC concluded that NEI 94-01, Revision 2, describes an acceptable approach for implementing the optional performance-based requirements of Option B of 10 CFR 50, Appendix J, and found that NEI 94-01, Revision 2, is acceptable for referencing by licensees proposing to amend their TS in regards to containment leakage rate testing, subject to the limitations and conditions noted in Section 4.0 of the SE. The following addresses each of the six limitations and conditions.

Limitation / Condition (from Section 4.1 of SE)	ANO-2 Response
1. For calculating the Type A leakage rate, the licensee should use the definition in the NEI TR 94-01, Revision 2, in lieu of that in ANSI/ANS-56.8-2002).	Following the NRC approval of this license amendment request, ANO-2 will use the definition in Section 5.0 of NEI 94-01, Revision 2-A, for calculating the Type A leakage rate when future ANO-2 Type A tests are performed (see Attachment 4, “List of Regulatory Commitments”).
2. The licensee submits a schedule of containment inspections to be performed prior to and between Type A tests.	A schedule of containment inspections is provided in Section 4.2 below.
3. The licensee address the areas of the containment structure potentially subjected to degradation.	General visual examination of accessible interior and exterior surfaces of the containment system for structural problems is typically conducted in accordance with the ANO-2 Containment Inservice Inspection Plan which implements the requirements of the ASME, Section XI, Subsections IWE and IWL, as required by 10 CFR 50.55a(g). The ANO-2 containment system does employ moisture barriers, but is not equipped with a sand cushion. There are no primary containment surface areas that require augmented examinations in accordance with ASME Section XI, IWE-1240.

4.	The licensee addresses any test and inspections performed following major modifications to the containment structure, as applicable.	ANO-2 has already replaced the steam generators that required modifications to the containment structure. When ANO-2 replaces the reactor vessel closure head, the containment structure may need to be modified. The design change process will address any testing requirements for this potential and any future containment structure modifications.
5.	The normal Type A test interval should be less than 15 years. If a licensee has to utilize the provisions 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.	Entergy acknowledges and accepts this NRC staff position, as communicated to the nuclear industry in Regulatory Issue Summary (RIS) 2008-27 dated December 8, 2008.
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 TR 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2, including the use of past containment ILRT data.	Not applicable. ANO-2 is not licensed pursuant to 10 CFR Part 52.

To comply with the requirement of 10 CFR 50, Appendix J, Option B, Section V.B, ANO-2 TS 6.5.16 currently references RG 1.163. RG 1.163 states that NEI 94-01, Revision 0, provides methods acceptable to the NRC for complying with Option B of 10 CFR 50, Appendix J, with four exceptions described therein.

The proposed change replaces the reference to RG 1.163 with a reference to NEI 94-01; however, the proposed TS change is worded to indicate that the Appendix J Testing Program must be in accordance with NRC-reviewed and accepted guidelines (i.e., NEI 94-01), with the specific version of those guidelines specified in the Appendix J Testing Program Plan. These proposed TS changes are consistent with the regulatory requirement to include the implementation document used to develop the performance-based leakage testing program, by general reference, in the plant TS, and assures that only NRC-reviewed and accepted guidance is used to develop the program. In addition, these changes will allow the use of later NRC-accepted versions of NEI 94-01 without the unnecessary burden of processing a license amendment.

The current ANO-2 TS does not list any exceptions to the guidelines contained in RG 1.163.

4.1 Previous ILRT Results

Previous ILRT testing confirmed that the ANO-2 containment structure leakage is acceptable, with considerable margin, with respect to the TS acceptance criterion of 0.1% of containment air weight at the design basis loss of coolant accident pressure (L_a). Since the last two ANO-2 Type A as-found results were less than 1.0 L_a, a test frequency of at least once per 15 years would be in accordance with NEI 94-01, Revision 2-A.

The first ANO-2 ILRT was performed on May 31, 1981. ANO-2 performed ILRTs on May 1, 1985; April 22, 1988; April 9, 1991; and March 17, 1994. The last ILRT was completed on November 30, 2000, after the installation of the replacement steam generators and closure of the construction opening made in the containment structure to support the replacement of the steam generators. In addition, the test was performed at the new higher design pressure of 58 psig. There have been no failed ILRTs at ANO-2.

Containment penetration (Type B and C) testing is being performed in accordance with Option B of 10 CFR 50, Appendix J. The current total penetration leakage on a minimum path basis is less than 10% of the leakage allowed for containment integrity.

No modifications that require a Type A test are planned prior to 2R24, when the next Type A test will be performed under this proposed change. Any unplanned modifications to the containment prior to the next scheduled Type A test would be subject to the special testing requirements of Section IV.A of 10 CFR 50, Appendix J. There have been no pressure or temperature excursions in the containment which could have adversely affected containment integrity. There is no anticipated addition or removal of plant hardware within containment which could affect leak-tightness.

4.2 Type B and Type C Testing Program

The ANO-2 Appendix J, Type B and Type C testing program requires testing of electrical penetrations, airlocks, hatches, flanges, and valves within the scope of the program as required by 10 CFR 50, Appendix J, Option B and TS 6.5.16. The Type B and Type C testing program consists of local leak rate testing of penetrations with a resilient seal, expansion bellows, double gasketed manways, hatches and flanges, and containment isolation valves that serve as a barrier to the release of the post-accident containment atmosphere.

A review of the most recent Type B and Type C test results and their comparison with the allowable leakage rate was performed. The combined Type B and Type C leakage acceptance criterion is 103,894 standard cubic centimeters per minute (sccm). The maximum and minimum pathway leak rate summary totals for the last two refueling outage are shown below.

2R19 As-Found Minimum Pathway Leakage	8,168 sccm
2R19 As-Left Maximum Pathway Leakage	17,561 sccm
2R20 As-Found Minimum Pathway Leakage	9,373 sccm
2R20 As-Left Maximum Pathway Leakage	18,810 sccm

As discussed in NUREG-1493, Type B and Type C tests can identify the vast majority (greater than 95%) of all potential containment leakage paths. This amendment request adopts the guidance in NEI 94-01, Revision 2-A, in place of NEI 94-01, Revision 0, but otherwise does not affect the scope, performance, or scheduling of Type B or Type C tests. Type B and Type C testing will continue to provide a high degree of assurance that containment integrity is maintained.

4.3 Supplemental Inspection Requirements

Prior to initiating a Type A test, a general visual examination 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 is performed. This inspection is typically conducted in accordance with the ANO-2 Containment Inservice Inspection (ISI) Plan, which implements the requirements of ASME, Section XI, Subsection IWE / IWL. The applicable code edition and addenda for the fourth ten-year interval IWE / IWL program is the 2001 Edition with the 2003 Addenda. There is one relief request associated with this interval.

The examination performed in accordance with the IWE / IWL program satisfies the general visual examination requirements specified in 10 CFR 50, Appendix J, Option B. Identification and evaluation of inaccessible areas are addressed in accordance with the requirements of 10 CFR 50.55a(b)(2)(ix)(A) and (E). Examination of pressure-retaining bolted connections and evaluation of containment bolting flaws or degradation are performed in accordance with the requirements of 10 CFR 50.55a(b)(ix)(G) and 10 CFR 50.55a(b)(ix)(H). Each ten-year ISI interval is divided into three approximately equal-duration inspection periods. A minimum of one inspection during each inspection period of the ISI interval is required by the IWE / IWL program. It should be noted that the moisture barrier, as part of the IWE / IWL program will be inspected each refueling outage this ten-year interval. Since a 15-year ILRT interval spans at least four ISI inspection periods, the frequency of the examinations performed in accordance with the IWE / IWL program satisfies the requirement of NEI 94-01, Revision 2-A, Section 9.2.3.2, to perform the general visual examinations during at least three other outages before the next Type A test, if the Type A test interval is to be extended to 15 years.

There are no primary containment surface areas that require augmented examination in accordance with ASME Section XI, IWE-1240.

4.4 Deficiencies Identified

Consistent with the guidance provided in NEI 94-01, Revision 2, Section 9.2.3.3, abnormal degradation of the primary containment structure identified during the conduct of IWE / IWL program examinations or at other times is entered into the corrective action program for evaluation to determine the cause of the degradation and to initiate appropriate corrective actions.

4.5 Plant-Specific Confirmatory Analysis

4.5.1 Methodology

An evaluation has been performed to assess the risk impact of extending the ANO-2 ILRT interval from the current ten years to 15 years. This plant-specific risk assessment followed the guidance in NEI 94-01, Revision 2-A, the methodology described in EPRI TR-1009325, Revision 2-A and the NRC regulatory guidance outlined in RG 1.174 on the use of Probabilistic Risk Assessment (PRA) findings and risk insights in support of a request to change the licensing basis of the plant. In addition, the methodology used for Calvert Cliffs Nuclear Power

Plant to estimate the likelihood and risk implication of corrosion-induced leakage of steel containment liners going undetected during the extended ILRT interval was also used for sensitivity analysis. The current ANO-2 Level 1 and Large Early Release Frequency (LERF) internal events PRA model was used to perform the plant-specific risk assessment. This PRA model has been updated to meet Capability Category II of ASME PRA Standard RA-Sb-2005 and RG 1.200, Revision 1. The analyses include evaluation for the dominant external events (seismic and fire) using conservative expert judgment with the information from the ANO-2 Individual Plant Examination of External Events (IPEEE). Though the IPEEE seismic and fire event models have not been updated since the original IPEEE, the insights and information of IPEEE have been used to estimate the effect on total LERF of including these external events in the ILRT interval extension risk assessment.

In the SE issued by NRC letter dated June 25, 2008, the NRC concluded that the methodology in EPRI TR-1009325, Revision 2, is acceptable for referencing by licensees proposing to amend their TS to extend the ILRT surveillance interval to 15 years, subject to the limitations and conditions noted in Section 4.0 of the SE. The following table addresses each of the four limitations and conditions for the use of EPRI TR-1009325, Revision 2.

Limitation/Condition (From Section 4.2 of SE)	**ANO-2 Response**
1. The licensee submits documentation indicating that the technical adequacy of their PRA is consistent with the requirements of RG 1.200 relevant to the ILRT extension	ANO-2 PRA quality is addressed in Section 4.5.2.
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 3.2.4.5 of this SE. 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-rem per year or 1 percent of the total population dose, whichever is restrictive. In addition, a small increase in CCFP should be defined as a value marginally greater than that accepted in a previous one-time ILRT extension requests. This would require that the increase in CCFP be less than or equal to 1.5 percentage point.	EPRI Report No. 1009325, Revision 2-A, incorporates these population dose and Conditional Containment Failure Probability (CCFP) acceptance guidelines, and these guidelines have been used for the ANO-2 plant specific assessment.
3. The methodology in EPRI Report No. 1009325, Revision 2, is acceptable except for the calculation of the increase in expected population dose (per year of reactor operation). In order to make the methodology acceptable, the average leak rate accident case (accident case 3b) used by the licensees shall be 100 L_a instead of 35 L_a	EPRI Report No. 1009325, Revision 2-A, incorporated the use of 100 L_a as the average leak rate for the pre-existing containment large leakage rate accident case (accident case 3b), and this value has been used in the ANO-2 plant specific risk assessment.

4. A licensee amendment request (LAR) is required in instances where containment over-pressure is relied upon for emergency core cooling system (ECCS) performance	ANO-2 does not rely on containment overpressure to assure adequate net positive suction head for ECCS pump following design basis accidents (See ANO-2 Safety Analysis Report Section 6.2.2 and 6.3.1)

4.5.2 PRA Quality

The ANO-2 PRA model, Revision 4p02, combines Level 1 and LERF models for internal events. Severe accident sequences have been developed from internally initiated events. The sequences have been mapped to the radiological release end state (i.e., source term release to environment).

The ANO-2 PRA is based on a detailed model of the plant developed from the Individual Plant Examination which underwent NRC review. Review comments, current plant design, current procedures, plant operating data, current industry PRA techniques, and general improvements identified by the NRC have been incorporated into the current PRA model. The model is maintained in accordance with Entergy PRA procedures.

The ANO-2 PRA internal events model has recently been updated to meet ASME PRA Standard RA-Sb-2005 and RG 1.200, Revision 1. The industry peer review of the updated PRA model has been performed. The updated PRA model meets ASME Capability Category II requirements by addressing gaps identified by the peer review. As such, the updated ANO-2 PRA model is considered acceptable for use in assessing the risk impact of extending the ANO-2 containment ILRT interval to 15 years.

4.5.3 Summary of Plant-Specific Risk Assessment Results

The findings of the ANO-2 risk assessment confirm the general findings of previous studies that the risk impact associated with extending the ILRT interval from three in ten years to one in 15 years is small. The ANO-2 plant-specific results for extending ILRT interval from the current 10 years to 15 years are summarized below.

1. Core Damage Frequency (CDF) is not significantly impacted by the proposed change. ANO-2 does not rely on containment overpressure to assure adequate net positive suction head for ECCS pumps following design basis accidents; thus, the CDF change is negligible and the relevant acceptance criterion is LERF.

2. The increase in LERF based on consideration of internal events only is conservatively estimated as 3.16E-9/yr. The guidance in RG 1.174 defines very small changes in LERF as those that are less than 1.E-7/yr. Therefore, the estimated change in LERF is determined to be very small using the guidelines of RG 1.174. An assessment of the impact from external events (seismic and fire) was also performed. In this case, the total increase in LERF for combined internal and external events was conservatively estimated as 6.76E-09. The total increase in LERF for the combined internal and external events model is also determined to be very small using the guidelines of RG 1.174.

3. The calculated increase in the 50-mile population dose is 1.45E-4 person-rem per year. EPRI TR-1009325, Revision 2-A, states that a small increase in population dose is defined as an increase of less than or equal to either 1.0 person-rem per year or 1 percent of the total population dose (for ANO-2, 1.36E-1 person-rem per year), whichever is less restrictive. Thus, the calculated 50-mile population dose increase is small using the guidelines of EPRI TR-1009325, Revision 2-A. Moreover, the risk impact when compared to other severe accident risks is negligible.

4. The calculated increase in the CCFP is 3.41E-3. EPRI TR-1009325 Revision 2-A, states that increase in CCFP of less than or equal to 1.5 percentage points is very small. Therefore, the calculated CCFP increase is judged to be very small.

Details of the ANO-2 risk assessment are contained in Attachment 3 to this enclosure.

4.6 Conclusion

NEI 94-01, Revision 2-A, describes an NRC-accepted approach for implementing the performance-based requirements of 10 CFR 50, Appendix J, Option B. It incorporates the regulatory positions stated in RG 1.163 and includes provisions for extending Type A intervals to 15 years. NEI 94-01, Revision 2-A delineates a performance-based approach for determining Type A, Type B, and Type C containment leakage rate surveillance test frequencies. Entergy is adopting the guidance of NEI 94-01, Revision 2-A for the ANO-2 10 CFR Appendix J testing program plan.

Based on the previous ILRT tests conducted at ANO-2, it may be concluded that extension of the containment ILRT interval from 10 to 15 years represents minimal risk to increased leakage. The risk is minimized by continued Type B and Type C testing performed in accordance with Option B of 10 CFR 50, Appendix J and inspection activities performed as part of the ANO-2 IWE / IWL ISI program.

This experience is supplemented by risk analysis studies, including the ANO-2 risk analysis provided in Attachment 3. The findings of the ANO-2 risk assessment confirm the general findings of previous studies, on a plant-specific basis, that extending the ILRT interval from ten to 15 years results in a very small change to the ANO-2 risk profile.

5.0 REGULATORY ANALYSIS

5.1 Applicable Regulatory Requirements/Criteria

The proposed change has been evaluated to determine whether applicable regulations and requirements continue to be met.

10 CFR 50.54(o) requires primary reactor containments for water-cooled power reactors to be subject to the requirements of Appendix J to 10 CFR 50, “Leakage Rate Testing of Containment of Water Cooled Nuclear Power Plants.” Appendix J specifies containment leakage testing requirements, including the types required to ensure the leak-tight integrity of the primary reactor containment and systems and components which penetrate the containment. In addition, Appendix J discusses leakage rate acceptance criteria, test methodology, frequency of testing and reporting requirements for each type of test.

RG 1.163 was developed to endorse NEI 94-01, Revision 0 with certain modifications and additions.

The adoption of the Option B performance-based containment leakage rate testing for Type A testing did not alter the basic method by which Appendix J leakage rate testing is performed; however, it did alter the frequency at which Type A, Type B, and Type C containment leakage tests must be performed. Under the performance-based option of 10 CFR 50, Appendix J, the test frequency is based upon an evaluation that review “as-found” leakage history to determine the frequency for leakage testing which provides assurance that leakage limits will be maintained. The change to the Type A test frequency did not directly result in an increase in containment leakage. Similarly, the proposed change to the Type A test frequency will not directly result in an increase in containment leakage.

NEI 94-01, Revision 2-A, describes an approach for implementing the performance-based requirements of 10 CFR 50, Appendix J, Option B. The document incorporates the regulatory positions stated in RG 1.163 and includes provisions for extending Type A intervals to 15 years. NEI 94-01, Revision 2-A, delineates a performance-based approach for determining Type A, Type B, and Type C containment leakage rate test frequencies. In the SE issued by NRC letter dated June 25, 2008, the NRC concluded that NEI 94-01, Revision 2, describes an acceptable approach for implementing the optional performance-based requirements of 10 CFR 50, Appendix J, and is acceptable for referencing by licensees proposing to amend their TS in regards to containment leakage rate testing, subject to the limitations and conditions, noted in Section 4.0 of the SE.

EPRI TR-1009325, Revision 2, provides a risk impact assessment for optimized Integrated Leak Rate Test (ILRT) intervals up to 15 years, utilizing current industry performance data and risk-informed guidance. NEI 94-01, Revision 2, states that a plant-specific risk impact assessment should be performed using the approach and methodology described in TR-1009325, Revision 2, for a proposed extension of the ILRT interval to 15 years. In the safety evaluation (SE) issued by NRC letter June 25, 2008, the NRC concluded that the methodology in EPRI TR-1009325, Revision 2, is acceptable for referencing by licensees proposing to amend their TS to extend the ILRT surveillance interval to 15 years, subject to the limitations and conditions noted in Section 4.0 of the SE.

Based on the considerations above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will continue to be conducted in accordance with the site licensing basis, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

In conclusion, Entergy Operations, Inc. (Entergy) has determined that the proposed change does not require any exemptions or relief from regulatory requirements, other than the TS, and does not affect conformance with any regulatory requirements / criteria.

5.2 No Significant Hazards Consideration

A change is proposed to the Arkansas Nuclear One, Unit 2 (ANO-2), Technical Specifications 6.5.16, “Containment Leakage Rate Testing Program.” The proposed amendment would replace the reference to Regulatory Guide (RG) 1.163 with a reference to Nuclear Energy Institute (NEI) topical report NEI 94-01, Revision 2-A, dated October 2008, as the implementation document used by ANO-2 to develop the ANO-2 performance-based leakage testing program in accordance with Option B of 10 CFR 50, Appendix J. The proposed amendment would also extend the interval for the primary containment integrated leak rate test (ILRT), which is required to be performed by 10 CFR 50, Appendix J, from ten years to no longer than 15 years from the last ILRT.

Entergy has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed amendment involves changes to the ANO-2 Containment Leakage Rate Testing Program. The proposed amendment does not involve a physical change to the plant or a change in the manner in which the plant is operated or controlled. The primary containment function is to provide an essentially leak tight barrier against the uncontrolled release of radioactivity to the environment for postulated accidents. As such, the containment itself and the testing requirements to periodically demonstrate the integrity of the containment exist to ensure the plant's ability to mitigate the consequences of an accident, do not involve any accident precursors or initiators. Therefore, the probability of occurrence of an accident previously evaluated is not significantly increased by the proposed amendment.

   The proposed amendment adopts the NRC-accepted guidelines of NEI 94-01, Revision 2-A, for development of the ANO-2 performance-based testing program. Implementation of these guidelines continues to provide adequate assurance that during design basis accidents, the primary containment and its components will limit leakage rates to less the values assumed in the plant safety analyses. The potential consequences of extending the ILRT interval to 15 years have been evaluated by analyzing the resulting changes in risk. The increase in risk in terms of person-rem per year within 50 miles resulting from design basis accidents was estimated to be acceptably small and determined to be within the guidelines published in RG 1.174. Additionally, the proposed change maintains defense-in-depth by preserving a reasonable balance among prevention of core damage, prevention of containment failure, and consequence mitigation. ANO-2 has determined that the increase in Conditional Containment Failure Probability due to the proposed change would be very small. Therefore, it is concluded that the proposed amendment does not significantly increase the consequences of an accident previously evaluated.

   Based on the above discussion, it is concluded that the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed amendment adopts the NRC-accepted guidelines of NEI 94-01, Revision 2-A, for the development of the ANO-2 performance-based leakage testing program, and establishes a 15-year interval for the performance of the containment ILRT. The containment and the testing requirements to periodically demonstrate the integrity of the containment exist to ensure the plant's ability to mitigate the consequences of an accident, do not involve any accident precursors or initiators. The proposed change does not involve a physical change to the plant (i.e., no new or different type of equipment will be installed) or a change to the manner in which the plant is operated or controlled.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The proposed amendment adopts the NRC-accepted guidelines of NEI 94-01, Revision 2-A, for the development of the ANO-2 performance-based leakage testing program, and establishes a 15 year interval for the performance of the containment ILRT. This amendment does not alter the manner in which safety limits, limiting safety system setpoints, or limiting conditions for operation are determined. The specific requirements and conditions of the Containment Leakage Rate Testing Program, as defined in the TS, ensure that the degree of primary containment structural integrity and leak-tightness that is considered in the plant's safety analysis is maintained. The overall containment leakage rate limit specified by the TS is maintained, and the Type A, Type B, and Type C containment leakage tests will be performed at the frequencies established in accordance with the NRC-accepted guidelines of NEI 94-01, Revision 2-A.

   Containment inspections performed in accordance with other plant programs serve to provide a high degree of assurance that the containment will not degrade in a manner that is not detectable by an ILRT. A risk assessment using the current ANO-2 PSA model concluded that extending the ILRT test interval from ten years to 15 years results in a very small change to the ANO-2 risk profile.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.3 Environmental Considerations

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 PRECEDENCE

This request is similar in nature to the license amendment authorized by the NRC on March 30, 2010, for the Nine Mile Point Nuclear Station, Unit 2 (TAC No. ME1650, ADAMS Accession Number ML100730032).

Attachment 2

2CAN061003

Proposed Technical Specification Changes (mark-up)

6.5.16 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, Revision 2-A, “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J,” dated October 2008~~Regulatory Guide 1.163, “Performance-Based Containment Leak-Test Program,” dated September 1995,~~ except that the next Type A test performed after the November 30, 2000 Type A test shall be performed no later than November 30, 2015~~February 29, 2012~~.

In addition, the containment purge supply and exhaust isolation valves shall be leakage rate tested prior to entering MODE 4 from MODE 5 if not performed within the previous 92 days.

The peak calculated containment internal pressure for the design basis loss of coolant accident, P_a, is 58 psig.

The maximum allowable containment leakage rate, L_a, shall be 0.1% of containment air weight per day at P_a.

Leakage rate acceptance criteria are:

a. Containment leakage rate acceptance criteria is $\leq$ 1.0 L_a. During the first unit startup following each test performed in accordance with this program, the leakage rate acceptance criteria are < 0.60 L_a for the Type B and Type C tests and $\leq$ 0.75 L_a for Type A tests.

b. Air lock acceptance criteria are:

    1. Overall air lock leakage rate is $\leq$ 0.05 L_a when tested at $\geq$ P_a.

    2. Leakage rate for each door is $\leq$ 0.01 L_a when pressurized to $\geq$ 10 psig.

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

The provisions of Specification 4.0.3 are applicable to the Containment Leakage Rate Testing Program.

Attachment 3

2CAN061003

Details of Risk Assessment

Details of Risk Assessment

Evaluation of Risk Significance of ILRT Extension for Outage 2R21

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LIST OF TABLES

1.0 PURPOSE

The purpose of this report is to provide an alternative estimation of the change in risk associated with extending the Type A integrated leak rate test interval beyond the current 10 years required by 10 CFR 50, Appendix J, Option B for Arkansas Nuclear One Unit 2 (ANO-2). This activity supports an award of an extension for outage 2R21. Specifically, this report utilizes the methodology identified in Reference 1.

1.1 SUMMARY OF THE ANALYSIS

10 CFR 50, Appendix J[2] allows individual plants to extend Type A surveillance testing requirements and to provide for performance-based leak testing. This report documents a risk-based evaluation of the proposed change of the integrated leak rate test (ILRT) interval for the ANO-2. The proposed change would impact testing associated with the current surveillance tests for Type A leakage, procedure 5120.401[3]. No change to Type B or Type C testing is proposed at this time.

This analysis utilizes the guidelines set forth in NEI 94-01[4], the methodology used in Reference 1 and considers the submittals generated by other utilities.

This calculation evaluates the risk associated with various ILRT intervals as follows:

- 3 years – Interval based on the original requirements of 3 tests per 10 years.
- 10 years – This is the current test interval required for ANO-2.
- 15 years – Proposed extended test interval.

The analysis utilizes the ANO-2 PRA results taken from Reference 6.
The release category and person-rem information is based on the approach suggested by Reference 1.

1.2 SUMMARY OF RESULTS/CONCLUSIONS

The specific results are summarized in Table 1 below. The Type A contribution to LERF is defined as the contribution from Class 3b.

Table 1
Summary of Risk Impact on Extending Type A ILRT Test Frequency

	Risk Impact for 3-years (baseline)	Risk Impact for 10-years (current requirement)	Risk Impact for 15-years
Total integrated risk (person-rem/yr)	0.13534	0.13554	0.13569
Type A testing risk (person-rem/yr)	9.038E-5	3.013E-4	4.519E-4
% total risk (Type A / total)	0.067%	0.222%	0.333%
Type A LERF (Class 3b) (per year)	1.90E-9/yr	6.32E-9/yr	9.48E-9/yr
Changes due to extension from 10 years (current)			
Δ Risk from current (Person-rem/yr)			1.45E-4
% Increase from current (Δ Risk / Total Risk)			0.107%
Δ LERF from current (per year)			3.16E-9
Δ CCFP from current			3.41E-3
Changes due to extension from 3 years (baseline)			
Δ Risk from baseline (Person-rem/yr)			3.49E-4
% Increase from baseline (Δ Risk / Total Risk)			0.258%
Δ LERF from baseline (per year)			7.59E-9
Δ CCFP from baseline			8.18E-3

The results are discussed below:

- The person-rem/year increase in risk contribution from extending the ILRT test frequency from the current once-per-ten-year interval to once-per-fifteen years is 1.45E-4 person-rem/year.
- The risk increase in LERF from extending the ILRT test frequency from the current once-per-10-year interval to once-per-15 years is 3.16E-9/yr.
- The change in conditional containment failure probability (CCFP) from the current once-per-10-year interval to once-per-15 years is 3.41E-3.
- The change in Type A test frequency from once-per-ten-years to once-per-fifteen-years increases the risk impact on the total integrated plant risk by only 0.107%. Also, the change in Type A test frequency from the original three-per-ten-years to once-per-fifteen-years increases the risk only 0.258%. Therefore, the risk impact when compared to other severe accident risks is negligible.
- Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test interval from a once-per-ten-years to a once per-fifteen-years is 3.16E-9/yr. Guidance in Reg. Guide 1.174 defines very small changes in LERF as below 10^{-7}/yr, increasing the ILRT interval from 10 to 15 years is therefore considered non-risk significant and the results support this determination. In addition, the change in LERF resulting from a change in the Type A ILRT test interval from a three-per-ten-years to a once per-fifteen-years is 7.59E-9/yr, is also below the guidance.
- R.G. 1.174 also encourages the use of risk analysis techniques to help ensure and show that the proposed change is consistent with the defense-in-depth philosophy. Consistency with defense-in-depth philosophy is maintained by demonstrating that the balance is preserved among prevention of core damage, prevention of containment failure, and consequence mitigation. The change in conditional containment failure probability was estimated to be 3.41E-3 for the proposed change and 8.18E-3 for the cumulative change of going from a test interval of 3 in 10 years to 1 in 15 years. These changes are small and demonstrate that the defense-in-depth philosophy is maintained.

In reviewing these results the ANO-2 analysis demonstrates that the change in plant risk is small as a result of this proposed extension of ILRT testing. The change in LERF defined in the analysis for both the baseline and the current cases is within the acceptance criterion.

In addition to the baseline assessment, three sensitivity exercises are included. These analyses are provided in Section 5 and are consistent with those outlined in Reference 1.

2.0 DESIGN INPUTS

The ANO-2 PRA is intended to provide "best estimate" results that can be used as input when making risk informed decisions. The PRA provides the most recent results for the ANO-2 PRA. The inputs for this calculation come from the information documented in the ANO-2 PRA Large Early Release Model (Reference 6). The ANO-2 release states are summarized in Table 2. ANO-2 Level 2 results are lumped into 4 sequence states that represent the summation of individual accident categories. The number of sequences comprising each sequence state is also presented in Table 2.

Table 2
Release Category Frequencies

Release Category	Contributing ANO-2 Accident Categories	Frequency (/yr)	EPRI Category
INTACT (S)	10	1.74E-08	Class 1
LERF	18	1.08E-07	Class 8
SERF	9	5.12E-10	Class 6
LATE	14	8.01 E-07	Class 1[1]
Total	n/a	9.27E-07	n/a

1. Consistent with Reference 1 and based on the timing and mode of failure, these contributions are classified as Class 1.

The LERF contribution for ANO-2 contains early containment failures due to containment phenomenon and by the EPRI guidance should be collected in Class 7. To accurately classify the contributions, the LERF contribution is separated to be consistent with Reference 1.

Table 4.3-2 of Reference 6 provides the endstate and frequency of the respective endstate. Table 3 shows the classification of each endstate and the totals of each classification. The description provided in Reference 6 is used to classify each of the 18 contributing endstates.

Table 3
Decomposition of ANO-2 LERF Frequency and EPRI Classification

Endstate	Description of Outcome	Frequency (per year)	EPRI Category
LERF01	Containment Failure following high-pressure (HP) vessel breach (VB)	3.51E-10	7
LERF02	Containment Failure following HP VB	3.24E-11	7
LERF03	Containment Failure following Low Pressure (LP) VB	4.61E-10	7
LERF04	Temperature Induced (TI) SGTR	1.5E-09	8
LERF05	Containment Failure following LP VB	6.11E-10	7
LERF06	Pressure Induced (PI) SGTR	4.21E-10	8
LERF07	Containment Failure following LP VB	4.62E-09	7
LERF08	Loss of Isolation	3.77E-10	6
LERF09	Containment bypass	9.24E-08	8
LERF10	Containment Failure following LP VB	0	7
LERF11	Containment Failure following HP VB	4.41E-11	7
LERF12	Containment Failure following LP VB	5.55E-10	7
LERF13	TI-SGTR	1.74E-09	8
LERF14	Containment Failure following LP VB	7.57E-10	7
LERF15	PI--SGTR	5.03E-10	8
LERF16	Containment Failure following LP VB	1.67E-12	7
LERF17	Loss of Isolation	4.9E-11	6
LERF18	Containment bypass	3.7E-09	8
Contribution to EPRI Classification 6		4.26E-10 /yr	
Contribution to EPRI Classification 7		7.43E-09 /yr	
Contribution to EPRI Classification 8		1.00E-07 /yr	
Total LERF		1.08E-07 /yr	

In order to develop the person-rem dose associated to the plant damage state it is necessary to associate each release category with an associated release of radionuclides and from this information to calculate the associated dose.

Reference 1 indicates that a surrogate can be applied and is acceptable for estimating risk and suggests one surrogate source is the results contained in NUREG 1150[7]. NUREG 1150 examined both pressurized water reactors (PWRs) and boiling water reactors (BWRs). The results presented for boiling water reactors (i.e, Peach Bottom, Grand Gulf) are not considered appropriate for this analysis since the core melt mechanics and design are substantially different between ANO-2 and the BWRs. Therefore, their results are excluded from consideration.

NUREG 1150 also analyzed Zion, Sequoyah and Surry PWR designs. Sequoyah utilizes an ice condenser design and the presence of ice and restricted flow paths can lead to sequences and conditions that are not found in a large dry containment design such as ANO-2. Therefore, Sequoyah is not considered a good PWR design for comparison.

Zion is a 4-loop Westinghouse design large dry containment and may be somewhat closer to the ANO-2 design. However the 4-loop design and power level may influence timing source term. Therefore it is not selected as a surrogate.

The remaining assessed design is Surry. It is a Westinghouse 3 loop design and given the power level and other factors, is considered the best surrogate after examination of the NUREG 1150 analyzed plants.

Reference 8 provides the Level 2 analysis and offsite consequence assessment for Surry. Table 4.3-1 of Reference 8 provides a summary of consequence results that includes population dose (exposure) within 50 miles for internal events. A range of outcomes exists for each source term group based on the consequence measures. A matrix is formed and values provided for figures of merit.

The exposure estimates for a range of 50 miles around the site are provided in Table 4 for each reported source term group.

Table 4
Reported Person Rem Estimates for Surry Source Term Groups
(summarized from Reference 8)

Source Term Grouping	Outcome 1 (Sv[1])	Outcome 2 (Sv)	Outcome 3 (Sv)
SUR-01	NA	2.33E+3	1.25E+3
SUR-02	5.33E+3	1.13E+4	5.82E+3
SUR-03	1.15E+4	2.26E+4	1.13E+4
SUR-04	1.04E+4	1.45E+4	NA
SUR-05	NA	5.15E+4	2.62E+4
SUR-06	NA	2.42E+4	2.15E+4
SUR-07	2.76E+4	3.43E+4	1.46E+4
SUR-08	1.68E+4	2.14E+4	1.61E+4
SUR-09	1.36E+4	1.74E+4	NA
SUR-10	4.73E+4	4.66E+4	3.34E+4
SUR-11	4.56E+4	2.77E+4	2.78E+4
SUR-12	2.69E+4	3.01E+4	2.67E+4
SUR-13	2.15E+4	2.68E+4	NA
SUR-14	1.88E+4	2.23E+4	NA
SUR-15	4.28E-1	3.10E+0	NA
SUR-16	4.28E+0	3.75E+1	NA
SUR-17	2.66E+3	6.71E+3	NA
SUR-18	0.00E+0	NA	NA

1. Values provided in Sieverts (Sv). Conversion factor 1 Sv = 100 rem.

In order to utilize this information it is necessary to convert it to the form needed in the ILRT analysis. This involves classification into one of the three EPRI classes and then determining the representative person-rem estimates.

Reference 8 provides some guidance with respect to the composition of the source term grouping. For example SUR-01 is dominated by bypass sequences. Using this information the Surry results are grouped to the EPRI classes. The grouping is presented in Table 5.

Table 5
Assignment of Surry Source Term Groups to EPRI Classes

EPRI Class	Surry Source Term Groups Applied[1]
Class 6	SUR-14
Class 7	SUR-04, SUR-07, SUR-08, SUR-09, SUR-11, SUR-12, SUR-13, SUR-15, SUR-16, SUR-17
Class 8	SUR-01, SUR-02, SUR-03, SUR-05, SUR-06, SUR-10

1. Group SUR-18 is not applied to an EPRI class since the listed outcomes in Table 3 are either 0.0 or NA.

The source term exposure estimates for each source term group are first averaged to obtain a value for the source term group and then the individual groups are averaged to obtain a class estimate. An example calculation is provided below.

Source term group (STG) SUR-01 has two estimates for exposure (see Table 4). These values are first averaged to obtain a STG average for SUR-1.

$$Sv_{avg} = (2.33E+3 + 1.25E+3)\ Sv /2 = 1.79E+3\ Sv \qquad \text{(eq. 1)}$$

Repeating this process arrives at the data provided in Table 6.

It is noted that for Class 7 and Class 8 there are multiple source term groups included. In these cases the individual results using Equation 1 for each contributing Surry STG were summed and then averaged to obtain an estimate for the EPRI class.

Table 6
Average Person-Rem for Surry Source Term Groups

Source Term Group	Exposure (Sv)
SUR-01	1.79E+3
SUR-02	7.48E+3
SUR-03	1.51E+4
SUR-04	1.25E+4
SUR-05	3.89E+4
SUR-06	2.29E+4
SUR-07	2.55E+4
SUR-08	1.81E+4
SUR-09	1.55E+4
SUR-10	4.24E+4
SUR-11	3.37E+4
SUR-12	2.79E+4
SUR-13	2.42E+4
SUR-14	2.06E+4
SUR-15	1.76E+0
SUR-16	2.09E+1
SUR-17	4.69E+3
SUR-18	NA

These results are then grouped into the EPRI Classes using Table 5 and the average, minimum and maximum exposures are defined. The results are presented in Table 7 in units of person-rem.

Table 7
Average Person-Rem for EPRI Classes Based on Surry Source Term Groups

EPRI Class	Weighted Average Exposure (person-rem)	Max Exposure in Class (person-rem)	Min Exposure in Class (person-rem)
Class 1	5.76E+2	NA[1]	NA
Class 6	2.06E+6	NA[2]	NA
Class 7	1.62E+6	3.37E+6	1.76E+2
Class 8	2.14E+6	4.24E+6	1.79E+5

1. Intact containment dose rate from Reference 1.
2. Only one source term group applied.

Reference 1 utilizes a multiplication factor to develop the design basis leakage value (L_a) that is based on generic information that ratios population size. The ANO-2 population dose is adjusted for the local plant-specific population using a "population dose factor". The population dose factor is used to adjust the Surry population dose to account for differences in the population between Surry and ANO-2. The population dose factor is calculated by dividing the ANO-2 population[9] by the Surry population information taken from Reference 1.

Total ANO-2 Population (Reference 9) = 725,177

Surry Population (Reference 1) = 1,230,000

Population Dose Factor = 0.59

As stated in Reference 1, the relationship above implies that the resultant doses are a direct function of population within 50 miles of each site. This does not take into account differences in meteorology, environmental factors, containment designs or other factors but does provide a reasonable first-order approximation of the population dose as would be generated by the Surry sequences. The release category dose information is presented in Table 8.

Table 8
ANO-2 Dose for EPRI Accident Classes

Release Category	Frequency (/yr)	EPRI Class	Weighted Average Exposure (person-rem)	Population Factor	ANO-2 Dose (person-rem)
INTACT + LATE[1]	8.18E-07	Class 1	5.76E+02	0.59	3.40E+02
SERF + LERF[2]	9.38E-10	Class 6	2.06E+06	0.59	1.21E+06
LERF[3]	7.43E-09	Class 7	1.62E+06	0.59	9.56E+05
LERF	1.00E-07	Class 8	2.14E+06	0.59	1.26E+06

1. Late failures classified as intact due to long-term basemat attack failure mode consistent with guidance in Reference 1.
2. ANO-2 assigned scrubbed isolation failures in SERF. LERF due to isolation failure is Re-categorized in Table 3.
3. ANO-2 assigned LERF contribution associated with phenomenological failures. Re-categorized in Table 3.

3.0 ASSUMPTIONS

1. The maximum containment leakage for EPRI Class 1 (Reference 1) sequences is 1 L_a (Type A acceptable leakage) because a new Class 3 has been added to account for increased leakage due to Type A inspections.
2. The maximum containment leakage for Class 3a (Reference 1) sequences is 10 La based on the EPRI guidance (Reference 1).
3. The maximum containment leakage for Class 3b sequences is 100 La based on the NEI guidance (Reference 1).
4. Class 3b is conservatively categorized as LERF based on the NEI guidance and previously approved methodology (Reference 1).
5. Containment leakage due to EPRI Classes 4 and 5 are considered negligible based on the NEI guidance and the previously approved methodology (Reference 1).
6. The containment releases are not impacted with time.
7. The containment releases for EPRI Classes 2, 6, 7 and 8 are not impacted by the ILRT Type A Test frequency. These classes already include containment failure with release consequences equal or greater than those impacted by Type A.
8. Because EPRI Class 8 sequences are containment bypass sequences, potential releases are directly to the environment. Therefore, the containment structure will not impact the release magnitude.

4.0 CALCULATIONS

This calculation applies the ANO-2 PRA release category information in terms of frequency and person-rem estimates to estimate the changes in risk due to increasing the ILRT test interval. The changes in risk are assessed consistent with the guidance provided in the EPRI guidance document (Reference 1).

The detailed calculations performed to support this report were of a level of mathematical significance necessary to calculate the results recorded. However, the tables and illustrational calculation steps presented may present rounded values to support readability.

4.1 CALCULATIONAL STEPS

The analysis employs the steps provided in Reference 1 and uses associated risk metrics to evaluate the impact of a proposed change on plant risk. These measures are the change in release frequency, the change in risk as defined by the change in person-rem, the change in LERF and the change in the conditional containment failure probability.

Reference 1 also lists the change in core damage frequency as a measure to be considered. Since the testing addresses the ability of the containment to maintain its function, the proposed change has no measurable impact on core damage frequency. Therefore, this attribute remains constant and has no risk significance.

The overall analysis process is documented as outlined below:

- Define and quantify the baseline plant damage classes and person-rem estimates.
- Calculate baseline leakage rates and estimate probability to define the analysis baseline.
- Develop baseline population dose (person-rem) and population dose rate (person-rem/yr).
- Modify Type A leakage estimate to address extension of the Type A test frequency and calculate new population dose rates, LERF and conditional containment failure probability.
- Compare analysis metrics to estimate the impact and significance of the increase related to those metrics.

The first step in the analysis is to define the baseline plant damage classes and person-rem dose measures. Plant damage state information is developed using the ANO-2 PRA level 2 PRA results. The containment end state information and the results of the containment analysis are used to define the representative sequences. The population person-rem dose estimates for the key plant damage classes are based on the application of the method described in Reference 1.

The product of the person-rem for the plant damage classes and the frequency of the plant damage state is used to estimate the annual person-rem for the plant damage state. Summing these estimates produces the annual person-rem dose based on the sequences defined in the PRA.

The PRA plant damage state definitions considered isolation failures due to Type B and Type C faults and examined containment challenges occurring after core damage and/or reactor vessel failure. These sequences are grouped into key plant damage classes. Using the plant damage state information, bypass, isolation failures and phenomena-related containment failures are identified. Once identified, the sequence was then classified by release category definitions specified in Reference 1. With this information developed, the PRA baseline inputs are completed.

The second step expands the baseline model to address Type A leakage. The PRA did not directly address Type A (liner-related) faults and this contribution must be added to provide a complete baseline. In order to define leakage that can be linked directly to the Type A testing, it is important that only failures that would be identified by Type A testing exclusively be included.

Reference 1 provides the estimate for the probability of a leakage contribution that could only be identified by Type A testing based on industry experience. This probability is then used to adjust the intact containment category of the ANO-2 PRA to develop a baseline model including Type A faults.

The release, in terms of person-rem, is developed based on information contained in Reference 1 and is estimated as a leakage increase relative to allowable dose (L_a) defined as part of the ILRT.

The predicted probability of Type A leakage is then modified to address the expanded time between testing. This is accomplished by a ratio of the existing testing interval and the proposed test interval. This assumes a constant failure rate and that the failures are randomly dispersed during the interval between the test.

The change due to the expanded interval is calculated and reported in terms of the change in release due to the expanded testing interval, the change in the population person-rem and the change in large early release frequency. The change in the conditional containment failure probability is also developed. From these comparisons, a conclusion is drawn as to the risk significance of the proposed change.

Using this process, the following were performed:

1. Map the ANO-2 release categories into the 8 release classes defined by the EPRI Report (Reference 1).
2. Calculate the Type A leakage estimate to define the analysis baseline.
3. Calculate the Type A leakage estimate to address the current testing frequency.
4. Modify the Type A leakage estimates to address extension of the Type A test interval.
5. Calculate increase in risk due to extending Type A testing intervals.
6. Estimate the change in LERF due to the Type A testing.
7. Estimate the change in conditional containment failure probability due to the Type A testing.

4.2 SUPPORTING CALCULATIONS

Step 1: Map the release categories into the 8 release classes defined by the EPRI Report

Reference 1 defines eight (8) release classes as presented in Table 9.

Table 9
Containment Failure Classifications (from Reference 1)

Failure Classification	Description	Interpretation for Assigning ANO-2 Release Category
1	Containment remains intact with containment initially isolated	Intact containment bins or late basemat attack sequences.
2	Dependent failure modes or common cause failures	Isolation faults that are related to a loss of power or other isolation failure mode that is not a direct failure of an isolation component
3	Independent containment isolation failures due to Type A related failures	Isolation failures identified by Type A testing
4	Independent containment isolation failures due to Type B related failures	Isolation failures identified by Type B testing
5	Independent containment isolation failures due to Type C related failures	Isolation failures identified by Type C testing
6	Other penetration failures	Containment isolation failures (dependent failure, personnel errors)
7	Induced by severe accident phenomena	Early containment failure sequences as a result of hydrogen burn or other early phenomena
8	Bypass	Bypass sequence or SGTR

Table 10 presents the ANO-2 release category mapping for these eight accident classes. Person-rem per year is the product of the frequency and the person-rem.

Table 10
ANO-2 PRA Release Category Grouping to EPRI Classes (Described in Reference 1)

Class	EPRI Description	Frequency	Person-Rem	Person-Rem/yr
1	Intact containment	8.18E-07[1]	3.40E+2	2.783E-4
2	Isolation faults that are related to a loss of power or other isolation failure mode that is not a direct failure of an isolation component	0.00E+00		
3a	Small isolation failures (liner breach)	Not addressed		0.00E+0
3b	Large isolation failures (liner breach)	Not addressed		0.00E+0
4	Small isolation failures - failure to seal (type B)	-		
5	Small isolation failures - failure to seal (type C)	-		
6	Containment isolation failures (dependent failure, personnel errors)	9.38E-10	1.21E+6[3]	1.137E-04
7	Severe accident phenomena induced failure (early)	7.43E-9	9.56E+5[3]	7.105E-03
8	Containment bypass	1.00E-7	1.26E+6[3]	1.267E-01
	Total	9.27E-7		1.353E-1

1. The late contribution involves very late failure due to basemat attack. Consistent with guidance provided in Reference 1, this contribution is classified as Class 1.
2. ε represents a probabilistically insignificant value.
3. The value presented represents an average of the contributing release categories.

Step 2: Calculate the Type A leakage estimate to define the analysis baseline (3 year test interval)

As displayed in Table 10 the ANO-2 PRA did not identify any release categories specifically associated with EPRI Classes 3, 4, or 5. Therefore each of these classes must be evaluated for applicability to this study.

Class 3:

Containment failures in this class are due to leaks such as liner breaches that could only be detected by performing a Type A ILRT. In order to determine the impact of the extended testing interval, the probability of Type A leakage must be calculated.

In order to better assess the range of possible leakage rates, the Class 3 calculation is divided into two classes. Class 3a is defined as a small liner breach and Class 3b is defined as a large liner breach. This division is consistent with the EPRI guidance (Reference 1). The calculation of Class 3a and Class 3b probabilities is presented below.

Calculation of Class 3a Probability

Data presented in Reference 1 contains 2 Type A leakage events in total of 217 events. Using the data a mean estimate for the probability of leakage is determined for Class 3a as shown in Equation 1.

$$p_{Class3a} = \frac{2}{217} = 0.0092 \qquad \text{(eq. 1)}$$

This probability, however, is based on three tests over a 10-year period and not the one per ten-year frequency currently employed at ANO-2 (Reference 3). The probability (0.0275) must be adjusted to reflect this difference and is adjusted in step 3 of this calculation.

Multiplying the CDF times the probability of a Class 3a leak develops the Class 3a frequency contribution in accordance with guidance provided in Reference 1. The total CDF includes contributions already binned to LERF. To include these contributions would result in a potentially conservative result. Therefore, the LERF contribution from CDF is removed (1.0E-7). The CDF for ANO-2 is 9.27E-7/yr as presented in Table 11 and is adjusted to remove the LERF contribution.

Therefore the frequency of a Class 3a failure is calculated as:

$FREQ_{class3a}$ = $PROB_{class3a}$ x (CDF – Class 8)
= 0.0092 x (9.27E-7/yr – 1.0E-7/yr) = 7.62E-9/yr (eq. 2)

Calculation of Class 3b Probability

To estimate the failure probability given that no failures have occurred, the guidance provided in Reference 1 suggests the use of a non-informative prior. This approach essentially updates a uniform distribution (no bias) with the available evidence (data) to provide a better estimation of an event.

A beta distribution is typically used for the uniform prior with the parameters α=0.5 and β=1. This is then combined with the existing data (no Class 3b events, 217 tests) using Equation 3.

$$p_{Class3b} = \frac{n+\alpha}{N+\beta} = \frac{0+0.5}{217+1} = \frac{0.5}{218} = 0.00229 \quad \text{(eq. 3)}$$

where: N is the number of tests, n is the number of events (faults) of interest, α, β are the parameters of the non-informative prior distribution. From this solution, the frequency for Class 3b is generated using Equation 4 and is adjusted appropriately to address LERF sequences.

$FREQ_{class3b}$ = $PROB_{class3b}$ x (CDF – Class 8)
= 0.00229 x (9.27E-7/yr – 1.0E-7/yr) = 1.90E-9/yr (eq. 4)

Class 4:

This group consists of all core damage accidents for which a failure-to-seal containment isolation failure of Type B test components occurs. By definition, these failures are dependent on Type B testing, and Type A testing will not impact the probability. Therefore this group is not evaluated any further, consistent with the approved methodology.

Class 5:

This group consists of all core damage accidents for which a failure-to-seal containment isolation failure of Type C test components occurs. By definition, these failures are dependent on Type C testing, and Type A testing will not impact the probability. Therefore this group is not evaluated any further, consistent with the approved methodology.

Class 6:

The Class 6 group is comprised of isolation faults that occur as a result of the accident sequence progression. The leakage rate is not considered large by the PRA definition and therefore it is placed into Class 6 to represent a small isolation failure and identified in Table 11 as Class 6. For ANO-2, this class is defined by the ANO-2 SERF category and that portion of LERF applicable to isolation faults and is mainly involves sequences with early large failure but scrubbing is available. The scrubbing reduces the leakage rate such that only a small release is expected.

$FREQ_{class6}$ = FREQclass6 + FREQclass6/LERF (eq. 5)
= 9.38E-10 = 4.26E-10/yr + 5.12E-10

Class 1:

Although the frequency of this class is not directly impacted by Type A testing, the PRA did not model Class 3 failures, and the frequency for Class 1 should be reduced by the estimated frequencies in the new Class 3a and Class 3b in order to preserve the total CDF. The revised Class 1 frequency is therefore:

$FREQ_{class1}$ = FREQclass1 – (FREQclass3a + FREQclass3b) (eq. 6)
$FREQ_{class1}$ = 8.18E-7/yr – (7.62E-9/yr + 1.90E-9/yr) = 8.09E-7/yr

<u>Class 2:</u>

The ANO-2 PRA did not identify any contribution to this group above the quantification truncation.

<u>Class 7:</u>

Class 7 represents early and containment failure sequences involving phenomena related containment breach. Consistent with the example provided in Reference 1, these long-term sequences are combined with the intact containment case and there is no frequency contribution from Class 7. Additionally, contributions from LERF related to phenomena are included.

$FREQ_{class7}$ = FREQclass7/LERF (eq. 7)

<u>Class 8:</u>

The frequency of Class 8 is the sum of those release categories identified in Table 11 as Class 8.

$FREQ_{class8}$ = 1.0E-7/yr (eq. 7)

Table 11 summarizes the above information by the EPRI defined classes. This table also presents dose exposures calculated using the methodology described in Reference 1. For Class 1, 3a and 3b, the person-rem is developed based on the design basis assessment of the intact containment as defined in Reference 1.

The Class 3a and 3b doses are represented as $10L_a$ and $100L_a$ respectively. Table 11 also presents the person-rem frequency data determined by multiplying the failure class frequency by the corresponding exposure.

Table 11
Baseline Risk Profile

Class	Description	Frequency (/yr)	Person-rem (calculated)[1]	Person-rem (from L_a factors)	Person-rem (/yr)
1	No containment failure	8.08E-7		3.40E+02	2.75E-4
2	Isolation faults that are related to a loss of power or other isolation failure mode that is not a direct failure of an isolation component				
3a	Small isolation failures (liner breach)	7.62E-9		3.40E+03[2]	2.59E-5
3b	Large isolation failures (liner breach)	1.90E-9		3.40E+04[3]	6.45E-5
4	Small isolation failures - failure to seal (type B)				
5	Small isolation failures - failure to seal (type C)				
6	Containment isolation failures (dependent failure, personnel errors)	9.38E-10	1.21E+6		1.14E-3
7	Severe accident phenomena induced failure (early and late)	7.43E-9	9.56E+5[4]		7.10E-3
8	Containment bypass	1.00E-7	1.26E+6[4]		1.27E-1
	Total	9.27E-7			1.3534E-1

1. From Table 4 using the method presented in Reference 2.
2. 10 times L_a.
3. 100 times L_a.
4. The value presented represents an average of the contributing release categories.

The percent risk contribution due to Type A testing is defined as follows:

$\%Risk_{BASE} = [(Class3a_{BASE} + Class3b_{BASE}) / Total_{BASE}] \times 100$ (eq. 8)

Where:

$Class3a_{BASE}$ = Class 3a person-rem/year =2.59E-5 person-rem/year
$Class3b_{BASE}$ = Class 3b person-rem/year = 6.45E-5 person-rem/year
$Total_{BASE}$ = total person-rem year for baseline interval = 1.3534E-1 person-rem/year (Table 11)
$\%Risk_{BASE}$ = [(2.59E-5 + 6.45E-5) / 1.3534E-1] x 100 = **0.067%** (eq. 9)

Step 3: Calculate the Type A leakage estimate to address the current inspection interval

The current surveillance testing requirement for Type A testing and allowed by 10 CFR 50, Appendix J is at least once per 10 years based on an acceptable performance history (defined as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than $1.0L_a$).

According to Reference 1, extending the Type A ILRT interval from 3-in-10 years to 1-in-10 years will increase the average time that a leak detectable only by an ILRT goes undetected from 18 to 60 months. Multiplying the testing interval by 0.5 and multiplying by 12 to convert from "years" to "months" calculates the average time for an undetected condition to exist.

The increase for a 10-yr ILRT interval is the ratio of the average time for a failure to detect for the increased ILRT test interval (from 18 months to 60 months) multiplied by the existing Class 3a probability as shown in Equation 10.

$$p_{Class3a}(10y) = 0.0092 \times \left(\frac{60}{18}\right) = 0.0307 \quad \text{(eq. 10)}$$

A similar calculation is performed for the Class 3b probability as presented in Equation 11.

$$p_{Class3b}(10y) = 0.00229 \times \left(\frac{60}{18}\right) = 0.00763 \quad \text{(eq. 11)}$$

<u>Risk Impact due to 10-year Test Interval</u>

Based on the approved methodology (Reference 1) and the NEI guidance (Reference 4), the increased probability of not detecting excessive leakage due to Type A tests directly impacts the frequency of the Class 3 sequences.

Consistent with Reference 1 the risk contribution is determined by multiplying the Class 3 accident frequency by the increase in the probability of leakage. Additionally the Class 1 frequency is adjusted to maintain the overall core damage frequency constant. The results of this calculation are presented in Table 12 below.

Table 12
Risk Profile for Once in Ten Year Testing

Class	Description	Frequency (/yr)	Person-rem [2]	Person-rem (/yr)
1	No Containment Failure[1]	7.87E-7	3.40E+2	2.67E-4
2	Isolation faults that are related to a loss of power or other isolation failure mode that is not a direct failure of an isolation component	N/A		
3a	Small Isolation Failures (Liner breach)	2.54E-8	3.40E+3	8.64E-5
3b	Large Isolation Failures (Liner breach)	6.32E-9	3.40E+4	2.15E-4
4	Small isolation failures - failure to seal (type B)	N/A		
5	Small isolation failures - failure to seal (type C)	N/A		
6	Containment Isolation Failures (dependent failure, personnel errors)	9.38E-10	1.21E+6	1.14E-3
7	Severe Accident Phenomena Induce Failure (Early and Late)	7.43E-9	9.56E+5[3]	7.10E-3
8	Containment Bypass	1.00E-7	1.26E+6[3]	1.27E-1
	Total	9.27E-7		1.3554E-1

1. The PRA frequency of Class 1 has been reduced by the frequency of Class 3a and Class 3b in order to preserve total CDF.
2. From Table 7.
3. The value presented represents an average of the contributing release categories

Using the same methods as for the baseline, and the data in Table 12 the percent risk contribution due to Type A testing is as follows:

%Risk10 = [(Class3a$_{10}$ + Class3b$_{10}$) **/** Total$_{10}$] x 100 (eq. 12)

Where:

Class3a$_{10}$ = Class 3a person-rem/year = 8.64E-4 person-rem/year

Class3b$_{10}$ = Class 3b person-rem/year = 2.15E-4 person-rem/year

Total$_{10}$ = total person-rem year for current 10-year interval = 1.3554E-1 person-rem/year (Table 12)

%Risk$_{10}$ = [(8.64E-4 + 2.15E-4) / 1.3554E-1] x 100 = **0.222%** (eq. 13)

The percent risk increase (□%Risk$_{10}$) due to a ten-year ILRT over the baseline case is as follows:

□%Risk$_{10}$ = [(Total$_{10}$ - Total$_{BASE}$) / Total$_{BASE}$] x 100.0 (eq. 14)

Where:

Total$_{BASE}$ = total person-rem/year for baseline interval = 1.3534E-1 person-rem/year (Table 11)

Total$_{10}$ = total person-rem/year for 10-year interval = 1.3554E-1 person-rem/year (Table 12)

□%Risk$_{10}$ = [(1.3554E-1 – 1.3534E-1) / 1.3534E-1] x 100.0 = **0.150%** (eq. 15)

Step 4: Calculate the Type A leakage estimate to address extended inspection intervals

If the test interval is extended to 1 per 15 years, the average time that a leak detectable only by an ILRT test goes undetected increases to 90 months (0.5 x 15 x 12). For a 15-yr-test interval, the result is the ratio (90/18) of the exposure times as was the case for the 10 year case. Thus, increasing the ILRT test interval from 3 years to 15 years results in a proportional increase in the overall probability of leakage.

The approach for developing the risk contribution for a 15-year interval is the same as that for the 10-year interval. The increase for a 15-yr ILRT interval is the ratio of the average time for a failure to detect for the increased ILRT test interval (from 18 months to 90 months) multiplied by the existing Class 3a probability as shown in Equation 16.

$$p_{Class\,3a}(15y) = 0.0092 \times \left(\frac{90}{18}\right) = 0.046 \qquad \text{(eq. 16)}$$

A similar calculation is performed for the Class 3b probability as presented in Equation 17.

$$p_{Class\,3b}(15y) = 0.00229 \times \left(\frac{90}{18}\right) = 0.0115 \qquad \text{(eq. 17)}$$

Risk Impact due to 15-year Test Interval

As stated for the 10-year case, the increased probability of not detecting excessive leakage due to Type A tests directly impacts the frequency of the Class 3 sequences.

The increased risk contribution is determined by multiplying the Class 3 accident frequency by the increase in the probability of leakage. Additionally the Class 1 frequency is adjusted to maintain the overall core damage frequency constant. The results of this calculation are presented in Table 13 below.

Table 13
Risk Profile for Once in Fifteen Year Testing

Class	Description	Frequency (/yr)	Person-rem [2]	Person-rem (/yr)
1	No Containment Failure[1]	7.71E-7	3.40E+2	2.62E-4
2	Isolation faults that are related to a loss of power or other isolation failure mode that is not a direct failure of an isolation component	N/A		
3a	Small Isolation Failures (Liner breach)	3.81E-8	3.40E+3	1.30E-4
3b	Large Isolation Failures (Liner breach)	9.48E-9	3.40E+4	3.22E-4
4	Small isolation failures - failure to seal (type B)	N/A		
5	Small isolation failures - failure to seal (type C)	N/A		
6	Containment Isolation Failures (dependent failure, personnel errors)	9.38E-10	1.21E+6	1.14E-3
7	Severe Accident Phenomena Induce Failure (Early and Late)	7.43E-9	9.56E+5[3]	7.10E-3
8	Containment Bypass	1.00E-7	1.26E+6[3]	1.27E-1
	Total	9.27E-7		1.3569E-1

1. The PRA frequency of Class 1 has been reduced by the frequency of Class 3a and Class 3b in order to preserve total CDF.
2. From Table 7.
3. The value presented represents an average of the contributing release categories

Using the same methods as for the baseline, and the data in Table 11 the percent risk contribution due to Type A testing is as follows:

$\%Risk_{15} = [(Class3a_{15} + Class3b_{15}) / Total_{15}] \times 100$ (eq. 18)

Where:

$Class3a_{15}$ = Class 3a person-rem/year = 1.30E-4 person-rem/year
$Class3b_{15}$ = Class 3b person-rem/year = 3.22E-4 person-rem/year
$Total_{15}$ = total person-rem year for 15-year interval = 1.3569E-1person-rem/year (Table 13)
$\%Risk_{15}$ = [(1.30E-4 + 3.22E-4) / 1.3586E-1] x 100 = **0.333%** (eq. 19)

The percent risk increase (□$\%Risk_{15}$) due to a fifteen-year ILRT over the baseline case is as follows:

$\Delta\%Risk_{15} = [(Total_{15} - Total_{BASE}) / Total_{BASE}] \times 100.0$ (eq. 20)

Where:

$Total_{BASE}$ = total person-rem/year for baseline interval = 1.3534E-1 person-rem/year (Table 11)
$Total_{15}$ = total person-rem/year for 15-year interval = 1.3569E-1person-rem/year (Table 13)
$\Delta\%Risk_{15}$ = [(1.3569E-1 – 1.3569E-1) / 1.3534E-1] x 100.0 = **0.258%** (eq. 21)

Step 5: Calculate increase in risk due to extending Type A inspection intervals

Based on the guidance in Reference 1, the percent increase in the total integrated plant risk from a fifteen-year ILRT over a current ten-year ILRT is computed as follows:

$\%Total10\text{-}15 = [(Total_{15} - Total_{10}) / Total_{10}] \times 100$ (eq. 22)

Where:

Total10 = total person-rem/year for 10-year interval = 1.3554E-1person-rem/year (Table 12)
Total15 = total person-rem/year for 15-year interval = 1.3569E-1 person-rem/year (Table 13)
% Total10-15 = [(1.3569E-1 – 1.3554E-1) / 1.3554E-1] x 100 = **0.107%** (eq. 23)

Step 6: Calculate the change in Risk in terms of Large Early Release Frequency (LERF)

The risk impact associated with extending the ILRT interval involves the potential that a core damage event that normally would result in only a small radioactive release from containment could in fact result in a larger release due to failure to detect a pre-existing leak during the relaxation period.

From References 1, 3, 4 and 6, the Class 3a dose is assumed to be 10 times the allowable intact containment leakage, L_a (or 3,400 person-rem) and the Class 3b dose is assumed to be 100 times L_a (or 34,000 person-rem). The method for defining the dose equivalent for allowable leakage (L_a) is developed in Reference 1. This compares to a historical observed average of twice L_a. Therefore, the estimate is somewhat conservative.

Based on the EPRI method guidance (Reference 1) only Class 3 sequences have the potential to result in large releases if a pre-existing leak were present. Class 1 sequences are not considered as potential large release pathways because for these sequences the containment remains intact ($1L_a$). Reference 1 indicates that any containment leak rate less than $2L_a$ should be considered small. A larger leak rate would imply an impaired containment, such as Classes 2, 3, 6 and 7. Late releases are excluded regardless of the size of the leak because late releases are, by definition, not a LERF event.

Therefore, the change in the frequency of Class 3b sequences is used as the increase in LERF for ANO-2, and the change in LERF can be determined by the differences. Reference 1 identifies that Class 3b is considered to be the contributor to LERF. Table 14 summarizes the results of the LERF evaluation that Class 3b is indicative of a LERF sequence.

Table 14
Impact on LERF due to Extended Type A Testing Intervals

ILRT Inspection Interval	3 Years (baseline)	10 Years	15 Years
Class 3b (Type A LERF)	1.90E-9/yr	6.32E-9/yr	9.48E-9/yr
ΔLERF (3 year baseline)		4.42E-9/yr	7.59E-9/yr
ΔLERF (10 year baseline)			3.16E-9/yr

Reg. Guide 1.174 (Reference 10) provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reference 1 cites Reg. Guide 1.174 and defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 1E-6/yr and increases in LERF below 1E-7/yr. Since the ILRT does not impact CDF, the relevant metric is LERF. Calculating the increase in LERF requires determining the impact of the ILRT interval on the leakage probability.

By increasing the ILRT interval from the currently acceptable 10 years to a period of 15 years results in an increase in the contribution to LERF of 3.16E-9/yr. This value meets the guidance in Reg. Guide 1.174 defining very small changes in LERF. The LERF increase measured from the original 3-in-10-year interval to the 15-year interval is 7.59E-9/yr, which is less than the criterion presented in Regulatory Guide 1.174.

Step 7: Calculate the change in Conditional Containment Failure Probability (CCFP)

The conditional containment failure probability (CCFP) is defined as the probability of containment failure given the occurrence of an accident. This probability can be expressed using the following equation:

$$CCFP = 1 - \left[\frac{f(ncf)}{CDF} \right] \qquad \text{(eq. 25)}$$

Where *f(ncf)* is the frequency of those sequences which result in no containment failure. This frequency is determined by summing the Class 1 and Class 3a results, and CDF is the total frequency of all core damage sequences.

Therefore the change in CCFP for this analysis is the CCFP using the results for 15 years ($CCFP_{15}$) minus the CCFP using the results for 10 years ($CCFP_{10}$). This can be expressed by the following:

$$\Delta CCFP_{10-15} = CCFP_{15} - CCFP_{10} \quad \text{(eq. 26)}$$

Using the data previously developed the change in CCFP from the current testing interval is calculated and presented in Table 15.

Table 15
Impact on Conditional Containment Failure Probability due to Extended Type A Testing Intervals

ILRT Inspection Interval	3 Years (baseline)	10 Years	15 Years
f(ncf) (/yr)	8.17E-7	8.12E-7	8.09E-7
f(ncf)/CDF	0.881	0.876	0.873
CCFP	0.119	0.124	0.127
ΔCCFP (3 year baseline)		4.77E-3	8.18E-3
ΔCCFP (10 year baseline)			3.41E-3

5.0 SENSITIVITY STUDIES

This appendix provides sensitivity studies suggested in Reference 1 for the ANO-2 ILRT extension assessment. This includes an evaluation of assumptions made in relation to liner corrosion, the use of the expert elicitation, and the impact of external events.

5.1 LINER CORROSION

The analysis approach utilizes the Calvert Cliffs Nuclear Plant (CCNP) methodology (Reference 16) as modified by Reference 1. This methodology is an acceptable approach to incorporate the liner corrosion issue into the integrated leak rate test (ILRT) extension risk evaluation. The results of the analysis indicate that increasing the interval from three years to fifteen years did not significantly increase plant risk of a large early release.

Table 16 summarizes the results obtained from the CCNP methodology utilizing plant-specific data for ANO-2.

Table 16
ANO-2 Liner Corrosion Risk Assessment Results Using CCNP Methodology

<table>
<tr><th>Step</th><th>Description</th><th colspan="2">Containment Cylinder and Dome (85%)</th><th colspan="2">Containment Basemat (15%)</th></tr>
<tr><td>1</td><td>Historical liner flaw likelihood
Failure data: containment location specific
Success data: based on 70 steel-lined containments and 5.5 years since the 10CFR 50.55a requirements of periodic visual inspections of containment surfaces</td><td colspan="2">Events 2
(Brunswick 2 and North Anna 2)
2 / (70 x 5.5) = 5.19E-03</td><td colspan="2">Events: 0
Assume a half failure
0.5 / (70 x 5.5) = 1.30E-03</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Aged adjusted liner flaw likelihood
During the 15-year interval, assume failure rate doubles every five years (14.9% increase per year). The average for the 5th to 10th year set to the historical failure rate.</td><td>Year
1
average 5-10
15</td><td>Failure rate
2.05E-03
5.19E-03
1.43E-02</td><td>Year
1
average 5-10
15</td><td>Failure rate
5.13E-04
1.30E-03
3.57E-03</td></tr>
<tr><td colspan="2">15 year average = 6.44E-03</td><td colspan="2">15 year average = 1.61E-03</td></tr>
<tr><td>3</td><td>Increase in flaw likelihood between 3 and 15 years
Uses aged adjusted liner flaw likelihood (Step 2), assuming failure rate doubles every five years.</td><td colspan="2">0.73% (1 to 3 years)
4.18% (1 to 10 years)
9.66% (1 to 15 years)</td><td colspan="2">0.18% (1 to 3 years)
1.04% (1 to 10 years)
2.41% (1 to 15 years)</td></tr>
<tr><td>4</td><td>Likelihood of breach in containment given liner flaw</td><td colspan="2">1%</td><td colspan="2">0.1%</td></tr>
</table>

Table 16 (Continued)
ANO-2 Liner Corrosion Risk Assessment Results Using CCNP Methodology

Step	Description	Containment Cylinder and Dome (85%)	Containment Basemat (15%)
5	Visual inspection detection failure likelihood	10% 5% failure to identify visual flaws plus 5% likelihood that the flaw is not visible (not through-cylinder but could be detected by ILRT) All events have been detected through visual inspection. 5% visible failure detection is a conservative assumption.	100% Cannot be visually inspected
6	Likelihood of non-detected containment leakage (Steps 3 x 4 x 5)	0.0073% (3 years) 0.73% x 1% x 10% 0.0418% (10 years) 4.18% x 1% x 10% 0.0966% (15 years) 9.66% x 1% x 10%	0.00180% (3 years) 0.18% x 0.1% x 100% 0.0104% (10 years) 1.04% x 0.1% x 100% 0.0241% (15 years) 2.41% x 0.1% x 100%

The total likelihood of the corrosion-induced, non-detected containment leakage is the sum of Step 6 for containment cylinder and dome and the containment basemat.

Total likelihood of non-detected containment leakage (3 yr) = 0.0073% + 0.00180% = 0.0091%

Total likelihood of non-detected containment leakage (10 yr) = 0.0418% + 0.0104% = 0.0522%

Total likelihood of non-detected containment leakage (15 yr) = 0.0966% + 0.0241% = 0.1207%

This likelihood is then multiplied by the non-LERF containment failures for ANO-2. This value is calculated by the following equation for each period of interest. LERF is comprised of Class 8 and Class 3b cases (Equation 26).

Non-LERF = CDF – Class 8 – Class 3b (eq. 26)

A final adjustment can be made to address cases with containment spray operation. It is conservatively not addressed and would not substantially alter the overall results. Table 17 presents the data and the resultant increase in LERF due to liner corrosion for each case.

Table 17
Liner Corrosion LERF Adjustment Using CCNP Methodology

Case	CDF (/yr)	Class 8 (/yr)	Class 3b (/yr)	Likelihood of Non-detected Corrosion Leakage	Increase in LERF (/yr)
3-years	9.27E-7	1.0E-7	1.90E-09	9.10E-5	7.51E-11
10-years	9.27E-7	1.0E-7	6.32E-09	5.22E-4	4.28E-10
15-years	9.27E-7	1.0E-7	9.48E-09	1.21E-3	9.89E-10

This contribution is added to the Class 3b LERF cases and the sensitivity analysis performed. Table 18 provides a summary of the base case as well as the corrosion sensitivity case. The “Delta Person-Rem” column provides the change in person-rem between the case without corrosion and the case that considers corrosion. Values within parentheses “( )” indicate the change or delta between the without corrosion and corrosion cases.

Table 18
ANO-2 Summary of Base Case and Corrosion Sensitivity Cases

EPRI Class	Base Case (3 per 10 years)					1 per 10 years					1 per 15 years				
	Without Corrosion		With Corrosion			Without Corrosion		With Corrosion			Without Corrosion		With Corrosion		
	Frequency	Person-rem per year	Frequency	Person-rem per year	Delta Person-Rem per year	Frequency	Person-rem per year	Frequency	Person-rem per year	Delta Person-Rem per year	Frequency	Person-rem per year	Frequency	Person-rem per year	Delta Person-Rem per year
1	8.09E-07	2.75E-04	8.09E-07	2.75E-04	-2.55E-08	7.87E-07	2.67E-04	7.86E-07	2.67E-04	-1.46E-07	7.71E-07	2.62E-04	7.70E-07	2.62E-04	-3.36E-07
3a	7.62E-09	2.59E-05	7.62E-09	2.59E-05	n/a	2.54E-08	8.64E-05	2.54E-08	8.64E-05	n/a	3.81E-08	1.30E-04	3.81E-08	1.30E-04	n/a
3b	1.90E-09	6.45E-05	1.97E-09	6.70E-05	2.55E-06	6.32E-09	2.15E-04	6.75E-09	2.29E-04	1.46E-05	9.48E-09	3.22E-04	1.05E-08	3.56E-04	3.36E-05
6	9.38E-10	1.14E-03	9.38E-10	1.14E-03	n/a	9.38E-10	1.14E-03	9.38E-10	1.14E-03	n/a	9.38E-10	1.14E-03	9.38E-10	1.14E-03	n/a
7	7.43E-09	7.10E-03	7.43E-09	7.10E-03	n/a	7.43E-09	7.10E-03	7.43E-09	7.10E-03	n/a	7.43E-09	7.10E-03	7.43E-09	7.10E-03	n/a
8	1.00E-07	1.27E-01	1.00E-07	1.27E-01	n/a	1.00E-07	1.27E-01	1.00E-07	1.27E-01	n/a	1.00E-07	1.27E-01	1.00E-07	1.27E-01	n/a
CDF	9.27E-07	1.35E-01	9.27E-07	1.35E-01	2.53E-06	9.27E-07	1.36E-01	9.27E-07	1.36E-01	1.44E-05	9.27E-07	1.36E-01	9.27E-07	1.36E-01	3.33E-05
CCFP	11.9%		11.9%			12.4%		12.4%			12.7%		12.8%		
Class 3b LERF	1.90E-9		1.97E-9 (7.51E-11)			6.32E-9		6.75E-9 (4.28E-10)			9.48E-9		1.05E-8 (9.89E-10)		
Delta LERF (from base case of 3 per 10 years)						4.42E-9		4.78E-9 (3.53E-10)			7.59E-9		8.50E-9 (9.14E-10)		
Delta LERF from 1 per 10 years						N/A					3.16E-9		3.72E-9 (5.61E-10)		

The inclusion of corrosion does not result in an increase in LERF sufficient to invalidate the baseline analysis and the overall impact is negligible.

5.2 DEFECT SENSITIVITY AND EXPERT ELICIATION SENSITIVITY

A second sensitivity case on the impacts of assumptions regarding pre-existing containment defect or flaw probabilities of occurrence and magnitude, or size of the flaw, is performed as described in Reference 1. In this sensitivity case, an expert elicitation was conducted to develop probabilities for pre-existing containment defects that would be detected by the ILRT only based on the historical testing data.

Using the expert knowledge, this information was extrapolated into a probability versus magnitude relationship for pre-existing containment defects. The failure mechanism analysis also used the historical ILRT data augmented with expert judgment to develop the results. Details of the expert elicitation process and results are contained in Reference 1. The expert elicitation process has the advantage of considering the available data for small leakage events, which have occurred in the data, and extrapolate those events and probabilities of occurrence to the potential for large magnitude leakage events.

The expert elicitation results are used to develop sensitivity cases for the risk impact assessment. Employing the results requires the application of the ILRT interval methodology using the expert elicitation to change in the probability of pre-existing leakage in the containment.

The baseline assessment uses the Jefferys non-informative prior and the expert elicitation sensitivity study uses the results of the expert elicitation. In addition, given the relationship between leakage magnitude and probability, larger leakage that is more representative of large early release frequency, can be reflected. For the purposes of this sensitivity, the same leakage magnitudes that are used in the basic methodology (i.e., 10 La for small and 100 La for large) are used here. Table 19 presents the magnitudes and probabilities associated with the Jefferys non-informative prior and the expert elicitation use in the base methodology and this sensitivity case.

Table 19
ANO-2 Summary of ILRT Extension Using Expert Elicitation Values (from Reference 1)

Leakage Size (L_a)	Jefferys Non-Informative Prior	Expert Elicitation Mean Probability of Occurrence	Percent Reduction
10	2.3E-02	3.88E-03	83%
100	2.3E-03	2.47E-04	89%

Taking the baseline analysis and using the values provided in Table 17 for the expert elicitation yields the results in Table 20 are developed.

Table 20
ANO-2 Summary of ILRT Extension Using Expert Elicitation Values

Accident Class	ILRT Interval							
	3 per 10 Years				1 per 10 years		1 per 15 Years	
	Base Frequency	Adjusted Base Frequency	Dose (person-rem)	Dose Rate (person-rem/yr)	Frequency	Dose Rate (person-rem/yr)	Frequency	Dose Rate (person-rem/yr)
1	8.18E-07	8.15E-07	3.40E+02	2.70E-04	8.07E-07	2.50E-04	8.01E-07	2.36E-04
3a	N/A	3.21E-09	3.40E+03	1.09E-05	1.07E-08	3.64E-05	1.60E-08	5.45E-05
3b	N/A	2.04E-10	3.40E+04	6.94E-06	6.81E-10	2.31E-05	1.02E-09	3.47E-05
6	9.38E-10	9.38E-10	1.21E+06	9.34E-04	9.38E-10	9.34E-04	9.38E-10	9.34E-04
7	7.43E-09	7.43E-09	9.56E+05	4.89E-03	7.43E-09	4.89E-03	7.43E-09	4.89E-03
8	1.00E-07	1.00E-07	1.26E+06	1.37E-01	1.00E-07	1.37E-01	1.00E-07	1.37E-01
Totals	9.27E-07	9.27E-07	3.47E+06	1.43E-01	9.27E-07	1.43E-01	9.27E-07	1.43E-01
Δ LERF (3 per 10 yrs base)	N/A				4.76E-10		8.17E-10	
Δ LERF (1 per 10 yrs base)					N/A		3.40E-10	
CCFP	11.74%				11.79%		11.83%	

The results illustrate how the expert elicitation reduces the overall change in LERF and the overall results are more favorable with regard to the change in risk.

5.3 POTENTIAL IMPACTS FROM EXTERNAL EVENTS

An assessment of the impact of external events is performed. Consistent with Reference 1, the primary basis for this investigation is the determination of the total LERF following an increase in the ILRT testing interval from 3 in 10 years to 1 in 15 years.

External events were evaluated in the ANO-2 Individual Plant Examination of External Events (IPEEE). The IPEEE program was a one-time review of external hazard risk and was limited in its purpose to the identification of potential plant vulnerabilities and an understanding of severe accident risk. The primary areas of external event analysis for the ANO-2 IPEEE were seismic hazards and internal fires. Both were examined at a high level and the analysis contained many conservative assumptions related to consequential failure such that the absolute CDF is considered a significant understatement of plant performance.

Seismic events were addressed through a Seismic Margin Assessment (SMA) as part of the IPEEE for ANO-2. The seismic external event study was based on a seismic margins approach which does not provide a convenient means to frequency information. It does, however, provide adequate (but conservative) information to assess the impact of seismic hazards on the possible impact of a seismic event with regard to the ANO-2 ILRT extension assessment.

The overall conclusions from the ANO-2 IPEEE indicated that the plant did meet high confidence low probability of failure (HCLPF) for the review level earthquake of 0.3g. Given that this is consistent with other evaluations, it can be assumed that the performance would be similar to other PWR designs with respect to seismic core damage frequency.

This would tend to support that the contributions from seismic would be controlled by moderate frequency station blackout sequences which involve a prolonged loss of offsite power combined with a failure of all onsite sources. In general, the combination of loss of offsite power and loss of offsite power recovery tend to equate to the lower-frequency seismic acceleration necessary to induce a loss of offsite power and therefore, the station blackout contributions are considered appropriate surrogates for the seismic contribution. From the internal events analysis the contribution to LERF from station blackout sequences is 7.35E-9/yr which would be excluded from Class 3b consistent with the method described in Reference 1. The summation of the results for the station blackout sequences from the current model contained in INTACT[18], LATE[19], and SERF[20] bins indicates an overall station blackout frequency of 1.09E-7/yr. Since the most prevalent sequence expected for the more frequency seismic events involves a prolonged loss of offsite power leading to the potential for a station blackout, these values are used to represent the seismic contribution to core damage frequency and LERF.

Internal fire events have been addressed in preparation for meeting NFPA 805. However, the state of the analysis is still conservative in many respects and is not sufficiently mature to be compared to the current internal model which has been updated on a regular basis to provide an accurate reflection of internal risk. There is also considerable uncertainty associated with any internal fire event such that detailed results could in bias the overall conclusions without detailed presentation of these uncertainties.

The findings contained in NUREG-1742[12] indicate that the fire CDF is primarily determined by plant transient type of events such as those from assessed plant transients. The judgment is made based on this observation that it is reasonable to assume that the ratio of intact to impaired containments will be similar for fire as for the internal events such that the total CDF and the breakdown by EPRI Class will be equivalent to that presented for the internal events.

For ANO-2 internal events the total CDF is 9.27E-7/yr. The associated LERF contribution is 1.0E-7/yr and is comprised of SGTR and ISLOCA. Since SGTR and ISLOCA are unique initiators removing them from the CDF provides an approximate value for a refined internal fire assessment.

Per the guidance contained in Reference 1 the figure-of-merit for the risk impact assessment of extended ILRT intervals is given as:

delta LERF = The change in frequency of Accident Class 3b

Using the percentage of total CDF contributing to LERF for the fire and seismic external events as an approximation for the early CDF applicable to EPRI Accident Class 3b yields the following:

Class 3b Frequency = [(CDF_{FIRE}) + ($CDF_{SEISMIC}$ -$LERF_{SEISMIC}$)] * Class 3b Leakage Probability

Class 3b Frequency = [(8.27E-7) + (1.09E-7 -7.53E-9)] * 2.29E-03

Class 3b Frequency = (8.27E-7 + 1.01E-7) * 2.29E-3 = 2.13E-09 per year

Given the extremely conservative nature of the external events studies and the fact that many of the external event scenarios are long term station blackout and long term containment heat removal use of the percentage is appropriate. Table 21 is developed using the relationships developed previously in the report for the LERF as a function of ILRT interval

Table 21
ANO-2 Upper Bound External Event Impact on ILRT LERF Calculation

Hazard	EPRI Accident Class 3b Frequency			LERF Increase (from 1 per 10 years)
	3 per 10 year	1 per 10 year	1 per 15 year	
External Events	2.13E-9	7.10E-9	1.07E-8	3.60E-9
Internal Events	1.19E-9	6.32E-9	9.48E-9	3.16E-9
Combined	3.32E-9	1.34E-8	2.02E-8	6.760E-9

The values reflect that the impact of external events is not sufficient to increase LERF above the significance level given in Reference 1. Given the extremely conservative nature of the external events studies and the fact that many of the external event scenarios are long term station blackout and long term containment heat removal the value tends to support the conclusion that the increase in exposure due to the change in testing interval is acceptable per the criterion defined in Reference 1.

6.0 REFERENCES

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18. Station Blackout INTACT Bin Cutset Results

File	Size	Date
INTATCT-rec-12.CUT	537 KB	2/5/2010 6:45 PM

19. Station Blackout LATE Bin Cutset Results

File	Size	Date
LATE-rec-12.CUT	4.3 MB	2/5/2010 7:50 PM

20. Station Blackout SERF Bin Cutset Results

File	Size	Date
SERF-rec-12.CUT	40 KB	2/5/2010 6:34 PM

Attachment 4

2CAN061003

List of Regulatory Commitments

List of Regulatory Commitments

This table identifies actions discussed in this letter for which Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are **not** commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
ANO will use the definition in Section 5.0 of NEI 94-01, Revision 2-A, for calculating the Type A leakage rate	X		Upon NRC approval of this License Amendment Request (LAR)