ENCLOSURE 1 TO NL-17-137

Risk Impact of One-Time Extending the ILRT Interval Associated With the Proposed Technical Specification Changes

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RISK ASSESSMENT FOR INDIAN POINT 3 REGARDING THE ILRT (TYPE A) ONE-TIME EXTENSION REQUEST

Prepared For

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REVISION RECORD SUMMARY

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1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this analysis is to provide an assessment of the risk associated with implementing a one-time extension of the Indian Point Unit 3 (IP3) containment Type A integrated leak rate test (ILRT) interval from ten years to sixteen years. This represents an update to the analysis previously developed to support the extension of the ILRT interval from ten years to 15 years for both IP2 and IP3 [8]. The calculation was updated solely to reflect the change from 15 to 16 years unless where otherwise noted to reflect IP3 specific assumptions. The risk assessment follows the guidelines from NEI 94-01 [1], the methodology outlined in EPRI TR-104285 [2], the EPRI Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals [3], the NRC regulatory guidance on the use of Probabilistic Risk Assessment (PRA) findings and risk insights in support of a request for a plant's licensing basis as outlined in Regulatory Guide (RG) 1.174 [4], and the methodology used for Calvert Cliffs to estimate the likelihood and risk implications of corrosion-induced leakage of a steel liner going undetected during the extended test interval [5]. The format of this document is consistent with the intent of the Risk Impact Assessment Template for evaluating extended integrated leak rate testing intervals provided in the October 2008 EPRI final report [3].

1.2 Background

Revisions to 10CFR50, Appendix J (Option B) allow individual plants to extend the Integrated Leak Rate Test (ILRT) Type A surveillance testing requirements from three-in-ten years to at least once per ten years. The revised Type A frequency is 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 the normal containment leakage of 1.0La (allowable leakage). The basis for a 10-year test interval is provided in Section 11.0 of NEI 94-01, Revision 0, and was established in 1995 during development of the performance-based Option B to Appendix J. Section 11.0 of NEI 94-01 states that NUREG-1493 [6], "Performance-Based Containment Leak Test Program," provides the technical basis to support rulemaking to revise leakage rate testing requirements contained in Option B to Appendix J. The basis consisted of qualitative and quantitative assessments of the risk impact (in terms of increased public dose) associated with a range of extended leakage rate test intervals. To supplement the NRC's rulemaking basis, NEI undertook a similar study. The results of that study are documented in Electric Power Research Institute (EPRI) Research Project Report TR-104285 [2].

The NRC report on performance-based leak testing, NUREG-1493, analyzed the effects of containment leakage on the health and safety of the public and the benefits realized from the containment leak rate testing. In that analysis, it was determined for a representative PWR plant (i.e., Surry) that containment isolation failures contribute less than 0.1 percent to the latent risks from reactor accidents. Because ILRTs represent substantial resource expenditures, it is desirable to show that extending the ILRT interval will not lead to a substantial increase in risk from containment isolation failures to support a reduction in the test frequency for IP3.

Earlier ILRT frequency extension submittals have used the EPRI TR-104285 [2] methodology to perform the risk assessment. In October 2008, EPRI 1018243 [3] was issued to develop a generic methodology for the risk impact assessment for ILRT interval extensions to 15 years using current performance data and risk informed guidance, primarily NRC Regulatory Guide 1.174 [4]. This more recent EPRI document considers the change in population dose, large early release frequency (LERF), and containment conditional failure probability (CCFP),

whereas EPRI TR-104285 considered only the change in risk based on the change in population dose. This ILRT interval extension risk assessment for IP3 employs the EPRI 1018243 methodology, with the affected System, Structure, or Component (SSC) being the primary containment boundary.

1.3 Acceptance Criteria

The acceptance guidelines in RG 1.174 are used to assess the acceptability of this one-time extension of the Type A test interval beyond that established during the Option B rulemaking of Appendix J. RG 1.174 defines very small changes in the risk-acceptance guidelines as increases in core damage frequency (CDF) less than 1.0E-06 per reactor year and increases in large early release frequency (LERF) less than 1.0E-07 per reactor year. Note that a separate discussion in Section 5.8 confirms that the CDF is not impacted by the proposed change for IP3. Therefore, since the Type A test does not impact CDF for IP3, the relevant criterion is the change in LERF. RG 1.174 also defines small changes in LERF as below 1.0E-06 per reactor year, provided that the total LERF from all contributors (including external events) can be reasonably shown to be less than 1.0E-05 per reactor year. RG 1.174 discusses defense-in-depth and encourages the use of risk analysis techniques to help ensure and show that key principles, such as the defense-in-depth philosophy, are met. Therefore, the increase in the conditional containment failure probability (CCFP) is also calculated to help ensure that the defense-in-depth philosophy is maintained.

With regard to population dose, examinations of NUREG-1493 and Safety Evaluation Reports (SERs) for one-time interval extension (summarized in Appendix G of [3]) indicate a range of incremental increases in population dose[1] that have been accepted by the NRC. The range of incremental population dose increases is from ≤0.01 to 0.2 person-rem/yr and 0.002 to 0.46% of the total accident dose. The total doses for the spectrum of all accidents (Figure 7-2 of NUREG-1493) result in health effects that are at least two orders of magnitude less than the NRC Safety Goal Risk. Given these perspectives, the NRC SER on this issue [7] defines a small increase in population dose as an increase of ≤ 1.0 person-rem per year, or ≤1 % of the total population dose, whichever is less restrictive for the risk impact assessment of the extended ILRT intervals. This definition has been adopted by the IP3 analysis.

The acceptance criteria are summarized below.

1. The estimated risk increase associated with performing a one-time extension of the ILRT surveillance interval to 16 years must be demonstrated to be small. (Note that Regulatory Guide 1.174 defines very small changes in risk as increases in CDF less than 1.0E-6 per reactor year and increases in LERF less than 1.0E-7 per reactor year. Since the type A ILRT test is not expected to impact CDF for Indian Point, the relevant risk metric is the change in LERF. Regulatory Guide 1.174 also defines small risk increase as a change in LERF of less than 1.0E-6 reactor year.) Therefore, a small change in risk for this application is defined as a LERF increase of less than 1.0E-6.

[1] The one-time extensions assumed a large leak (EPRI class 3b) magnitude of 35La, whereas this analysis uses 100La.

2. Per the NRC SE, a small increase in population dose is also 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 less restrictive.

3. In addition, the SE notes that a small increase in Conditional Containment Failure Probability (CCFP) should be defined as a value marginally greater than that accepted in previous one-time 15-year ILRT extension requests (typically about 1% or less, with the largest increase being 1.2%). This would require that the increase in CCFP be less than or equal to 1.5 percentage points.

2.0 METHODOLOGY

A simplified bounding analysis approach consistent with the EPRI methodology is used for evaluating the change in risk associated with increasing the test interval to sixteen years [3]. The analysis uses results from a Level 2 analysis of core damage scenarios from the IP3 PRA analyses of record that was previously used to support the extension of the ILRT test interval from 10 to 15 years for IP2 and IP3 [8], and the subsequent containment responses to establish the various fission product release categories, including the release size.

The six general steps of this assessment are as follows:

- Quantify the baseline risk in terms of the frequency of events (per reactor year) for each of the eight containment release scenario types identified in the EPRI report [3].
- Develop plant-specific population dose rates (person-rem per reactor year) for each of the eight containment release scenario types from plant specific consequence analyses.
- Evaluate the risk impact (i.e., the change in containment release scenario type frequency and population dose) of extending the ILRT interval to sixteen years.
- Determine the change in risk in terms of Large Early Release Frequency (LERF) in accordance with RG 1.174 and compare this change with the acceptance guidelines of RG 1.174 [4].
- Determine the impact on the Conditional Containment Failure Probability (CCFP)
- Evaluate the sensitivity of the results to assumptions in the liner corrosion analysis and to variations in the fractional contributions of large isolation failures (due to liner breach) to LERF.

Furthermore,

- Consistent with the previous industry containment leak risk assessments, the IP3 assessment uses population dose as one of the risk measures. The other risk measures used in the IP3 assessment are the conditional containment failure probability (CCFP) for defense-in-depth considerations, and change in LERF to demonstrate that the acceptance guidelines from RG 1.174 are met.
- This evaluation for IP3 uses ground rules and methods to calculate changes in the above risk metrics that are consistent with those outlined in the current EPRI methodology [3].

3.0 GROUND RULES

The following ground rules are used in the analysis:

- The IP3 Level 1 and Level 2 internal events PRA models provide representative core damage frequency and release category frequency distributions to be utilized in this analysis.
- It is appropriate to use the IP3 internal events PRA model as a gauge to effectively describe the risk change attributable to the ILRT extension. It is reasonable to assume that the impact from the ILRT extension (with respect to percent increases in population dose) will not substantially differ if external events were to be included in the calculations; however, external events have been accounted for in the analysis based on the available information from the IP3 IPEEE [9] as reported and used in the IP3 SAMA analysis performed as part of the License Renewal efforts as described in Section 5.7.
- Dose results for the containment failures modeled in the PRA can be characterized by information that was prepared to support the SAMA analysis as part of the License Renewal effort [10]. This information is supplemented with revised calculations [11] for the base case containment intact scenarios which are critical for use in the ILRT extension assessment.
- Accident classes describing radionuclide release end states and their definitions are consistent with the EPRI methodology [3] and are summarized in Section 4.2.
- The representative containment leakage for Class 1 sequences is 1La. Class 3 accounts for increased leakage due to Type A inspection failures.
- The representative containment leakage for Class 3a is 10 La and for Class 3b sequences is 100La, based on the recommendations in the latest EPRI report [3] and as recommended in the NRC SE on this topic [7]. It should be noted that this is more conservative than the earlier previous industry ILRT extension requests, which utilized 35La for the Class 3b sequences.
- Based on the EPRI methodology and the NRC SE, the Class 3b sequences are categorized as LERF and the increase in Class 3b sequences is used as a surrogate for the ΔLERF metric.
- The impact on population doses from containment bypass scenarios is not altered by the proposed ILRT extension, but is accounted for in the EPRI methodology as a separate entry for comparison purposes. Since the containment bypass contribution to population dose is fixed, no changes on the conclusions from this analysis will result from this separate categorization.
- The reduction in ILRT frequency does not impact the reliability of containment isolation valves to close in response to a containment isolation signal.
- The use of the estimated 2035 population data from the MACCS2 off-site consequence runs [10, 11] is appropriate for this analysis. This assumption is consistent with that made in the SAMA analysis.
- An evaluation of the risk impact of the ILRT on shutdown risk is addressed using the generic results from EPRI TR-105189 [12].

4.0 INPUTS

This section summarizes the general resources available as input (Section 4.1) and the plant specific resources required (Section 4.2).

4.1 General Resources Available

Various industry studies on containment leakage risk assessment are briefly summarized here:

- NUREG/CR-3539 [13]
- NUREG/CR-4220 [14]
- NUREG-1273 [15]
- NUREG/CR-4330 [16]
- EPRI TR-105189 [12]
- NUREG-1493 [6]
- EPRI TR-104285 [2]
- Calvert Cliffs liner corrosion analysis [5]
- EPRI 1018243 [3]
- NRC Final Safety Evaluation [7]

The first study is applicable because it provides one basis for the threshold that could be used in the Level 2 PRA for the size of containment leakage that is considered significant and to be included in the model. The second study is applicable because it provides a basis of the probability for significant pre-existing containment leakage at the time of a core damage accident. The third study is applicable because it is a subsequent study to NUREG/CR-4220 that undertook a more extensive evaluation of the same database. The fourth study provides an assessment of the impact of different containment leakage rates on plant risk. The fifth study provides an assessment of the impact on shutdown risk from ILRT test interval extension. The sixth study is the NRC's cost-benefit analysis of various alternative approaches regarding extending the test intervals and increasing the allowable leakage rates for containment integrated and local leak rate tests. The seventh study is an EPRI study of the impact of extending ILRT and LLRT test intervals on at-power public risk. The eighth study addresses the impact of age-related degradation of the containment liner on ILRT evaluations. EPRI 1018243 complements the previous EPRI report and provides the results of an expert elicitation process to determine the relationship between pre-existing containment leakage probability and magnitude. Finally, the NRC Safety Evaluation (SE) documents the acceptance by the NRC of the proposed methodology with a few exceptions. These exceptions (associated with the ILRT Type A tests) were addressed in the Revision 2-A of NEI 94-01 and the final version of the updated EPRI report [3], which was used for this application.

<u>NUREG/CR-3539 [13]</u>

Oak Ridge National Laboratory (ORNL) documented a study of the impact of containment leak rates on public risk in NUREG/CR-3539. This study uses information from WASH-1400 [31] as the basis for its risk sensitivity calculations. ORNL concluded that the impact of leakage rates on LWR accident risks is relatively small.

NUREG/CR-4220 [14]

NUREG/CR-4220 is a study performed by Pacific Northwest Laboratories for the NRC in 1985. The study reviewed over two thousand LERs, ILRT reports and other related records to calculate the unavailability of containment due to leakage. It assessed the "large" containment leak probability to be in the range of 1E-3 to 1E-2, with 5E-3 identified as the point estimate based on 4 events in 740 reactor years and conservatively assuming a one-year duration for each event.

NUREG-1273 [15]

A subsequent NRC study, NUREG-1273, performed a more extensive evaluation of the NUREG/CR-4220 database. This assessment noted that about one-third of the reported events were leakages that were immediately detected and corrected. In addition, this study noted that local leak rate tests can detect "essentially all potential degradations" of the containment isolation system.

NUREG/CR-4330 [16]

NUREG/CR-4330 is a study that examined the risk impacts associated with increasing the allowable containment leakage rates. The details of this report have no direct impact on the modeling approach of the ILRT test interval extension, as NUREG/CR-4330 focuses on leakage rate and the ILRT test interval extension study focuses on the frequency of testing intervals. However, the general conclusions of NUREG/CR-4330 are consistent with NUREG/CR-3539 and other similar containment leakage risk studies:

> "...the effect of containment leakage on overall accident risk is small since risk is dominated by accident sequences that result in failure or bypass of containment."

EPRI TR-105189 [12]

The EPRI study TR-105189 is useful to the ILRT test interval extension risk assessment because this EPRI study provides insight regarding the impact of containment testing on shutdown risk. This study performed a quantitative evaluation (using the EPRI ORAM software) for two reference plants (a BWR-4 and a PWR) of the impact of extending ILRT and LLRT test intervals on shutdown risk .

The result of the study concluded that a small but measurable safety benefit (shutdown CDF reduced by 1.0E-8/yr to 1.0E-7/yr) is realized from extending the test intervals from 3 per 10 years to 1 per 10 years.

NUREG-1493 [6]

NUREG-1493 is the NRC's cost-benefit analysis for proposed alternatives to reduce containment leakage testing frequencies and/or relax allowable leakage rates. The NRC conclusions are consistent with other similar containment leakage risk studies:

Reduction in ILRT frequency from 3 per 10 years to 1 per 20 years results in an "imperceptible" increase in risk.

Given the insensitivity of risk to the containment leak rate and the small fraction of leak paths detected solely by Type A testing, increasing the interval between integrated leak rate tests is possible with minimal impact on public risk.

EPRI TR-104285 [2]

Extending the risk assessment impact beyond shutdown (the earlier EPRI TR-105189 study), the EPRI TR-104285 study is a quantitative evaluation of the impact of extending Integrated Leak Rate Test (ILRT) and (Local Leak Rate Test) LLRT test intervals on at-power public risk. This study combined IPE Level 2 models with NUREG-1150 [17] Level 3 population dose models to perform the analysis. The study also used the approach of NUREG-1493 [6] in calculating the increase in pre-existing leakage probability due to extending the ILRT and LLRT test intervals.

EPRI TR-104285 used a simplified Containment Event Tree to subdivide representative core damage sequences into eight categories of containment response to a core damage accident:

- Containment intact and isolated
- Containment isolation failures due to support system or active failures
- Type A (ILRT) related containment isolation failures
- Type B (LLRT) related containment isolation failures
- Type C (LLRT) related containment isolation failures
- Other penetration related containment isolation failures
- Containment failure due to core damage accident phenomena
- Containment bypass

Consistent with the other containment leakage risk assessment studies, this study concluded:

> "These study results show that the proposed CLRT [containment leak rate tests] frequency changes would have a minimal safety impact. The change in risk determined by the analyses is small in both absolute and relative terms..."

Release Category Definitions

Table 4.1-1 defines the accident classes used in the ILRT extension evaluation, which is consistent with the EPRI methodology [3]. These containment failure classifications are used in this analysis to determine the risk impact of extending the Containment Type A test interval as described in Section 5 of this report.

Table 4.1-1
EPRI/NEI Containment Failure Classifications

Class	Description
1	Containment remains intact including accident sequences that do not lead to containment failure in the long term. The release of fission products (and attendant consequences) is determined by the maximum allowable leakage rate values L_a, under Appendix J for that plant
2	Containment isolation failures (as reported in the IPEs) include those accidents in which there is a failure to isolate the containment.

Table 4.1-1
EPRI/NEI Containment Failure Classifications

Class	Description
3	Independent (or random) isolation failures include those accidents in which the pre-existing isolation failure to seal (i.e., provide a leak-tight containment) is not dependent on the sequence in progress.
4	Independent (or random) isolation failures include those accidents in which the pre-existing isolation failure to seal is not dependent on the sequence in progress. This class is similar to Class 3 isolation failures, but is applicable to sequences involving Type B tests and their potential failures. These are the Type B-tested components that have isolated but exhibit excessive leakage.
5	Independent (or random) isolation failures include those accidents in which the pre-existing isolation failure to seal is not dependent on the sequence in progress. This class is similar to Class 4 isolation failures, but is applicable to sequences involving Type C tests and their potential failures.
6	Containment isolation failures include those leak paths covered in the plant test and maintenance requirements or verified per in service inspection and testing (ISI/IST) program.
7	Accidents involving containment failure induced by severe accident phenomena. Changes in Appendix J testing requirements do not impact these accidents.
8	Accidents in which the containment is bypassed (either as an initial condition or induced by phenomena) are included in Class 8. Changes in Appendix J testing requirements do not impact these accidents.

Calvert Cliffs Liner Corrosion Analysis [5]

This submittal to the NRC describes a method for determining the change in likelihood, due to extending the ILRT, of detecting liner corrosion, and the corresponding change in risk. The methodology was developed for Calvert Cliffs in response to a request for additional information regarding how the potential leakage due to age-related degradation mechanisms was factored into the risk assessment for the ILRT one-time extension. The Calvert Cliffs analysis was performed for a concrete cylinder and dome and a concrete basemat, each with a steel liner. IP3 has a similar type of containment.

EPRI 1018243 [3]

This report presents a risk impact assessment for extending integrated leak rate test (ILRT) surveillance intervals to 15 years. This risk impact assessment complements the previous EPRI report, TR-104285, Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals. The earlier report considered changes to local leak rate testing intervals as well as changes to ILRT testing intervals. The original risk impact assessment considers the change in risk based on population dose, whereas the revision considers dose as well as large early release frequency (LERF) and conditional containment failure probability (CCFP). This report deals with changes to ILRT testing intervals and is intended to provide bases for supporting changes to industry and regulatory guidance on ILRT surveillance intervals.

The risk impact assessment using the Jeffrey's Non-Informative Prior statistical method is further supplemented with a sensitivity case using expert elicitation performed to address conservatisms. The expert elicitation is used to determine the relationship between pre-existing

containment leakage probability and magnitude. The results of the expert elicitation process from this report are used as a separate sensitivity investigation for the IP3 analysis presented here in Section 6.2.

NRC Safety Evaluation Report [7]

This SE documents the NRC staff's evaluation and acceptance of NEI TR 94-01, Revision 2, and EPRI Report No. 1009325, Revision 2, subject to the limitations and conditions identified in the SE and summarized in Section 4.0 of the SE. These limitations (associated with the ILRT Type A tests) were addressed in the Revision 2-A of NEI 94-01 which are also included in Revision 3-A of NEI 94-01 [1] and the final version of the updated EPRI report [3]. Additionally, the SE clearly defined the acceptance criteria to be used in future Type A ILRT extension risk assessments as delineated previously in the end of Section 1.3.

4.2 Plant-Specific Inputs

The IP3-specific information used to perform this ILRT interval extension risk assessment includes the following:

Level 1 and Level 2 PRA model quantification results [19]

Population dose within a 50-mile radius for various release categories [10, 11]

IP3 Internal Events Core Damage Frequency

The IP3 Internal Events PRA analysis used for this assessment is the same as that used in the analysis to support the extension of the IP3 ILRT test interval to 15 years in 2013, which is based on an event tree / linked fault tree model characteristic of the as-built, as-operated plant. Based on the results found in Tables J1.6-2 of Reference [19], the internal events Level 1 PRA core damage frequency (CDF) is 1.48E-05/yr for IP3.

IP3 Internal Events Release Category Frequencies

The IP3 Level 2 release category frequencies were developed from the contributions to CDF for those analyzed containment failure modes that were documented in Tables J1.6-2 and J1.7-4 of Reference [19]. Table 4.2-1 summarizes the pertinent IP3 results in terms of end-states where a representative release category is assigned for each end-state. The total Large Early Release Frequency (LERF) in Table 4.2-1 is 1.25E-06/yr. The individual release category frequencies are utilized here to provide the necessary delineation for the ILRT risk assessment with the corresponding EPRI class for each release category. A discussion of the available population dose information for various release categories follows this table.

Table 4.2-1
Level 2 Release Category Frequencies for IP3

Release Category Description	Indian Point 3 (Frequency/yr)
No Containment Failure	1.13E-05
Late Release	2.17E-06
Low to Moderate Early Release	1.17E-07
High Early Release (LERF)	1.25E-06

Table 4.2-1
Level 2 Release Category Frequencies for IP3

Release Category Description		**Indian Point 3 (Frequency/yr)**
LERF:	Containment Bypass (SGTR Initiating Events)	9.19E-07
LERF:	Containment Bypass (ISLOCA)	1.93E-07
LERF:	Containment Bypass (Induced SGTR events)	5.78E-08
LERF:	Containment Isolation Failure	3.99E-09
LERF:	Energetic Containment Failures	7.14E-08
	Total:	**1.48E-05**

IP3 Population Dose Information

In the License Renewal analysis for IP3 [20], the release categories considered the magnitude of the radionuclide release, e.g., concentration of cesium iodide (CsI), and the time of the release. Table 4.2-2 shows how the different release categories were organized for the license renewal effort. While that breakdown was appropriate for that submittal, the breakdown in Table 4.2-1 is sufficient for this ILRT extension risk assessment.

Table 4.2-2
Release Category Definitions from the License Renewal Effort

Release Timing		**Release Severity Source Term Release Fraction**	
Classification Category	Time of Release (noble gases or CsI)	Classification Category	Percent CsI in Release
Late (L)	> 12 hours	High (H)	> 10
		Moderate (M)	1 to 10
Early (E)	< 12 hours	Low (L)	0.1 to 1
		Low-Low (LL)	0.01 to 0.1
		No Containment Failure (NCF)	< 0.01 (Little to No Release)

The population dose results from latest relevant License Renewal submittal [10] form the basis of the initial ILRT assessment using the latest available release category frequency information as described above. The results for IP3 are taken from Table 6 of Reference [10]. Those population dose results are reproduced in Table 4.2-3 converted to the corresponding values in person-rem (i.e., 100 * person-sv) used for this analysis.

Table 4.2-3
Population Dose per License Renewal Release Category for IP3

Release Category Description	Indian Point 3 (person-rem)
No Containment Failure (NCF)	8.04E+03
Early High	5.08E+07
Early Medium	2.00E+07
Early Low	5.21E+06
Late High	1.63E+07
Late Medium	6.85E+06
Late Low	1.61E+06
Late Low-Low	1.38E+06

Since the ILRT methodology is based on multipliers to a bounding case which is representative of an allowable leakage of 1.0La, the NCF case from the License Renewal effort, which represents a best estimate release, could not be used. As a result, additional analyses were required for the ILRT assessment to be consistent with the methodology employed. Table 4.2-4 shows the results of four different potential case runs to provide a representative 1.0La release [11]. These case results are representative of the 1.0La release as required by the ILRT methodology.

Table 4.2-4
Population Dose for Intact Containment Cases for IP3

Release Category Description	Indian Point 3 (person-rem)
Intact Scenario #1 (Vessel Breach Occurs, Containment Fan Coolers Available)	8.28E+04
Intact Scenario #2 (Vessel Breach Occurs, Containment Sprays Available)	1.59E+04
Intact Scenario #3 (Vessel Breach Occurs, Fan Coolers and Sprays Available)	1.32E+04
Intact Scenario #4 (No Vessel Breach, Containment Fan Coolers Available)	2.94E+04

Based on a review of cutsets associated with the intact containment end state, an apportionment of the intact containment associated release categories was made. First, it was noted that containment sprays were not failed in more than 99% of the intact containment cases, but their use could only be definitively declared in Medium and Large LOCA scenarios or when vessel breach occurs (i.e., other cases with fan coolers available and no vessel breach are unlikely to reach the automatic containment spray initiation set point of 22 psig). For IP3,

about 63% of the intact containment cases involved no vessel breach. The medium and large LOCA contribution to the intact containment case was about 10%. Therefore, it was conservatively assumed that just 10% of the intact containment cases could be represented by a case with containment sprays available (i.e., intact scenario #2 from Table 4.2-4). Of the remaining 90%, based on the contribution from no vessel breach scenarios noted above, it was assumed that about 60% of the cases involved scenarios with no vessel failure and about 30% involved scenarios where vessel failure occurred. Intact scenario #4 from Table 4.2-4 is then used as a representative case for the no vessel failure scenarios, and intact scenario #1 is then conservatively used as a representative case for the remaining vessel failure scenarios. Although sprays are likely available in those scenarios, the SAMG procedures may limit their use based on hydrogen detonation concerns. This leads to an overall weighted average population dose for the intact containment case as shown in Table 4.2-5. This weighted average population dose of 4.41E+04 person-rem is used in the remainder of the calculations using the ILRT methodology.

Table 4.2-5
Weighted Average Population Dose for Intact Containment Case for IP3

Release Category Description	Percent Contribution	Population Dose (Person-Rem)
Intact Scenario #1 (Vessel Breach Occurs, Containment Fan Coolers Available)	30%	8.28E+04
Intact Scenario #2 (Vessel Breach Occurs, Containment Sprays Available)	10%	1.59E+04
Intact Scenario #3 (Vessel Breach Occurs, Fan Coolers and Sprays Available)	N/A	1.32E+04
Intact Scenario #4 (No Vessel Breach, Containment Fan Coolers Available)	60%	2.94E+04
Weighted Average	0.3 * (8.28E+04) + 0.1 * (1.59E+04) + 0.6 * (2.94E+04)	4.41E+04

<u>Population Dose Risk Calculations</u>

The next step is to take the frequency information from Table 4.2-1, assign each category to the relevant EPRI release category class from Table 4.1-1, and then associate a representative population dose from Table 4.2-3 or Table 4.2-5 for each release category. Table 4.2-6 lists the population dose risk and average population dose organized by EPRI release category, including the delineation of early and late frequencies for Class 7, and a delineation of SGTR and ISLOCA frequencies for Class 8. Note that the population dose risk (Column 4 of Table 4.2-6) was found by multiplying the release category frequency (Column 2 of Table 4.2-6) by the associated population dose (Column 3 of Table 4.2-6). Note that only the applicable EPRI release categories at this point are shown in the tables (i.e., the Class 3 frequencies are derived later and the Class 4, 5, and 6 frequencies are not utilized in the EPRI methodology for the ILRT extension risk assessment).

Table 4.2-6
IP3 Population Dose and Population Dose Risk Organized by EPRI Release Category

EPRI Release Category and Description	Release Frequency (1/yr)	Assigned Population Dose (Person-Rem)	Population Dose Risk (Person-Rem/yr)
1: Containment intact	1.13E-05	4.41E+04 [Weighted Average From Table 4.2-5]	4.98E-01
2: Large containment isolation failures	3.99E-09	5.08E+07 [Early High From Table 4.2-3]	2.03E-01
7-CFE: Phenomena-induced containment failures (Early-non LERF)	1.17E-07	2.00E+07 [Early Medium From Table 4.2-3]	2.34E+00
7-CFE: Phenomena-induced containment failures (Early LERF)	7.14E-08	5.08E+07 [Early High From Table 4.2-3]	3.63E+00
7-CFL: Phenomena-induced containment failures (Late)	2.17E-06	6.85E+06 [Late Medium From Table 4.2-3][(1)]	1.49E+01
8-SGTR: Containment bypass (SGTR)	9.77E-07	5.08E+07 [Early High From Table 4.2-3]	4.96E+01
8-ISLOCA: Containment bypass (ISLOCA)	1.93E-07	5.08E+07 [Early High From Table 4.2-3]	9.80E+00
Total:	**1.48E-05**		**80.96**

(1) Although the current model does not distinguish between the different late release categories, the weighted average late release from the License Renewal was within 10% of the Late Medium population dose. The use of the Late Medium population dose for this release category was therefore deemed appropriate for the ILRT assessment.

The frequencies for the severe accident classes defined in Table 4.1-1 are developed based on the assignments shown above in Tables 4.2-6. Then, the frequencies for Classes 3a and 3b can be determined with that portion removed from Class 1. This step in the process is described in Section 4.3. Furthermore, adjustments are made to the Class 3b as well as Class 1 frequencies to account for the impact of undetected corrosion of the steel liner per the methodology described in Section 4.4.

4.3 Impact of Extension on Detection of Component Failures That Lead to Leakage (Small and Large)

The ILRT can detect a number of component failures such as liner breach and failure of some sealing surfaces, which can lead to leakage. The proposed ILRT test interval extension may influence the conditional probability of detecting these types of failures. To ensure that this effect is properly accounted for, the EPRI Class 3 accident class as defined in Table 4.1-1 is divided into two sub-classes representing small and large leakage failures. These subclasses are defined as Class 3a and Class 3b, respectively.

The probability of the EPRI Class 3a failures may be determined, consistent with the latest EPRI guidance [3], as the mean failure estimated from the available data (i.e., 2 "small" failures that could only have been discovered by the ILRT in 217 tests leads to a 2/217=0.0092 mean value). For Class 3b, consistent with latest available EPRI data, a non-informative prior distribution is assumed for no "large" failures in 217 tests (i.e., 0.5/(217+1) = 0.0023).

The EPRI methodology contains information concerning the potential that the calculated delta LERF values for several plants may fall above the "very small change" guidelines of the NRC regulatory guide 1.174. This information includes a discussion of conservatisms in the quantitative guidance for delta LERF. EPRI describes ways to demonstrate that, using plant-specific calculations, the delta LERF is smaller than that calculated by the simplified method.

The methodology states:

> "The methodology employed for determining LERF (Class 3b frequency) involves conservatively multiplying the CDF by the failure probability for this class (3b) of accident. This was done for simplicity and to maintain conservatism. However, some plant-specific accident classes leading to core damage are likely to include individual sequences that either may already (independently) cause a LERF or could never cause a LERF, and are thus not associated with a postulated large Type A containment leakage path (LERF). These contributors can be removed from Class 3b in the evaluation of LERF by multiplying the Class 3b probability by only that portion of CDF that may be impacted by type A leakage."

The application of this additional guidance to the analysis (as detailed in Section 5) means that the Class 2, Class 7, and Class 8 LERF sequences are subtracted from the CDF that is applied to Class 3b. To be consistent, the same change is made to the Class 3a CDF, even though these events are not considered LERF. Note that Class 2 events refer to sequences with a large pre-existing containment isolation failure that lead to LERF, a subset of Class 7 events are LERF sequences due to an early containment failure from energetic phenomena, and Class 8 event are containment bypass events that contribute to LERF.

Consistent with the EPRI methodology [3], the change in the leak detection probability can be estimated by comparing the average time that a leak could exist without detection. For example, the average time that a leak could go undetected with a three-year test interval is 1.5 years (3 yr / 2), and the average time that a leak could exist without detection for a ten-year interval is 5 years (10 yr / 2). This change would lead to a non-detection probability that is a factor of 3.33 (5.0/1.5) higher for the probability of a leak that is detectable only by ILRT testing, given a 10-year vs. a 3-yr interval. Correspondingly, an extension of the ILRT interval to sixteen years can be estimated to lead to about a factor of 5.33 (8.0/1.5) increase in the non-detection probability of a leak.

<u>IP3 Past ILRT Results</u>

The surveillance frequency for Type A testing in NEI 94-01 under option B criteria is at least once per ten years based on an acceptable performance history (i.e., two consecutive periodic Type A tests at least 24 months apart) where the calculated performance leakage rate was less than 1.0La, and in compliance with the performance factors in NEI 94-01, Section 11.3. Based on the successful completion of two consecutive ILRTs at IP3, the current ILRT interval is once per ten years. Note that the probability of a pre-existing leakage due to extending the ILRT interval is based on the industry-wide historical results as noted in the EPRI guidance document [3].

EPRI Methodology

This analysis uses the approach outlined in the EPRI Methodology [3]. The six steps of the methodology are:

- Quantify the baseline (three-year ILRT frequency) risk in terms of frequency per reactor year for the EPRI accident classes of interest.
- Develop the baseline population dose (person-rem, from the plant PRA or IPE, or calculated based on leakage) for the applicable accident classes.
- Evaluate the risk impact (in terms of population dose rate and percentile change in population dose rate) for the interval extension cases.
- Determine the risk impact in terms of the change in LERF and the change in CCFP.
- Consider both internal and external events.
- Evaluate the sensitivity of the results to assumptions in the liner corrosion analysis.

The first three steps of the methodology deal with calculating the change in dose. The change in dose is the principal basis upon which the Type A ILRT interval extension was previously granted and is a reasonable basis for evaluating additional extensions. The fourth step in the methodology calculates the change in LERF and compares it to the guidelines in Regulatory Guide 1.174. Because there is no change in CDF for IP3, the change in LERF forms the quantitative basis for a risk informed decision per current NRC practice, namely Regulatory Guide 1.174. The fourth step of the methodology calculates the change in containment failure probability, referred to as the conditional containment failure probability, CCFP. The NRC has identified a CCFP of less than 1.5% as the acceptance criteria for extending the Type A ILRT test intervals as the basis for showing that the proposed change is consistent with the defense in depth philosophy [7]. As such, this step suffices as the remaining basis for a risk informed decision per Regulatory Guide 1.174. Step 5 takes into consideration the additional risk due to external events, and Step 6 investigates the impact on results due to varying the assumptions associated with the liner corrosion rate and failure to visually identify pre-existing flaws.

4.4 Impact of Extension on Detection of Steel Liner Corrosion that Leads to Leakage

An estimate of the likelihood and risk implications of corrosion-induced leakage of the steel liner occurring and going undetected during the extended test interval is evaluated using the methodology from the Calvert Cliffs liner corrosion analysis [5]. The Calvert Cliffs analysis was performed for a concrete cylinder and dome and a concrete basemat, each with a steel liner. IP3 has a similar type of containment.

The following approach is used to determine the change in likelihood, due to extending the ILRT, of detecting corrosion of the containment steel liner. This likelihood is then used to determine the resulting change in risk. Consistent with the Calvert Cliffs analysis, the following issues are addressed:

- Differences between the containment basemat and the containment cylinder and dome
- The historical steel liner flaw likelihood due to concealed corrosion
- The impact of aging

- The corrosion leakage dependency on containment pressure
- The likelihood that visual inspections will be effective at detecting a flaw

Assumptions

- A half failure is assumed for the basemat concealed liner corrosion due to lack of identified failures.
- The two corrosion events over a 5.5 year data period are used to estimate the liner flaw probability in the Calvert Cliffs analysis and are assumed to be applicable to the IP3 containment analysis. These events, one at North Anna Unit 2 and one at Brunswick Unit 2, were initiated from the non-visible (backside) portion of the containment liner. It is noted that two additional events have occurred in recent years (based on a data search covering approximately 9 years documented in Reference [21]). In November 2006, the Turkey Point 4 containment building liner developed a hole when a sump pump support plate was moved. In May 2009, a hole approximately 3/8" by 1" in size was identified in the Beaver Valley 1 containment liner. For risk evaluation purposes, these two more recent events occurring over a 9 year period are judged to be adequately represented by the two events in the 5.5 year period of the Calvert Cliffs analysis incorporated in the EPRI guidance (See Table 4.4-1, Step 1).
- Consistent with the Calvert Cliffs analysis, the steel liner flaw likelihood is assumed to double every five years. This is based solely on judgment and is included in this analysis to address the increased likelihood of corrosion as the steel liner ages (See Table 4.4-1, Steps 2 and 3). Sensitivity studies are included that address doubling this rate every two years and every ten years.
- In the Calvert Cliffs analysis, the likelihood of the containment atmosphere reaching the outside atmosphere given that a liner flaw exists was estimated as 1.1% for the cylinder and dome region, and 0.11% (10% of the cylinder failure probability) for the basemat. These values were determined from an assessment of the probability of containment failure versus containment pressure, and the selected values are consistent with a pressure that corresponds to the ILRT target pressure of 37 psig. For IP3, the containment failure probabilities are less than these values at 47 psig, which is the containment design pressure [19]. The probabilities of 1% for the cylinder and dome, and 0.1% for the basemat, albeit conservative, are used in this analysis. Sensitivity studies are included that increase and decrease the probabilities by an order of magnitude (See Table 4.4-1, Step 4).
- Consistent with the Calvert Cliffs analysis, a 5% visual inspection detection failure likelihood given the flaw is visible and a total detection failure likelihood of 10% is used for the containment cylinder and dome. For the containment basemat, 100% is assumed unavailable for visual inspection. To date, all liner corrosion events have been detected through visual inspection (See Table 4.4-1, Step 5). Sensitivity studies are included that evaluate total detection failure likelihood of 5% and 15%, respectively.
- Consistent with the Calvert Cliffs analysis, all non-detectable containment failures are assumed to result in early releases. This approach avoids a detailed analysis of containment failure timing and operator recovery actions.

Table 4.4-1
Steel Liner Corrosion Base Case

Step	Description	Containment CYLINDER AND dome		Containment Basemat	
1	**Historical Steel Liner Flaw Likelihood** Failure Data: Containment location specific (consistent with Calvert Cliffs analysis).	Events: 2 2/(70 * 5.5) = **5.2E-3**		Events: 0 (assume half a failure) 0.5/(70 * 5.5) = **1.3E-3**	
2	**Age Adjusted Steel Liner Flaw Likelihood** During 15-year interval, assume failure rate doubles every five years (14.9% increase per year). The average for 5th to 10th year is set to the historical failure rate (consistent with Calvert Cliffs analysis).	Year	Failure Rate	Year	Failure Rate
		1	2.1E-3	1	5.0E-4
		avg 5-10	5.2E-3	avg 5-10	1.3E-3
		15	1.4E-2	15	3.5E-3
		15 year average = 6.27E-3		**15 year average = 1.57E-3**	
3	**Flaw Likelihood at 3, 10, and 15 years** Uses age adjusted liner flaw likelihood (Step 2), assuming failure rate doubles every five years (consistent with Calvert Cliffs analysis – See Table 6 of Reference [5]).	**0.71% (1 to 3 years)** **4.06% (1 to 10 years)** **9.40% (1 to 15 years)** (Note that the Calvert Cliffs analysis presents the delta between 3 and 15 years of 8.7% to utilize in the estimation of the delta-LERF value. For this analysis, the values are calculated based on the 3, 10, and 16 year intervals[2].) 11.29% (1 to 16 years)		**0.18% (1 to 3 years)** **1.04% (1 to 10 years)** **2.42% (1 to 15 years)** (Note that the Calvert Cliffs analysis presents the delta between 3 and 15 years of 2.2% to utilize in the estimation of the delta-LERF value. For this analysis, however, values are calculated based on the 3, 10, and 16 year intervals.) 2.83% (1 to 16 years)	
4	**Likelihood of Breach in Containment Given Steel Liner Flaw** The failure probability of the containment cylinder and dome is assumed to be 1% (compared to 1.1% in the Calvert Cliffs analysis). The basemat failure probability is assumed to be a factor of ten less, 0.1% (compared to 0.11% in the Calvert Cliffs analysis).	**1%**		**0.1%**	

[2] The flaw likelihood for year 16, which was not provided in the Calvert Cliffs Analysis, was calculated based on the 14.9% increase per year in the flaw likelihood. The approximations for the 1 to 16 year period conservatively do not account for the probability of not having flaws in the years prior to year 16.

Table 4.4-1
Steel Liner Corrosion Base Case

Step	Description	Containment CYLINDER AND dome	Containment Basemat
5	**Visual Inspection Detection Failure Likelihood** Utilize assumptions consistent with Calvert Cliffs analysis.	**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 * 4 * 5)	**0.00071% (at 3 years)** =0.71% * 1% * 10% **0.00406% (at 10 years)** =4.06% * 1% * 10% **0.01129% (at 16 years)** =11.29% * 1% * 10%	**0.00018% (at 3 years)** =0.18% * 0.1% * 100% **0.00104% (at 10 years)** =1.04% * 0.1% * 100% **0.00283% (at 16 years)** =2.83% * 0.1% * 100%

The total likelihood of the corrosion-induced, non-detected containment leakage that is subsequently added to the EPRI Class 3b contribution is the sum of Step 6 for the containment cylinder and dome, and the containment basemat:

- At 3 years : 0.00071% + 0.00018% = 0.00089%
- At 10 years: 0.00406% + 0.00104% = 0.00510%
- At 16 years: 0.01129% + 0.00283% = 0.01412%

5.0 RESULTS

The application of the approach based on EPRI Guidance [3] has led to the following results. The results are displayed according to the eight accident classes defined in the EPRI report. Table 5.0-1 lists these accident classes.

Table 5.0-1
Accident Classes

Accident Classes (Containment Release Type)	Description
1	Containment Intact
2	Large Isolation Failures (Failure to Close)
3a	Small Isolation Failures (liner breach)
3b	Large Isolation Failures (liner breach)
4	Small Isolation Failures (Failure to seal –Type B)
5	Small Isolation Failures (Failure to seal—Type C)
6	Other Isolation Failures (e.g., dependent failures)
7	Failures Induced by Phenomena (Early and Late)
8	Bypass (SGTR and Interfacing System LOCA)
CDF	All CET End states (including very low and no release)

The analysis performed examined IP3-specific accident sequences in which the containment remains intact or the containment is impaired. Specifically, the categorization of the severe accidents contributing to risk was considered in the following manner:

- Core damage sequences in which the containment remains intact initially and in the long term (EPRI Class 1 sequences).
- Core damage sequences in which containment integrity is impaired due to random isolation failures of plant components other than those associated with Type B or Type C test components. For example, liner breach or bellows leakage, if applicable. (EPRI Class 3 sequences).

Core damage sequences in which containment integrity is impaired due to containment isolation failures of pathways left "opened" following a plant post-maintenance test. (For example, a valve failing to close following a valve stroke test. (EPRI Class 6 sequences). Consistent with the EPRI Guidance, this class is not specifically examined since it will not significantly influence the results of this analysis.

Accident sequences involving containment bypass (EPRI Class 8 sequences), large containment isolation failures (EPRI Class 2 sequences), and small containment isolation "failure-to-seal" events (EPRI Class 4 and 5 sequences) are accounted for in this evaluation as part of the baseline risk profile. However, they are not affected by the ILRT frequency change.

Class 4 and 5 sequences are impacted by changes in Type B and C test intervals; therefore, changes in the Type A test interval do not impact these sequences.

The steps taken to perform this risk assessment evaluation are as follows:

- Step 1 Quantify the base-line risk in terms of frequency per reactor year for each of the accident classes presented in Table 5.0-1.
- Step 2 Develop plant-specific person-rem dose (population dose) per reactor year for each of the accident classes.
- Step 3 Evaluate risk impact of extending Type A test interval from 3 to 16 and 10 to 16 years.
- Step 4 Determine the change in risk in terms of Large Early Release Frequency (LERF) in accordance with RG 1.174.
- Step 5 Determine the impact on the Conditional Containment Failure Probability (CCFP).

5.1 Step 1 – Quantify the Base-Line Risk in Terms of Frequency per Reactor Year

This step involves the review of the IP3 Level 2 release category frequency results [19]. As described in Section 4.2, the release categories were assigned to the EPRI classes as shown in Table 4.2-6. This application, combined with the IP3 dose risk (person-rem/yr), also shown in Table 4.2-6, forms the basis for estimating the increase in population dose risk.

For the assessment of the impact on the risk profile due to the ILRT extension, the potential for pre-existing leaks is included in the model. These pre-existing leak events are represented by the Class 3 sequences in EPRI 1018243 [3]. Two failure modes were considered for the Class 3 sequences, namely Class 3a (small breach) and Class 3b (large breach).

The determination of the frequencies associated with each of the EPRI categories listed in Table 5.0-1 is presented next.

Class 1 Sequences

This group represents the frequency when the containment remains intact (modeled as Technical Specification Leakage). The frequency per year for these sequences is 1.11E-05/yr (refer to Table 5.1-1 for Containment Release Type 1) and is determined by subtracting all containment failure end states including the EPRI/NEI Class 3a and 3b frequency calculated below, from the total CDF. For this analysis, the associated maximum containment leakage for this group is 1La, consistent with an intact containment evaluation. Note that the value for this Class reported in Table 5.1-1 is slightly lower than that reported in Table 4.2-6 since the 3a and 3b frequencies are now subtracted from Class 1.

Class 2 Sequences

This group consists of large containment isolation failures. For IP3, this frequency is 3.99E-09/yr (refer to Table 5.1-1, Containment Release Type 2).

Class 3 Sequences

This group represents pre-existing leakage in the containment structure (e.g., containment liner). The containment leakage for these sequences can be either small (2La to 100La) or large (>100La). In this analysis, a value of 10La was used for small pre-existing flaws and 100La for relatively large flaws.

The respective frequencies per year are determined as follows:

$PROB_{Class\_3a}$ = probability of small pre-existing containment liner leakage

= 0.0092 (see Section 4.3)

$PROB_{Class\_3b}$ = probability of large pre-existing containment liner leakage

= 0.0023 (see Section 4.3)

As described in Section 4.3, additional consideration is made to not apply these failure probabilities to those cases that are already considered LERF scenarios (i.e., the Class 2, Class 7, and Class 8 LERF contributions). This adjustment is made for based on the frequency information from Table 4.2-6 as shown below.

Class_3a = 0.0092 * [CDF – (Class 2 + Class 7 LERF + Class 8 SGTR + Class 8 ISLOCA)]

= 0.0092 * [1.48E-05 – (3.99E-09 + 7.14E-08 + 9.77E-07 + 1.93E-07)]

= 1.25E-07/yr

Class_3b = 0.0023 * [CDF – (Class 2 + Class 7 LERF + Class 8 SGTR + Class 8 ISLOCA)]

= 0.0023 * [1.48E-05 – (3.99E-09 + 7.14E-08 + 9.77E-07 + 1.93E-07)]

= 3.13E-08/yr

For this analysis, the associated containment leakage for Class 3a is 10La and 100La for Class 3b, which is consistent with the latest EPRI methodology [3] and the NRC SE [7].

Class 4 Sequences

This group represents containment isolation failure-to-seal of Type B test components. Because these failures are detected by Type B tests which are unaffected by the Type A ILRT, this group is not evaluated any further in this analysis.

Class 5 Sequences

This group represents containment isolation failure-to-seal of Type C test components. Because these failures are detected by Type C tests which are unaffected by the Type A ILRT, this group is not evaluated any further in this analysis.

Class 6 Sequences

This group is similar to Class 2. These are sequences that involve core damage with a failure-to-seal containment leakage due to failure to isolate the containment. These sequences are dominated by misalignment of containment isolation valves following a test/maintenance evolution. Consistent with the EPRI guidance, this accident class is not explicitly considered since it has a negligible impact on the results.

Class 7 Sequences

This group represents containment failure induced by early and late severe accident phenomena. From Table 4.2-6, the frequency for early Class 7 sequences is 1.17E-07/yr + 7.14E-08/yr = 1.88E-07/yr, and the frequency for the late Class 7 sequences is 2.17E-06/yr.

Class 8 Sequences

This group represents sequences where containment bypass occurs (SGTR or ISLOCA). From the frequency information provided in Table 4.2-6, the total SGTR contribution to core damage is 9.77E-07/yr and the ISLOCA contribution to core damage is 1.93E-07/yr.

Summary of Accident Class Frequencies

In summary, the accident sequence frequencies that can lead to release of radionuclides to the public have been derived in a manner consistent with the definition of accident classes defined in EPRI 1018243 [3] and are shown in Table 5.1-1 for IP3.

Table 5.1-1
Radionuclide Release Frequencies As A Function Of Accident Class (IP3 Base Case)

Accident Class (Containment Release Type)	Description	IP3 Frequency (1/yr)
1	Containment Intact	1.11E-05
2	Large Isolation Failures (Failure to Close)	3.99E-09
3a	Small Isolation Failures (liner breach)	1.25E-07
3b	Large Isolation Failures (liner breach)	3.13E-08
4	Small Isolation Failures (Failure to seal –Type B)	N/A
5	Small Isolation Failures (Failure to seal—Type C)	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A
7-CFE	Failures Induced by Phenomena (Early)	1.88E-07
7-CFL	Failures Induced by Phenomena (Late)	2.17E-06
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	9.77E-07
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	1.93E-07
CDF	**All CET End States (Including Intact Case)**	**1.48E-05**

5.2 Step 2 – Develop Plant-Specific Person-REM Dose (Population Dose) per Reactor Year

Plant-specific release analyses were performed to estimate the weighted average person-rem doses to the population within a 50-mile radius from the plant. The releases are based on a combination of the information provided by the IP3 SAMA re-analysis [10], additional population dose runs for the intact containment scenarios [11], and the Level 2 containment failure release frequencies [19] (see Table 4.2-6 of this analysis). The results of applying these releases to the EPRI containment failure classifications are summarized below. Note that the 7-CFE release category is further refined to be the weighted average of the two contributors for moving forward in the ILRT methodology since it is not impacted by the change to the ILRT interval.

Class 1 = 4.41E+04 person-rem (at 1.0La)

Class 2	=	5.08E+07 person-rem
Class 3a	=	4.41E+04 person-rem x 10La = 4.41E+05 person-rem
Class 3b	=	4.41E+04 person-rem x 100La = 4.41E+06 person-rem
Class 4	=	Not analyzed
Class 5	=	Not analyzed
Class 6	=	Not analyzed
Class 7-CFE	=	(1.17E-07 * 2.00E+07 + 7.14E-08 * 5.08E+07) / (1.17E-07 + 7.14E-08) = 3.17E+07 person-rem
Class 7-CFL	=	6.85E+06 person-rem
Class 8-SGTR	=	5.08E+07 person-rem
Class 8-ISLOCA	=	5.08E+07 person-rem

In summary, the population dose estimates derived for use in the risk evaluation per the EPRI methodology [3] for all EPRI classes are provided in Table 5.2-1, which includes the values previously presented in Table 4.2-6 as well as the Class 3a, 3b, and 7-CFE population doses calculated above.

Table 5.2-1
IP3 Population Dose
for Population Within 50 Miles

Accident Class (Containment Release Type)	Description	IP3 Person-Rem (0-50 miles)
1	Containment Intact	4.41E+04
2	Large Isolation Failures (Failure to Close)	5.08E+07
3a	Small Isolation Failures (liner breach)	4.41E+05
3b	Large Isolation Failures (liner breach)	4.41E+06
4	Small Isolation Failures (Failure to seal –Type B)	N/A
5	Small Isolation Failures (Failure to seal -Type C)	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A
7-CFE	Failures Induced by Phenomena (Early)	3.17E+07
7-CFL	Failures Induced by Phenomena (Late)	6.85E+06
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	5.08E+07
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	5.08E+07

The above population doses, when multiplied by the frequency results presented in Table 5.1-1, yield the IP3 baseline mean dose risk for each EPRI accident class. These results are presented in Table 5.2-2. Note that the additional contribution to EPRI Class 3b from the corrosion analysis as described in Section 4.4 is also included in these tables.

Table 5.2-2
IP3 Annual Dose As A Function Of Accident Class; Characteristic Of Conditions For 3 in 10 Year ILRT Frequency

Accident Classes (Containment Release Type)	Description	Person-Rem (0-50 miles)	EPRI Methodology		EPRI Methodology Plus Corrosion		Change Due to Corrosion (Person-Rem/yr) (1)
			Frequency (1/YR)	Person-Rem/yr (0-50 miles)	Frequency (1/YR)	Person-Rem/yr (0-50 miles)	
1	Containment Intact (2)	4.41E+04	1.11E-05	4.91E-01	1.11E-05	4.91E-01	-5.32E-6
2	Large Isolation Failures (Failure to Close)	5.08E+07	3.99E-09	2.03E-01	3.99E-09	2.03E-01	--
3a	Small Isolation Failures (liner breach)	4.41E+05	1.25E-07	5.51E-02	1.25E-07	5.51E-02	--
3b	Large Isolation Failures (liner breach)	4.41E+06	3.13E-08	1.38E-01	3.14E-08	1.38E-01	5.32E-4
4	Small Isolation Failures (Failure to seal –Type B)	N/A	N/A	N/A	N/A	N/A	N/A
5	Small Isolation Failures (Failure to seal—Type C)	N/A	N/A	N/A	N/A	N/A	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A	N/A	N/A	N/A	N/A	N/A
7-CFE	Failures Induced by Phenomena (Early)	3.17E+07	1.88E-07	5.97E+00	1.88E-07	5.97E+00	--
7-CFL	Failures Induced by Phenomena (Late)	6.85E+06	2.17E-06	1.49E+01	2.17E-06	1.49E+01	--
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	5.08E+07	9.77E-07	4.96E+01	9.77E-07	4.96E+01	–
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	5.08E+07	1.93E-07	9.80E+00	1.93E-07	9.80E+00	–
CDF	**All CET end states**		**1.48E-05**	**8.114E+01**	**1.48E-05**	**8.115E+01**	**5.27E-4**

(1) Only release Classes 1 and 3b are affected by the corrosion analysis. During the 16-year interval, the failure rate is assumed to double every five years. The additional frequency added to Class 3b is subtracted from Class 1 and the population dose rates are recalculated. This results in a small reduction to the Class 1 dose rate and an increase to the Class 3b dose rate.

(2) Characterized as $1L_a$ release magnitude consistent with the derivation of the ILRT non-detection failure probability for ILRTs. Release classes 3a and 3b include failures of containment to meet the Technical Specification leak rate.

The baseline IP3 doses compare reasonably with other plants given the relative population densities surrounding each location:

Plant	Annual Dose (Person-Rem/yr)	Reference
Indian Point 3	81.1	[Table 5.2-2]
Peach Bottom 2	8.6	[22]
Farley Unit 1, 2	1.5, 2.4	[23]
Crystal River	1.4	[24]

5.3 Step 3 – Evaluate Risk Impact of Extending Type A Test Interval From 10-to-16 Years

The next step is to evaluate the risk impact of extending the test interval from its current ten-year value to sixteen-years. To do this, an evaluation must first be made of the risk associated with the ten-year interval since the base case applies to a 3-year interval (i.e., a simplified representation of a 3-in-10 year interval).

Risk Impact Due to 10-year Test Interval

As previously stated, Type A tests impact only Class 3 sequences. For Class 3 sequences, the release magnitude is not impacted by the change in test interval (a small or large breach remains the same, even though the probability of not detecting the breach increases). Thus, only the frequency of Class 3a and 3b sequences is impacted. The risk contribution is changed based on the EPRI guidance as described in Section 4.3 by a factor of 3.33 compared to the base case values. The results of the calculation for a 10-year interval are presented in Table 5.3-1.

Risk Impact Due to 16-Year Test Interval

The risk contribution for a 16-year interval is calculated in a manner similar to the 10-year interval. The difference is in the increase in probability of not detecting a leak in Classes 3a and 3b. For this case, the value used in the analysis is a factor of 5.33 compared to the 3-year interval value, as described in Section 4.3. The results for this calculation are presented in Table 5.3-2.

Table 5.3-1
IP3 Annual Dose As A Function Of Accident Class;
Characteristic Of Conditions For 1 in 10 Year ILRT Frequency

Accident Classes (Containment Release Type)	Description	Person-Rem (0-50 miles)	EPRI Methodology		EPRI Methodology Plus Corrosion		Change Due to Corrosion (Person-Rem/yr) (1)
			Frequency (1/yr)	Person-Rem/yr (0-50 miles)	Frequency (1/yr)	Person-Rem/yr (0-50 miles)	
1	Containment Intact (2)	4.41E+04	1.08E-05	4.75E-01	1.08E-05	4.75E-01	-3.05E-5
2	Large Isolation Failures (Failure to Close)	5.08E+07	3.99E-09	2.03E-01	3.99E-09	2.03E-01	--
3a	Small Isolation Failures (liner breach)	4.41E+05	4.16E-07	1.84E-01	4.16E-07	1.84E-01	--
3b	Large Isolation Failures (liner breach)	4.41E+06	1.04E-07	4.59E-01	1.05E-07	4.62E-01	3.05E-3
4	Small Isolation Failures (Failure to seal –Type B)	N/A	N/A	N/A	N/A	N/A	N/A
5	Small Isolation Failures (Failure to seal—Type C)	N/A	N/A	N/A	N/A	N/A	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A	N/A	N/A	N/A	N/A	N/A
7-CFE	Failures Induced by Phenomena (Early)	3.17E+07	1.88E-07	5.97E+00	1.88E-07	5.97E+00	--
7-CFL	Failures Induced by Phenomena (Late)	6.85E+06	2.17E-06	1.49E+01	2.17E-06	1.49E+01	--
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	5.08E+07	9.77E-07	4.96E+01	9.77E-07	4.96E+01	--
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	5.08E+07	1.93E-07	9.80E+00	1.93E-07	9.80E+00	--
CDF	**All CET end states**		**1.48E-05**	**8.158E+01**	**1.48E-05**	**8.158E+01**	**3.02E-3**

(1) Only release classes 1 and 3b are affected by the corrosion analysis. During the 16-year interval, the failure rate is assumed to double every five years. The additional frequency added to Class 3b is subtracted from Class 1 and the population dose rates are recalculated. This results in a small reduction to the Class 1 dose rate and an increase to the Class 3b dose rate.

(2) Characterized as 1La release magnitude consistent with the derivation of the ILRT non-detection failure probability for ILRTs. Release classes 3a and 3b include failures of containment to meet the Technical Specification leak rate.

Table 5.3-2
IP3 Annual Dose As A Function Of Accident Class; Characteristic Of Conditions For 1 in 16 Year ILRT Frequency

Accident Classes (Containment Release Type)	Description	Person-Rem (0-50 miles)	EPRI Methodology		EPRI Methodology Plus Corrosion		Change Due to Corrosion (Person-Rem/yr) (1)
			Frequency (1/yr)	Person-Rem/yr (0-50 miles)	Frequency (1/yr)	Person-Rem/yr (0-50 miles)	
1	Containment Intact (2)	4.41E+04	1.05E-05	4.64E-01	1.05E-05	4.62E-01	-8.46E-5
2	Large Isolation Failures (Failure to Close)	5.08E+07	3.99E-09	2.03E-01	3.99E-09	2.03E-01	--
3a	Small Isolation Failures (liner breach)	4.41E+05	6.66E-07	2.94E-01	6.66E-07	2.94E-01	--
3b	Large Isolation Failures (liner breach)	4.41E+06	1.67E-07	7.35E-01	1.68E-07	7.43E-01	8.46E-3
4	Small Isolation Failures (Failure to seal –Type B)	N/A	N/A	N/A	N/A	N/A	N/A
5	Small Isolation Failures (Failure to seal—Type C)	N/A	N/A	N/A	N/A	N/A	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A	N/A	N/A	N/A	N/A	N/A
7-CFE	Failures Induced by Phenomena (Early)	3.17E+07	1.88E-07	5.97E+00	1.88E-07	5.97E+00	–
7-CFL	Failures Induced by Phenomena (Late)	6.85E+06	2.17E-06	1.49E+01	2.17E-06	1.49E+01	–
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	5.08E+07	9.77E-07	4.96E+01	9.77E-07	4.96E+01	–
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	5.08E+07	1.93E-07	9.80E+00	1.93E-07	9.80E+00	–
CDF	**All CET end states**		**1.48E-05**	**8.195E+01**	**1.48E-05**	**8.196E+01**	**8.38E-3**

(1) Only release classes 1 and 3b are affected by the corrosion analysis. During the 16-year interval, the failure rate is assumed to double every five years. The additional frequency added to Class 3b is subtracted from Class 1 and the population dose rates are recalculated. This results in a small reduction to the Class 1 dose rate and an increase to the Class 3b dose rate.

(2) Characterized as $1L_a$ release magnitude consistent with the derivation of the ILRT non-detection failure probability for ILRTs. Release classes 3a and 3b include failures of containment to meet the Technical Specification leak rate.

5.4 Step 4 – Determine the Change in Risk in Terms of Large Early Release Frequency

Regulatory Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. RG 1.174 defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 1E-06/yr and increases in LERF below 1E-07/yr, and small changes in LERF as below 1E-06/yr. Because the ILRT does not impact CDF for IP3, the relevant metric is LERF.

For IP3, 100% of the frequency of Class 3b sequences can be used as a conservative first-order estimate to approximate the potential increase in LERF from the ILRT interval extension (consistent with the EPRI guidance methodology and the NRC SE). Based on the original 3-in-10 year test interval assessment from Table 5.2-2, the Class 3b frequency is 3.14E-08/yr, which includes the corrosion effect of the containment liner. Based on a ten-year test interval from Table 5.3-1, the Class 3b frequency is 1.05E-07/yr; and, based on a sixteen-year test interval from Table 5.3-2, it is 1.68E-07/yr. Thus, the increase in the overall probability of LERF due to Class 3b sequences that is due to increasing the ILRT test interval from 3 to 16 years (including corrosion effects) is 1.37E-07/yr. Similarly, the increase in LERF due to increasing the interval from 10 to 16 years (including corrosion effects) is 6.37E-08/yr. As can be seen, even with the conservatisms included in the evaluation (per the EPRI methodology), the estimated change in LERF is well within Region II of Figure 4 of Reference [4] (i.e., the acceptance criteria for small changes in LERF) when comparing the 16 year results to the original 3-in-10 year requirement.

5.5 Step 5 – Determine the Impact on the Conditional Containment Failure Probability

Another parameter that can provide input into the decision-making process is the change in the conditional containment failure probability (CCFP). The change in CCFP is indicative of the effect of the ILRT on all radionuclide releases, not just LERF. The CCFP can be calculated from the results of this analysis. One of the difficult aspects of this calculation is providing a definition of the "failed containment." In this assessment, the CCFP is defined such that containment failure includes all radionuclide release end states other than the intact state and, consistent with the EPRI guidance, the small isolation failures (Class 3a). The conditional part of the definition is conditional given a severe accident (i.e., core damage).

The change in CCFP can be calculated by using the method specified in the EPRI methodology [3]. The NRC SE has noted a change in CCFP of <1.5% as the acceptance criterion to be used as the basis for showing that the proposed change is consistent with the defense-in-depth philosophy. Table 5.5-1 shows the CCFP values that result from the assessment for the various testing intervals including corrosion effects in which the flaw rate is assumed to double every five years.

Table 5.5-1
IP3 ILRT Conditional Containment Failure Probabilities

Unit	CCFP 3 in 10 yrs	CCFP 1 in 10 yrs	CCFP 1 in 16 yrs	$\Delta CCFP_{16\text{-}3}$	$\Delta CCFP_{16\text{-}10}$
Indian Point 3	24.03%	24.52%	24.95%	0.92%	0.43%

$$CCFP = [1 - (\text{Class 1 frequency} + \text{Class 3a frequency})/CDF] \times 100\%$$

The change in CCFP of less than 1% as a result of extending the test interval to 16 years from the original 3-in-10 year requirement is judged to be relatively insignificant, and is less than the NRC SE acceptance criteria of < 1.5%.

5.6 Summary of Internal Events Results

Table 5.6-1 summarizes the internal events results of this ILRT extension risk assessment for IP3. The results between the 3-in-10 year interval and the 16 year interval compared to the acceptance criteria are then shown in Table 5.6-2, and it is demonstrated that the acceptance criteria are met for the change in LERF and CCPF; while the change in dose risk is equal to, rather than less than a 1.0% change in dose risk. However, given the conservative nature of the approach, the 1.00% change in dose risk is still considered to meet the intent of the acceptance criteria, as supported by the sensitivity analysis presented in Section 5.7.5.

Table 5.6-1
IP3 ILRT Cases:
Base, 3 to 10, and 3 to 16 Yr Extensions
(Including Age Adjusted Steel Liner Corrosion Likelihood)

EPRI Class	DOSE Person-Rem	Base Case 3 in 10 Years		Extend to 1 in 10 Years		Extend to 1 in 16 Years	
		CDF (1/yr)	Person-Rem/yr	CDF (1/Yr)	Person-Rem/yr	CDF (1/yr)	Person-Rem/yr
1	4.41E+04	1.11E-05	4.91E-01	1.08E-05	4.75E-01	1.05E-05	4.62E-01
2	5.08E+07	3.99E-09	2.03E-01	3.99E-09	2.03E-01	3.99E-09	2.03E-01
3a	4.41E+05	1.25E-07	5.51E-02	4.16E-07	1.84E-01	6.66E-07	2.94E-01
3b	4.41E+06	3.14E-08	1.38E-01	1.05E-07	4.62E-01	1.68E-07	7.43E-01
7-CFE	3.17E+07	1.88E-07	5.97E+00	1.88E-07	5.97E+00	1.88E-07	5.97E+00
7-CFL	6.85E+06	2.17E-06	1.49E+01	2.17E-06	1.49E+01	2.17E-06	1.49E+01
8-SGTR	5.08E+07	9.77E-07	4.96E+01	9.77E-07	4.96E+01	9.77E-07	4.96E+01
8-ISLOCA	5.08E+07	1.93E-07	9.80E+00	1.93E-07	9.80E+00	1.93E-07	9.80E+00
Total		1.48E-05	8.115E+01	1.48E-05	8.158E+01	1.48E-05	8.196E+01

		Base Case 3 in 10 Years	Extend to 1 in 10 Years	Extend to 1 in 16 Years
ILRT Dose Rate (person-rem/yr) from 3a and 3b		1.93E-01	6.46E-01	1.04E+00
Delta Total Dose Rate(1)	From 3 yr	---	4.36E-01	8.13E-01
	From 10 yr	---	---	3.77E-01
3b Frequency (LERF)		3.14E-08	1.05E-07	1.68E-07
Delta 3b LERF	From 3 yr	---	7.34E-08	1.37E-07
	From 10 yr	---	---	6.37E-08
CCFP %		24.03%	24.52%	24.95%
Delta CCFP %	From 3 yr	---	0.49%	0.92%
	From 10 yr	---	---	0.43%

(1) The overall difference in total dose rate is less than the difference of only the 3a and 3b categories between two testing intervals. This is due to the fact that the Class 1 person-rem/yr decreases when extending the ILRT frequency.

Table 5.6-2
IP3 ILRT Extension Comparison to Acceptance Criteria

Unit	ΔLERF	ΔPerson-Rem/yr	ΔCCFP
Indian Point 3	1.37E-7/yr	0.813/yr (1.00%)	0.92%
Acceptance Criteria	<1.0E-6/yr	<1.0 person-rem/yr or <1.0%	<1.5%

5.7 External Events Contribution

Since the risk acceptance guidelines in RG 1.174 are intended for comparison with a full-scope assessment of risk, including internal and external events, a bounding analysis of the potential impact from external events is presented here.

The method chosen to account for external events contributions is similar to that used in the SAMA analysis [20] in which a multiplier was applied to the internal events results based on information from the IPEEE [9]. Similar to that provided in the SAMA analysis, a description of the external events contribution to risk at IP3 is provided below.

5.7.1 Indian Point 3 External Events Discussion

The IP3 Individual Plant Examination of External Events (IPEEE) concluded for high winds, floods, and "Other" external events that no undue risks are present that might contribute to CDF with a predicted frequency in excess of 1.0E-06/yr. Note that at IP3 (compared to IP2), the EDGs are in separate concrete bunkered cells and as such are not susceptible to high winds. In any event, as these other events are not dominant contributors to external event risk and quantitative analysis of these events is not practical, they are considered negligible in estimation of the external events impact on the ILRT extension assessment. The IPEEE analyses using the seismic PRA and fire PRA provided quantitative, but conservative, results. Therefore, the results were combined as described below to represent the total external events risk.

A seismic PRA analysis was performed for the seismic portion of the IP3 IPEEE. The seismic PRA analysis is a conservative analysis. Therefore, its results should not be compared directly with the best-estimate internal events results. Conservative assumptions in the seismic PRA analysis included the following.

- Each of the sequences in the seismic PRA assumes unrecoverable loss of off-site power. If off-site power was maintained, or recovered, following a seismic event, there would be many more systems available to maintain core cooling and containment integrity than were credited in the analysis.
- Seismic events were assumed to induce a small loss of coolant accident (LOCA) in addition to a loss of offsite power.
- A single, conservative, surrogate element whose failure leads directly to core damage was used in the seismic risk quantification to model the most seismically rugged components.
- Redundant components were conservatively assumed to be completely correlated by treating them as if they were one component for the purpose of determining the probability of seismic induced failures.

- The ATWS event tree was conservatively simplified so that all conditions which lead to a failure to trip result in core damage, without the benefit of emergency boration or other mitigating systems.
- Because there is little industry experience with crew actions following seismic events, human actions were conservatively characterized.

The seismic CDF in the IPEEE was conservatively estimated to be 4.40E-05/yr. As described above, this is a conservative value. The seismic PRA CDF has been re-evaluated to reflect updated random component failure probabilities and to model recovery of onsite power and local operation of the turbine-driven AFW pump. The updated seismic CDF is 2.65E-05/yr. Although it remains conservative, consistent with the SAMA analysis, the seismic risk contribution of 2.65E-05/yr is maintained to determine the external events impact on the ILRT extension assessment.

The EPRI Fire PRA Implementation Guide was followed for the IP3 IPEEE fire analysis. The EPRI Fire Induced Vulnerability Evaluation (FIVE) method was used for the initial screening, for treatment of transient combustibles, and as the source of fire frequency data. The sum of the resulting fire zone CDF values is approximately 5.58E-05/yr. Conservatisms in the IP3 IPEEE fire analysis include the following.

- The frequency and severity of fires were generally conservatively overestimated. A revised NRC fire events database indicates a trend toward lower frequency and less severe fires. This trend reflects improved housekeeping, reduction in transient fire hazards, and other improved fire protection steps at utilities.
- There is little industry experience with crew actions following fires. This led to conservative characterization of crew actions in the IPEEE fire analysis. Because CDF is strongly correlated with crew actions, this conservatism has a profound effect on fire results.
- Hot gas layer temperature timing calculations were based on simplified analyses (versus more detailed calculations such as GOTHIC or even COMPBURN) which are believed to result in more severe timing (i.e., shorter time to equipment failure).
- Heat and combustion products from a fire within a zone were assumed to be confined within the zone. Heat loss through separating zones was not considered; nor was heat loss through open equipment hatches, ladder ways, open doorways, or unsealed penetrations.
- Cable failure due to fire damage was assumed to arise from open circuits, hot shorts circuits, and short circuits to ground. In damaging a cable, the fire was always assumed to induce the conductor failure mode of concern.
- A plant trip was assumed for all fires, including those for which immediate operator actions are not specified in emergency response procedures.
- For several fire zones, a minimum heat requirement for target damage was estimated.
- Propagation of fires in cable spreading room trays and electrical tunnels was modeled using a maximum heat release rate. This results in a shorter time to damage than the five-minute delay using heat release rate scaling factors as a function of distance recommended in the EPRI fire PRA implementation guide.

Implementation of the IP3 IPEEE recommendations reduced the fire risk. The fire suppression system in the 480V switchgear room was restored to automatic actuation, and realignment and rerouting of the power feeds to the EDG exhaust fans and engine auxiliaries in emergency diesel generator room 31, emergency diesel generator room 32, and emergency diesel generator room 33 significantly reduce the respective fire zone's CDF. In addition, restoration of the 480V switchgear room fire suppression system to automatic actuation results in a similar reduction in the fire zone 14/37A multiple compartment fire CDF. Consequently, the IPEEE fire CDF value was reduced from 5.58E-05/yr to 2.55E-05/yr. Although it remains conservative, consistent with the SAMA analysis, the fire risk contribution of 2.55E-05/yr is maintained to determine the potential external event impact on the ILRT extension assessment.

In summary, combining the reduced seismic and fire CDF values results in an external events risk estimate of 5.20E-05/yr, which is 3.5 times higher than the internal events CDF (1.48E-05/yr).

5.7.2 Additional Seismic Risk Discussion

As an additional consideration, it can be noted that in June 2013, Entergy submitted information to the NRC that addressed some conservatisms in the original IPEEE analyses, and indicated that the seismic CDF risk at IP2 and IP3 are both actually less than 1.0E-05/yr [25]. However, to maintain consistency with the approach utilized in the SAMA analysis, the additional information will not be factored into this analysis but is noted here for completeness.

5.7.3 External Events Impact Summary

Table 5.7-1 summarizes the external events CDF contribution for IP3. Although noted as conservative, these values are consistent with that used in the SAMA analysis [20].

Table 5.7-1
External Events Contributor Summary [20]

External Event Initiator Group	IP3 CDF (1/YR)
Seismic	2.65E-05
Internal Fire	2.55E-05
High Winds	Screened
Other Hazards	Screened
Total (for initiators with CDF available)	**5.20E-05**
Internal Events CDF	1.48E-05
External Events Multiplier	**3.51**

From Table 5.7-1, the external events multiplier for IP3 is conservatively estimated to be 3.51.

5.7.4 External Events Impact on ILRT Extension Assessment

The EPRI Category 3b frequency for the 3-per-10 year, 1-per-10 year, and 1-per-16 year ILRT intervals are shown in Table 5.6-1 as 3.14E-08/yr, 1.05E-07/yr, and 1.58E-07/yr, respectively. Using an external events multiplier of 3.51 for IP3, the change in the LERF risk measure due to extending the ILRT from 3-per-10 years to 1-per-16 years, including both internal and external hazards risk, is estimated as shown in Table 5.7-2.

Table 5.7-2
IP3 3b (LERF/YR) as a Function of ILRT Frequency for Internal and External Events (Including Age Adjusted Steel Liner Corrosion Likelihood)

	3b Frequency (3-per-10 yr ILRT)	3b Frequency (1-per-10 year ILRT)	3b Frequency (1-per-16 year ILRT)	LERF Increase(1)
Internal Events Contribution	3.14E-08	1.05E-07	1.68E-07	1.37E-07
External Events Contribution (Internal Events CDF x 3.51)	1.10E-07	3.67E-07	5.91E-07	4.81E-07
Combined (Internal + External)	1.41E-07	4.72E-07	7.59E-7	6.18E-07

(1) Associated with the change from the baseline 3-per-10 year frequency to the proposed 1-per-16 year frequency.

Thus for IP3, the total increase in LERF (measured from the baseline 3-per-10 year ILRT interval to the proposed 1-per-16 year frequency) due to the combined internal and external events contribution is estimated as 6.18E-07/yr, which includes the age adjusted steel liner corrosion likelihood.

The other acceptance criteria for the ILRT extension risk assessment can be similarly derived using the multiplier approach. The results between the 3-in-10 year interval and the 16 year interval compared to the acceptance criteria are shown in Table 5.7-3. As can be seen, the impact from including the external events contributors would not change the conclusion of the risk assessment. When considering the conservative nature of the approach[3], the acceptance criteria are all met such that the estimated risk increase associated with a one-time extension of the ILRT surveillance interval to 16 years has been demonstrated to be small. Note that a bounding analysis for the total LERF contribution follows Table 5.7-3 to demonstrate that the total LERF value for IP3 is less than 1.0E-5/yr consistent with the requirements for a "Small Change" in risk of the RG 1.174 acceptance guidelines.

3 Refer to Section 5.7.5 for a more realistic treatment of the external events contributions to LERF.

Table 5.7-3
Comparison to Acceptance Criteria Including External Events Contribution for IP3

Contributor	ΔLERF	ΔPerson-Rem/yr	ΔCCFP
IP3 Internal Events	1.37E-7/yr	0.813/yr (1.00%)	0.92%
IP3 External Events	4.81E-7/yr	2.85/yr (1.00%)	0.92%
Indian Point 3 Total	6.18E-7/yr	3.67/yr (1.00%)	0.92%
Acceptance Criteria	**<1.0E-6/yr**	**<1.0 person-rem/yr or <1.0%**	**<1.5%**

The 6.18E-07/yr increase in LERF due to the combined internal and external events from extending the ILRT frequency from 3-per-10 years to 1-per-16 years falls within Region II between 1.0E-7 to 1.0E-6 per reactor year ("Small Change" in risk) of the RG 1.174 acceptance guidelines. Per RG 1.174, when the calculated increase in LERF due to the proposed plant change is in the "Small Change" range, the risk assessment must also reasonably show that the total LERF is less than 1.0E-5/yr. Similar bounding assumptions regarding the external event contributions that were made above are used for the total LERF estimate.

From Table 4.2-1, the total LERF due to postulated internal event accidents is 1.25E-06/yr. Although some of the LERF contributors may not be applicable to external events initiators, the base LERF distribution due to external events is assumed to be the same as the internal events contribution. The total LERF values are then shown in Table 5.7-4.

Table 5.7-4
Impact of 16-yr ILRT Extension on LERF for IP3

LERF Contributor	IP3 (1/yr)
Internal Events LERF	1.25E-06
External Events LERF	4.38E-06 [Internal Events LERF * 3.51]
Internal Events LERF due to ILRT (at 16 years)[4]	1.68E-07
External Events LERF due to ILRT (at 16 years)	5.91E-07
Total	**6.39E-06/yr**

(1) Including age adjusted steel liner corrosion likelihood as reported in Table 5.7-2.

4 Including age adjusted steel liner corrosion likelihood as reported in Table 5.7-2. The External Events LERF ILRT contribution also accounts for the impacts of corrosion because it is derived using a multiplier on the internal events results.

As can be seen, the estimated upper bound LERF for IP3 it is 6.39E-06/yr. These values are both less than the RG 1.174 requirement to demonstrate that the total LERF due to internal and external events is less than 1.0E-5/yr.

5.7.5 Alternative Approach for External Events Impact on ILRT Extension Assessment

The approach above described in Section 5.7.4 for the external events impact is consistent with that used in the Palisades ILRT extension risk assessment evaluation that was submitted by Entergy [26] and approved by the NRC [27]. As shown, the IP3 results are consistent with the value in the NRC SER for a small increase in population dose, as defined by percent increase in dose (i.e., <1.0% person-rem/yr). However, since the IP3 results rely on that criterion rather than the absolute increase in dose criteria (i.e., < 1.0 person-rem/yr), additional information is provided to further demonstrate that the percent increase in dose criteria is not exceeded.

To do this, a reasonable estimate for the base case dose risk associated with external events must be determined. In this case, each EPRI accident class is re-examined considering the potential contribution for external events. Since the Class 1 frequency is determined based on remaining contribution not assigned to other classes, the discussion appears in reverse order starting with EPRI Class 8 and ending with EPRI Class 1. However, EPRI Class 2 is discussed prior to Class 3 since its value is used in the final determination of the Class 3 frequencies.

<u>Class 8 Sequences</u>

This group represents sequences where containment bypass occurs (SGTR or ISLOCA). ISLOCA and SGTR initiators are deemed inapplicable to the external events assessment so only induced SGTR scenarios need to be considered. From the frequency information provided in Table 4.2-1, the induced SGTR contribution to core damage is 0.39% for IP3. (Note that a weighted average of 0.5% was previously used in the 15 year interval assessment for IP2 and IP3 [8].) A High Early release magnitude dose is assigned.

Class_8 = 0.0039 * [IP3 External Events CDF]

= 0.0039 * [5.20E-05]

= 2.03E-07/yr

<u>Class 7 Sequences</u>

This group represents containment failure induced by early and late severe accident phenomena. From Table 5.1-1, the contribution from the early Class 7 sequences is about 1.3% for IP3. (Note that a weighted average of 1% was previously used in the 15 year interval assessment for IP2 and IP3 [8].). A High Early release magnitude dose is assigned. From Table 5.1-1, the contribution from the late Class 7 sequences is about 15%. However, since the external events contributors are more dominated by unrecoverable SBO-like scenarios, a value of 50% is assumed for the external events contribution. A High Late release magnitude dose is assigned.

Class_7-CFE = 0.013 * [IP3 External Events CDF]

= 0.013 * [5.20E-05]

= 6.76E-07/yr

Class_7-CFL = 0.50 * [IP3 External Events CDF]

= 0.50 * [5.20E-05]

= 2.60E-05/yr

Class 4, 5, and 6 Sequences

Similar to the internal events assessment, because these failures are unaffected by the Type A ILRT, these groups are not evaluated any further in this analysis.

Class 2 Sequences

This group consists of large containment isolation failures. From the frequency information provided in Table 4.2-1, the internal events contribution to this accident class was approximately 0.03% of the CDF. Since seismic and fire initiated events would likely be more susceptible to this failure mode, a contribution of 0.1% is assumed. The population doses are assigned the same as the Class 2 scenarios in the internal events assessment.

Class_2 = 0.001 * [IP3 External Events CDF]

= 0.001 * [5.20E-05]

= 5.20E-08/yr

Class 3 Sequences

Similar to the internal events assessment, the respective frequencies per year are determined as follows:

$PROB_{Class\_3a}$ = probability of small pre-existing containment liner leakage

= 0.0092 (see Section 4.3)

$PROB_{Class\_3b}$ = probability of large pre-existing containment liner leakage

= 0.0023 (see Section 4.3)

As described in Section 4.3, additional consideration is made to not apply these failure probabilities to those cases that are already considered LERF scenarios (i.e., the Class 2, Class 7, and Class 8 LERF contributions). This adjustment is made for based on the frequency information described above for IP3, as shown below.

Class_3a = 0.0092 * [CDF – (Class 2 + Class 7-CFE + Class 8)]

= 0.0092 * [5.20E-05 – (5.20E-08 + 6.76E-07 + 2.03E-07)]

= 4.70E-07/yr

Class_3b = 0.0023 * [CDF – (Class 2 + Class 7-CFE + Class 8)]

= 0.0023 * [5.20E-05 – (5.20E-08 + 6.76E-07 + 2.03E-07)]

= 1.17E-07/yr

For this analysis, the associated containment leakage for Class 3a is 10La and 100La for Class 3b, which is consistent with the latest EPRI methodology [3] and the NRC SE [7].

Class 1 Sequences

Similar to the internal events assessment, the frequency is determined by subtracting all containment failure end states including the EPRI/NEI Class 3a and 3b frequency calculated below, from the total CDF. The internal events intact containment dose of 4.41E+04 person-rem is also utilized.

<u>Summary of Alternative External Events Base Case Dose Assessment</u>

In summary, the accident sequence frequencies that can lead to release of radionuclides to the public have been derived in a manner consistent with the definition of accident classes defined in EPRI 1018243 [3]. These frequencies have been combined with reasonable assumptions regarding the population dose associated with each class to determine the base case population dose risk for external events. This information is provided in Table 5.7-5. Additionally, following the same EPRI methodology utilized for internal events to determine the risk impact assessment of extending the ILRT interval, the external events accident class frequencies indicative of a 16 year ILRT interval are provided in Table 5.7-6.

Table 5.7-7 then shows the changes due to the ILRT extension from 3 year to a 16 year interval in the LERF, person-rem/yr, and CCFP figures of merit. When these values are added to the internal events results, the acceptance criteria are all clearly met by using this detailed alternative external events evaluation instead of the simple evaluation that was utilized in Section 5.7.4. A comparison to the acceptance criteria is also shown in Table 5.7-7. Note that the ΔLERF, person-rem/yr, and change in CCFCP shown in Table 5.7-7 are slightly higher than the corresponding values shown in Table 5.7-3. This is because the simple method in Table 5.7-3 assumes the same distribution of LERF contributors exists between the internal and external events models whereas the alternative assessment re-apportions the base case LERF contributions based on more realistic assumptions while conservatively maintaining the total CDF value. That is, since the contribution from SGTR initiators and ISLOCA initiators (which contribute to the base LERF value) are not applicable to the external events contribution, more of the remaining CDF distribution is potentially affected by the ILRT extension as represented by the Class 3b multiplier on CDF (that is not already LERF). Additionally, the alternative detailed assessment leads to slightly different percent increases in person-rem/yr which are a function of the base case dose estimates.

Table 5.7-5
Population Dose Risk As A Function Of Accident Class
(IP3 Alternative External Events Base Case)[5]

Accident Class (Containment Release Type)	Description	Frequency (1/yr)	Dose (Person-Rem)	Dose Risk (Person-Rem/yr)
1	Containment Intact	2.46E-05	4.41E+04	1.08E+00
2	Large Isolation Failures (Failure to Close)	5.20E-08	5.08E+07	2.64E+00
3a	Small Isolation Failures (liner breach)	4.70E-07	4.41E+05	2.07E-01
3b	Large Isolation Failures (liner breach)	1.17E-07	4.41E+06	5.18E-01
4	Small Isolation Failures (Failure to seal –Type B)	N/A	N/A	N/A
5	Small Isolation Failures (Failure to seal—Type C)	N/A	N/A	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A	N/A	N/A
7-CFE	Failures Induced by Phenomena (Early)	6.76E-07	5.08E+07	3.43E+01
7-CFL	Failures Induced by Phenomena (Late)	2.60E-05	1.63E+07	4.24E+02
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	2.03E-07	5.08E+07	1.03E+01
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	0.00E+00	5.08E+07	0.00E+00
CDF	**All CET End States (Including Intact Case)**	**5.20E-05**		**472.9**
CCFP	**Conditional Containment Failure Probability**	**52.02%**		

5 The results do not include the impacts of corrosion, which are demonstrated to be small in Section 6.1.

Table 5.7-6
Population Dose Risk As A Function Of Accident Class (IP3 Alternative External Events Evaluation Characteristic of Conditions For 1 in 16 Year ILRT Frequency)[6]

Accident Class (Containment Release Type)	Description	Frequency (1/yr)	Dose (Person-Rem)	Dose Risk (Person-Rem/yr)
1	Containment Intact	2.19E-05	4.41E+04	9.68E-01
2	Large Isolation Failures (Failure to Close)	5.20E-08	5.08E+07	2.64E+00
3a	Small Isolation Failures (liner breach)	2.50E-06	4.41E+05	1.10E+00
3b	Large Isolation Failures (liner breach)	6.26E-07	4.41E+06	2.76E+00
4	Small Isolation Failures (Failure to seal –Type B)	N/A	N/A	N/A
5	Small Isolation Failures (Failure to seal—Type C)	N/A	N/A	N/A
6	Other Isolation Failures (e.g., dependent failures)	N/A	N/A	N/A
7-CFE	Failures Induced by Phenomena (Early)	6.76E-07	5.08E+07	3.43E+01
7-CFL	Failures Induced by Phenomena (Late)	2.60E-05	1.63E+07	4.24E+02
8-SGTR	Containment Bypass (Steam Generator Tube Rupture)	2.03E-07	5.08E+07	1.03E+01
8-ISLOCA	Containment Bypass (Interfacing System LOCA)	0.00E+00	5.08E+07	0.00E+00
CDF	**All CET End States (Including Intact Case)**	**5.20E-05**		**475.9**
CCFP	**Conditional Containment Failure Probability**	**52.99%**		

6 The results do not include the impacts of corrosion, which are demonstrated to be small in Section 6.1.

Table 5.7-7
Comparison to Acceptance Criteria Including Alternative External Events Evaluation Contribution for IP3[7]

Contributor	LERF	Person-Rem/yr	CCFP
IP3 Internal Events$_{3\text{-in-}10}$	3.14E-08	81.15	24.03%
IP3 External Events$_{3\text{-in-}10}$	1.17E-07	472.89	52.02%
IP3 Total$_{3\text{-in-}10}$	1.49E-07	554.03	45.80%[8]
IP3 Internal Events$_{1\text{-in-}16}$	1.68E-07	81.96	24.95%
IP3 External Events$_{1\text{-in-}16}$	6.26E-07	475.92	52.99%
IP3 Total$_{1\text{-in-}16}$	7.95E-07	557.88	46.77%
Delta	6.46E-07/yr	3.84/yr (0.69%)	0.97%
Acceptance Criteria	**<1.0E-6/yr**	**<1.0 person-rem/yr or <1.0%**	**<1.5%**

The 6.46E-07/yr increase in LERF due to the combined internal and external events from extending the ILRT frequency from 3-per-10 years to 1-per-16 years falls within Region II between 1.0E-7 to 1.0E-6 per reactor year ("Small Change" in risk) of the RG 1.174 acceptance guidelines. Per RG 1.174, when the calculated increase in LERF due to the proposed plant change is in the "Small Change" range, the risk assessment must also reasonably show that the total LERF is less than 1.0E-5/yr.

While the absolute change in dose risk of 3.84 person-rem/yr remains larger than the <1.0 person-rem/yr criterion when the alternative external events assessment approach is used, the alternative criterion of a change that is less than 1.0% of the total dose is clearly met. The change in CCFP remains well below the 1.5% limit.

From Table 4.2-1, the total LERF due to postulated internal event accidents is 1.25E-06/yr for IP3. From Table 5.7-5, the base external events LERF can be derived from the Class 2, Class 3b, Class 7-CFE, and Class 8 contributions. From the individual contributions of 5.20E-08/yr + 1.17E-07/yr + 6.76E-07/yr + 2.03E-07/yr, this equates to 1.05E-06/yr. The increase in LERF due to the change in the ILRT frequency to 1-in-16 years is 1.68E-07/yr (from Table 5.7-7) for internal events and 5.09E-7/yr for external events (6.26E-07 – 1.17E-07/yr). Note that the 1.68E-07 ILRT LERF contribution for internal events is added directly to the LERF total because the baseline internal events LERF does not include a contribution from ILRT whereas the Externa Events baseline LERF does, which requires the addition of the ΔLERF from ILRT rather than the 1-in-16 year value. The total LERF value using the alternative external events evaluation is then shown in Table 5.7-8.

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7 The external events results do not include the impacts of corrosion, which are demonstrated to be small in Section 6.1.

8 The total CCFP (accounting for internal and external events) is a frequency weighted result calculated using a baseline internal events CDF of 1.48E-05 and a baseline external events CDF of 5.20E-05. As with other entries in the table, the results calculated by the supporting Excel file differ slightly from what would be manually calculated using the results reported in the table due to rounding differences.

Table 5.7-8
Impact of 16-yr ILRT Extension on LERF for IP3

LERF Contributor	IP3 (1/yr)
Internal Events LERF	1.25E-06
External Events LERF	1.05E-06
Internal Events LERF due to ILRT (at 16 years)[9]	1.68E-07
External Events LERF increase due to ILRT extension[10]	5.09E-07
Total	**2.98E-06/yr**

5.8 Containment Overpressure Impacts on CDF

For IP3, ECCS NPSH calculations made in support of the GSI-191 effort [28, 29] confirmed that containment overpressure is not required to obtain adequate NPSH [30]. This is consistent with the PRA models which indicate there is no impact on CDF from the ILRT extension risk assessment.

In IP-CALC-07-00054 [29], the NPSHA / NPSHR relationship for IP3 ECCS pumps was being evaluated. For conservatism in obtaining the NPSHA and NPSHR, the maximum volumetric flow rate was used. The greatest volumetric flow rate occurs when the least dense fluid is being pumped. This is at the highest temperature in the recirculation phase of the accident. For IP3, this temperature was 242.8 F which occurs at start of recirculation. The saturation pressure at 242.8 F is close to 26.1 psia, which is the boundary condition pressure input in the calculation. The implication is that essentially no containment overpressure is being invoked since 242.8 F and 26.1 psia is basically equivalent to 212 F and 14.7 psia (0 psig).

9 Including age adjusted steel liner corrosion likelihood as reported in Table 5.7-2.

10 As shown in Table 5.7-7. This did not include the impacts of age adjusted steel liner corrosion likelihood, which are demonstrated to be small in Section 6.1.

6.0 SENSITIVITIES

6.1 Sensitivity to Corrosion Impact Assumptions

The results in Tables 5.2-2, 5.3-1, and 5.3-2 show that including corrosion effects calculated using the assumptions described in Section 4.4 does not significantly affect the results of the ILRT extension risk assessment. In any event, sensitivity cases were developed to gain an understanding of the sensitivity of the results to the key parameters in the corrosion risk analysis. The time for the flaw likelihood to double was adjusted from every five years to every two and every ten years. The failure probabilities for the cylinder, dome and basemat were increased and decreased by an order of magnitude. The total detection failure likelihood was adjusted from 10% to 15% and 5%. The results are presented in Table 6.1-1. In every case, the impact from including the corrosion effects is very minimal. Even the upper bound estimates with very conservative assumptions for all of the key parameters yield increases in LERF due to corrosion of only 6.80E-08/yr. The results indicate that even with very conservative assumptions, the conclusions from the base analysis would not change.

Table 6.1-1
Steel Liner Corrosion Sensitivity Cases for IP3

Age (Step 3 in the corrosion analysis)	Containment Breach (Step 4 in the corrosion analysis)	Visual Inspection & Non-Visual Flaws (Step 5 in the corrosion analysis)	Increase in Class 3b Frequency (LERF) for ILRT Extension From 3 in 10 to 1 in 16 years (per Year)	
			Total Increase	**Increase Due to Corrosion**
Base Case Doubles every 5 yrs	Base Case (1.0% Cylinder-Dome, 0.1% Basemat)	Base Case (10% Cylinder-Dome, 100% Basemat)	1.37E-07	1.80E-09
Doubles every 2 yrs	Base	Base	1.40E-07	4.79E-09
Doubles every 10 yrs	Base	Base	1.37E-07	1.40E-09
Base	Base	15% Cylinder-Dome	1.38E-07	2.52E-09
Base	Base	5% Cylinder-Dome	1.36E-07	1.08E-09
Base	10% Cylinder-Dome, 1% Basemat	Base	1.53E-07	1.80E-08
Base	0.1% Cylinder-Dome, 0.01% Basemat	Base	1.35E-07	1.80E-10
Lower Bound				
Doubles every 10 yrs	0.1% Cylinder-Dome, 0.01% Basemat	5% Cylinder-Dome, 100% Basemat	1.35E-07	8.42E-11
Upper Bound				
Doubles every 2 yrs	10% Cylinder-Dome, 1% Basemat	15% Cylinder-Dome, 100% Basemat	2.02E-07	6.71E-08

6.2 EPRI Expert Elicitation Sensitivity

An expert elicitation was performed to reduce excess conservatisms in the data associated with the probability of undetected leaks within containment [3]. Since the risk impact assessment of the extensions to the ILRT interval is sensitive to both the probability of the leakage as well as the magnitude, it was decided to perform the expert elicitation in a manner to solicit the probability of leakage as a function of leakage magnitude. In addition, the elicitation was performed for a range of failure modes which allowed experts to account for the range of failure mechanisms, the potential for undiscovered mechanisms, inaccessible areas of the containment as well as the potential for detection by alternate means. 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 basic difference in the application of the ILRT interval methodology using the expert elicitation is a change in the probability of pre-existing leakage within containment. The base case methodology uses the Jeffrey's non-informative prior for the large leak size and the expert elicitation sensitivity study uses the results from 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 base case methodology (i.e., 10La for small and 100La for large) are used here. Table 6.2-1 illustrates the magnitudes and probabilities of a pre-existing leak in containment associated with the base case and the expert elicitation statistical treatments. These values are used in the ILRT interval extension for the base methodology and in this sensitivity case. Details of the expert elicitation process, including the input to expert elicitation as well as the results of the expert elicitation, are available in the various appendices of EPRI 1018243 [3].

Table 6.2-1
EPRI Expert Elicitation Results

Leakage Size (La)	base case mean Probability of occurrence	Expert Elicitation Mean Probability of Occurrence [3]	Percent Reduction
10	9.2E-03	3.88E-03	58%
100	2.3E-03	2.47E-04	89%

The summary of results using the expert elicitation values for probability of containment leakage is provided in Table 6.2-2. As mentioned previously, probability values are those associated with the magnitude of the leakage used in the base case evaluation (10La for small and 100La for large). The expert elicitation process produces a relationship between probability and leakage magnitude in which it is possible to assess higher leakage magnitudes that are more reflective of large early releases; however, these evaluations are not performed in this particular study.

The net effect is that the reduction in the multipliers shown above also leads to a dramatic reduction on the calculated increases in the LERF values. As shown in Table 6.2-2, the increase in the overall value for LERF due to Class 3b sequences that is due to increasing the ILRT test interval from 3 to 16 years is just 1.45E-08/yr. Similarly, the increase due to increasing the interval from 10 to 16 years is just 6.70E-09/yr. As such, if the expert elicitation probabilities of occurrence are used instead of the non-informative prior estimates, the change

in LERF for IP3 is within the range of a "very small" change in risk when compared to the current 1-in-10, or baseline 3-in-10 year requirement. Additionally, as shown in Table 6.2-2, the increase in dose rate and CCFP are similarly reduced to much smaller values. The results of this sensitivity study are judged to be more indicative of the actual risk associated with the ILRT extension than the results from the assessment as dictated by the values from the EPRI methodology [3], and yet are still conservative given the assumption that all of the Class 3b contribution is considered to be LERF.

Table 6.2-2
IP3 ILRT Cases:
3 in 10 (Base Case), 1 in 10, and 1 in 16 Yr intervals
(Based on EPRI Expert Elicitation Leakage Probabilities)

EPRI Class		DOSE Per-Rem	Base Case 3 in 10 Years		Extend to 1 in 10 Years		Extend to 1 in 16 Years	
			CDF (1/yr)	Person-Rem/yr	CDF (1/yr)	Person-Rem/yr	CDF (1/yr)	Person-Rem/yr
1		4.41E+04	1.12E-05	4.96E-01	1.11E-05	4.90E-01	1.10E-05	4.85E-01
2		5.08E+07	3.99E-09	2.03E-01	3.99E-09	2.03E-01	3.99E-09	2.03E-01
3a		4.41E+05	5.27E-08	2.32E-02	1.76E-07	7.74E-02	2.81E-07	1.24E-01
3b		4.41E+06	3.36E-09	1.48E-02	1.12E-08	4.93E-02	1.79E-08	7.89E-02
7-CFE		3.17E+07	1.88E-07	5.97E+00	1.88E-07	5.97E+00	1.88E-07	5.97E+00
7-CFL		6.85E+06	2.17E-06	1.49E+01	2.17E-06	1.49E+01	2.17E-06	1.49E+01
8-SGTR		5.08E+07	9.77E-07	4.96E+01	9.77E-07	4.96E+01	9.77E-07	4.96E+01
8-ISLOCA		5.08E+07	1.93E-07	9.80E+00	1.93E-07	9.80E+00	1.93E-07	9.80E+00
Total			**1.48E-05**	**8.099E+01**	**1.48E-05**	**8.108E+01**	**1.48E-05**	**8.115E+01**
ILRT Dose Rate from 3a and 3b			3.81E-02		1.27E-01		2.03E-01	
Delta Total Dose Rate(1)	From 3 yr		---		8.29E-02		1.54E-01	
	From 10 yr		---		---		7.12E-02	
3b Frequency (LERF)			3.36E-09		1.12E-08		1.79E-08	
Delta 3b LERF	From 3 yr		---		7.84E-09		1.45E-08	
	From 10 yr		---		---		6.70E-09	
CCFP %			23.84%		23.89%		23.93%	
Delta CCFP %	From 3 yr		---		0.05%		0.10%	
	From 10 yr		---		---		0.04%	

The overall difference in total dose rate is less than the difference of only the 3a and 3b categories between two testing intervals. This is due to the fact that the Class 1 person-rem/yr decreases when extending the ILRT frequency.

7.0 CONCLUSIONS

Based on the results from Section 5 and the sensitivity calculations presented in Section 6, the following conclusions regarding the assessment of the plant risk are associated with a one-time extension of the Type A ILRT test frequency to sixteen years:

- Reg. Guide 1.174 [4] 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 CDF below 1.0E-06/yr and increases in LERF below 1.0E-07/yr. "Small" changes in risk are defined as increases in CDF below 1.0E-05/yr and increases in LERF below 1.0E-06/yr. Since the ILRT extension was demonstrated to have no impact on CDF for IP3, the relevant criterion is LERF. The increase in internal events LERF resulting from a change in the Type A ILRT test interval for the base case with corrosion included for IP3 is 1.37E-07/yr (see Table 5.6-1), which is within the small change region of the acceptance guidelines in Reg. Guide 1.174. In using the EPRI Expert Elicitation methodology, the change is estimated as 1.45E-08/yr (see Table 6.2-2), which is within the very small change region of the acceptance guidelines in Reg. Guide 1.174.
- The change in dose risk for changing the Type A test frequency from three-per-ten years to once-per-sixteen-years, measured as an increase to the total integrated dose risk for all internal events accident, it is 0.813 person-rem/yr (1.00%) using the EPRI guidance with the base case corrosion case (Table 5.6-1). The change in dose risk drops to 1.54E-01 person-rem/yr when using the EPRI Expert Elicitation methodology (Table 6.2-2). The values calculated per the EPRI guidance are lower than the acceptance criteria of ≤1.0 person-rem/yr or <1.0% person-rem/yr defined in Section 1.3.
- The increase in the conditional containment failure frequency from the three in ten year interval to one in sixteen years including corrosion effects using the EPRI guidance (see Section 5.5) is 0.92% for IP3. This value drops to 0.10% using the EPRI Expert Elicitation methodology (see Table 6.2-2). This is below the acceptance criteria of less than 1.5% defined in Section 1.3.
- To determine the potential impact from external events, a bounding assessment from the risk associated with external events utilizing information from the IP3 IPEEE similar to the approach used in the License Renewal SAMA analysis was performed. As shown in Table 5.7-2, the total increase in LERF due to internal events and the bounding external events assessment is 6.18E-07/yr. This value is in Region II of the Reg. Guide 1.174 acceptance guidelines.
- As shown in Table 5.7-4, the same bounding analysis indicates that the total LERF from both internal and external risks is 6.39E-06/yr for IP3, which is less than the Reg. Guide 1.174 limit of 1.0E-05/yr given that the ΔLERF is in Region II (small change in risk).
- Finally, since the external events assessment led to a challenge of the dose risk acceptance criteria (i.e. greater than 1.0 person-rem/yr and equal to a 1.00% change in the total dose risk), an alternative detailed bounding external events assessment was also performed to demonstrate that the acceptance criterion requiring the change in dose risk to be less than 1.00% of the total dose risk could be met. In this case, as shown in Table 5.7-7, the total change in LERF

from both internal and external events was 6.46E-7/yr, the change in person-rem/yr was 3.84/yr representing 0.69% of the total, and the change in the CCFP was 0.97%. All of these calculated changes meet the acceptance criteria. As shown in Table 5.7-8, this assessment indicates that the total LERF from both internal and external risks is 2.98E-06/yr, which is less than the Reg. Guide 1.174 limit of 1.0E-05/yr given that the ΔLERF is in Region II (small change in risk).

- Including age-adjusted steel liner corrosion effects in the ILRT assessment was demonstrated to be a small contributor to the impact of extending the ILRT interval for IP3.
- The risk assessment for the one-time extension to 16 years was performed measuring the delta risk compared to the original 3-in-10 year ILRT test interval. The acceptance criteria were demonstrated to be met with high confidence such that the cumulative impact of the proposed change is also acceptable. The actual delta-risk compared to the currently approved 1-in-15 year test interval is minimal and would fall in Region III of the RG 1.174 acceptance guidelines for "very small" changes in risk.

Therefore, allowing a one-time increase of the ILRT interval to a one-in-sixteen year frequency is not considered to be significant since it represents only a small change in the IP3 risk profile.

<u>Previous Assessments</u>

The NRC in NUREG-1493 [6] has previously concluded the following:

- Reducing the frequency of Type A tests (ILRTs) from three per 10 years to one per 20 years was found to lead to an imperceptible increase in risk. The estimated increase in risk is very small because ILRTs identify only a few potential containment leakage paths that cannot be identified by Type B and C testing, and the leaks that have been found by Type A tests have been only marginally above existing requirements.
- Given the insensitivity of risk to containment leakage rate and the small fraction of leakage paths detected solely by Type A testing, increasing the interval between integrated leakage-rate tests is possible with minimal impact on public risk. The impact of relaxing the ILRT frequency beyond one in 20 years has not been evaluated. Beyond testing the performance of containment penetrations, ILRTs also test the integrity of the containment structure.

The findings for IP3 confirm these general findings on a plant specific basis considering the severe accidents evaluated, the containment failure modes, and the local population surrounding IP3.

8.0 REFERENCES

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