PSEG Nuclear LLC
P.O. Box 236, Hancocks Bridge, New Jersey 08038-0236

PSEG
Nuclear LLC

MAR 2 2 2002

LR-N02-0106
LCR-S02-01

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

REQUEST FOR CHANGE TO TECHNICAL SPECIFICATIONS REQUIREMENTS
SUPPLEMENTAL REQUEST
ONE-TIME EXTENSION TO INCREASE THE INTERVAL OF THE INTEGRATED LEAK RATE TEST FROM TEN TO FIFTEEN YEARS
SALEM GENERATING STATION, UNIT 2
FACILITY OPERATING LICENSE DPR-75
DOCKET NO. 50-311

By letters dated January 17, 2002, and March 8, 2002 PSEG Nuclear LLC submitted a one-time request for a revision to the Technical Specifications (TS) to increase the interval of the integrated leak rate test from ten to fifteen years for Salem Unit 2. The Nuclear Regulatory Commission's Salem Project Manager, Mr. Robert Fretz, requested additional information during a telephone conference on March 19, 2002. This required calculation S-C-ZZ-MEE-1613, "Salem Generating Station 2 ILRT Extension" to be revised. In accordance with 10CFR50.91(b)(1), a copy of this submittal has been sent to the State of New Jersey.

Calculation S-C-ZZ-MEE-1613, "Salem Generating Station 2 ILRT Extension" has been revised to include changes in the following two areas:

1. In our original analysis, a factor of 0.5 was assumed for effectiveness of the IWE inspection program. Based on a more refined analysis, a factor of 0.34 is used which assumes that the IWE inspection in accessible areas is as effective as the Type A ILRT if proper inspection frequency is maintained.

2. The Class 3a and 3b frequency is related with the part of CDF that can be impacted by an ILRT.

A017

These changes cascade through the calculation requiring revision. Revision 1 to Calculation S-C-ZZ-MEE-1613, "Salem Generating Station 2 ILRT Extension" is provided in Attachment 1. Table 1 to this letter shows the results of these changes. The delta LERF, CCFP and delta population dose are insignificant. This is considered to be very small change in risk as defined in Regulatory Guide 1.174 and other applicable criteria.

Should you have any questions regarding this request, please contact Mr. Michael Mosier at 856-339-5434.

Sincerely,

Gabor Salamon
Nuclear Safety and Licensing Manager

Attachment

Table 1

Summary of Risk Impact on Extending Type A ILRT Test Frequency

	Risk Impact for 3-year interval (baseline)	Risk Impact for 10-year interval (current requirement)	Risk Impact for 15-year interval (proposed)
Total Integrated Risk (Person-Rem/yr)	37.50	37.56	37.60
Type A Testing Risk (Person-Rem/yr)	0.0286	0.0953	0.143
% Total Risk (Type A / Total)	0.076%	0.25%	0.38%
Type A LERF (Class 3b) (per year)	6.35E-08	7.19E-08	1.08E-07
Changes due to extension from 10 years (current)			
Δ Risk from current (Person-rem/yr)			0.04
% Increase from current (Δ Risk / Total Risk)			0.12%
Δ LERF from current (per year)			3.60E-08
Δ CCFP from current			0.17%
Changes due to extension from 3 years (baseline)			
Δ Risk from baseline (Person-rem/yr)			0.10
% Increase from baseline (Δ Risk / Total Risk)			0.28%
Δ LERF from baseline (per year)			4.44E-08
Δ CCFP from baseline			0.40%

I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 22, 2002

Gabor Salamon
Nuclear Safety and Licensing Manager

MAR 2 2 2002

C: Mr. H. Miller, Administrator – Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. R. Fretz, Project Manager - Salem
U. S. Nuclear Regulatory Commission
Mail Stop 8B2
Washington, DC 20555

USNRC Senior Resident Inspector (X24)

Mr. K. Tosch, Manager IV
Bureau of Nuclear Engineering
PO Box 415
Trenton, New Jersey 08625

SALEM GENERATING STATION-UNIT 2
FACILITY OPERATING LICENSE
DOCKET NO. 50-311

Calculation S-C-ZZ-MEE-1613 Rev. 1
Salem Generating Station 2 ILRT Extension

CALC NO.: S-C-ZZ-MEE-1613 **REVISION: 1**			**CALCULATION COVER SHEET**			**Page 0 of 25**	
CALC. TITLE:	PRA Analysis of Salem Generation Station ILRT EXtension						
# SHTS (CALC):	26	**# ATT / # SHTS:**		**# IDV/50.59 SHTS:**	14	**# TOTAL SHTS:**	40

CHECK ONE:

x☐ FINAL ☐ INTERIM (Proposed Plant Change) ☐ FINAL (Future Confirmation Req'd) ☐ VOID

SALEM OR HOPE CREEK: S☐ Q – LIST ☐ IMPORTANT TO SAFETY x☐ NON-SAFETY RELATED

HOPE CREEK ONLY: ☐Q ☐Qs ☐Qsh ☐F ☐R

☐ STATION PROCEDURES IMPACTED, IF SO CONTACT SYSTEM MANAGER
☐ CDs INCORPORATED (IF ANY): ______

DESCRIPTION OF CALCULATION REVISION (IF APPL.):

N/A

PURPOSE:

The purpose of this calculation is to estimate the risk associated with extending the Type A Integrated Leak Rate Test (ILRT) interval from the current 10 years required by 10 CFR 50, Appendix J [1] at Salem Generating Station (SGS) to 15 years.

CONCLUSIONS: The change in Type A test frequency from once every ten years to once every fifteen years increases the risk impact on the total integrated plant risk by only 0.12%. Also, the change in Type A test frequency from the original every three years to once every fifteen years increases the risk only 0.28%. Therefore, the risk impact when compared to other severe accident risks is negligible. Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of CDF below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test frequency from the current once every 10 years to once every 15 years is 3.60E-8/yr. Since guidance in Reg. Guide 1.174 defines very small changes in LERF as below 10^{-7}/yr, increasing the ILRT interval from 10 to 15 years is therefore considered non-risk significant. The LERF increase is 4.44E-8 for the cumulative change of going from a test frequency of three every ten years to once every fifteen years, which is still non-risk significant. R.G. 1.174 also encourages the use of risk analysis techniques to help ensure and show that the proposed change is consistent with the defense-in-depth philosophy. Consistency with defense-in-depth philosophy is maintained by demonstrating that the balance is preserved among prevention of core damage, prevention of containment failure, and consequence mitigation. The change in conditional containment failure probability was estimated to be 0.17% for the proposed change and 0.40% for the cumulative change of going from a test frequency of three every ten years to once every fifteen years. These changes are small and that the defense-in-depth philosophy is maintained.

	Printed Name / Signature	**Date**
ORIGINATOR/COMPANY NAME:	Wei He [signature]	03/21/02
~~**PEER REVIEWER**~~**/COMPANY NAME:** VERIFIER	Thomas K. Carrier T. K. Carrier	3/22/02
~~**VERIFIER/COMPANY NAME:**~~ PSEG MANAGER APPROVAL	[signature]	3/22/02
~~**PSEG SUPERVISOR APPROVAL:**~~		

FORM 2
Page 2 of 2 (Page 1 contains the instructions)
CALCULATION CONTINUATION SHEET

	CALCULATION CONTINUATION SHEET	SHEET: 1 of 25
CALC. NO.: S-C-ZZ-MEE-1613	REFERENCE:	
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1	
REVIEWER/VERIFIER, DATE		Tom Carrier

PAGE	SECTION	REVISION
0	COVER SHEET	1
1	LIST OF EFFECTIVE PAGES	1
2	TABLE OF CONTENTS	1
3	REVISION 1 SUMMARY	1
4	1.0	1
4	2.0	1
5	3.0	1
6	4.0	1
6	5.0	1
23	6.0	1

	CALCULATION CONTINUATION SHEET	SHEET: 2 of 25
CALC. NO.: S-C-ZZ-MEE-1613		REFERENCE:
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1	
REVIEWER/VERIFIER, DATE		Tom Carrier

TABLE OF CONTENTS

CALCULATION NO. S-C-ZZ-MEE-1613 REV. 1

	CALCULATION CONTINUATION SHEET			SHEET: 3 of 25		
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

Revision 1 Summary:

There are two major changes that impact essentially all calculations (due to cascading effect). Therefore, no revision bar is employed in this revision.

The first change is the discussion on CDF composition. In revision 0, the discussion was carried out in the section (step 7 of the calculation section) discussing LERF. It was stated that some core damage sequences wouldn't impact LERF. For instance, these sequences could be LERF due to other type of pathways. To be consistent, this discussion is carried out at the beginning of the calculation. More specifically, the discussion is carried out when frequencies of Class 3a and 3b are discussed. This impacts both population dose calculation and the containment failure calculation. The population dose calculation is cascaded from Table 7 to the end.

The second change is to give the IWE full credit in the accessible area. In revision 0, it was stated that the credit was rounded to 0.5 to be on the conservative side. In this revision, the credit is equivalent to the containment area accessible to IWE. For Salem, the area is 0.66 thus the credit is 0.34 for this revision. This change impacts LERF values for 10-year and 15-year interval and the delta LERF.

	CALCULATION CONTINUATION SHEET			SHEET: 4 of 25		
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

1.0 PURPOSE/SCOPE

The purpose of this calculation is to demonstrate that the risk is negligible by extending the Type A Integrated Leak Rate Test (ILRT) interval from the current 10 years required by 10 CFR 50, Appendix J [1] at Salem Generating Station (SGS) unit 2 to 15 years. The risk in this analysis is defined in terms of population dose (person-rem) per reactor year, large early release (LERF) and conditional containment failure probability (CCFP). Consequently, the impact of Type A extension is evaluated against the person-rem, LERF and CCFP. The results will be used to support a plant license amendment (PLA).

This calculation evaluates the risk associated with various ILRT intervals as follows. The focus is the risk changes from the current 10 years to the proposed 15 years.

- 3 years - interval based on the original requirements of 3 tests per 10 years
- 10 years – current test interval required for SGS
- 15 years – interval extension approved for Indian Point 3, Crystall River, etc. and proposed for SGS

2.0 REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors".
2. Florida Power, 3F0601-06, "Crystal River – Unit 3 – License Amendment Request #267, Revision 2, Supplemental Risk-Informed Information in Support of License Amendment Request #267," June 20, 2001.
3. Entergy, IPN-01-007, Indian Point 3 Nuclear Power Plant, "Supplemental Information Regarding Proposed Change to Section 6.14 of the Administrative Section of the Technical Specification", January 18, 2001.
4. United States Nuclear Regulatory Commission, Indian Point Nuclear Generating Unit No.3 – Issuance of Amendment Re: Frequency of Performance-Based Leakage Rate Testing (TAC NO. MBO178), April 17, 2001.
5. NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J", July 26, 1995, Revision 0
6. EPRI TR-104285, "Risk Assessment of Revised Containment Leak Rate Testing Intervals" August 1994.
7. NUREG-1493, "Performance-Based Containment Leak-Test Program", July 1995.
8. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis" July 1998.
9. Salem Units 1 and 2 Probabilistic Risk Assessment Individual Plant Examination Submittal, Revision 0, July, 1993.
10. Scientech 17087-001, "Salem MACCS2 Model and Level 3 Application," 12/2001.
11. EPRI Interim Guidance, Rev. 4, November, 2001.

	CALCULATION CONTINUATION SHEET				SHEET: 5 of 25	
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE				Tom Carrier		

12. 1998 Edition of Subsection IWE, "Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Power Plants," of Section XI, Division 1, of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code).
13. NEI Memo to the USNRC, 'One-time extensions of containment integrated leak rate test interval – additional information.' November 30, 2001.

3.0 METHODOLOGY

The evaluation for SGS is consistent with similar assessments performed for Crystal River 3 (CR3) [2], Indian Point 3 (IP3) [3] with enhancement outlined in the EPRI Interim Guidance [11]. The IP3 [4] and CR3 submittals were recently approved by the NRC. These assessments utilize the guidelines set forth in NEI 94-01 [5], the methodology used in EPRI TR-104285 [6] and NUREG-1493 [7] and the regulatory guidance on the use of Probabilistic Safety Assessment (PSA) findings in support of a licensee request to a plant's licensing basis, RG 1.174 [8]. The calculation applies the SGS IPE release categories and the Level 3 PRA person-rem estimates to estimate the changes in risk due to increasing the ILRT test interval. This information is obtained from the SGS IPE [9] and a Level 3 PRA study [10] performed by SCIENTECH for SGS.

In addition to references mentioned above, improvements suggested in the references [11] and [13] are implemented in this evaluation. The previous methodology for LERF (Class 3b frequency) calculation 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, core damage sequences include individual sequences that either may already (independently) cause a LERF or could never cause a LERF[1], and are thus not associated with a postulated large Type A containment leakage path (LERF). These contributors should be removed from Class 3b release evaluation by multiplying the Class 3b probability by only that portion of CDF that may be impacted by type A leakage.

Frequency 3b=(3b Failure probability)*(CDF minus CDF with independent LERF minus CDF that cannot cause LERF)

Salem has in place additional programs to provide for defense in depth relative to containment failure, including IWE/IWL and maintenance inspections of the containment. Experiences suggested that the visual inspection will detect concrete and liner failures. (More technical discussions are carried out in LERF section.) It should be noted that the calculations are carried out using the MS Excel Spreadsheet. The round offs are carried through. Hand calculation of a single equation may yield a slightly different value. The basic analysis steps are listed below:

1. Calculate the Level 3 release category population doses.
2. Map the Level 3 release categories into the 8 release classes defined by the EPRI report.

[1] This point is noted in CR3 and IP2 application. The CR3 evaluation assumption number 7 states that "The containment releases for Classes 2, 6, 7, and 8 are not impacted by the ILRT Type A test frequency. These classes already include containment failure with release consequences equal or greater than those impacted by Type A."

	CALCULATION CONTINUATION SHEET				SHEET: 6 of 25
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:		
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1				
REVIEWER/VERIFIER, DATE			Tom Carrier		

3. Calculate the Type A leakage estimate to define the analysis baseline.
4. Calculate the Type A leakage to address the current inspection frequency.
5. Calculate the Type A leakage estimates to address extension of the Type A test interval.
6. Calculate the change in population dose due to extending Type A inspection intervals.
7. Calculate the change in LERF due to extending Type A inspection intervals.
8. Calculate the change in CCFP due to extending Type A inspection intervals.

4.0 ASSUMPTIONS/BASES

1. The maximum containment leakage for Class 1 sequences is estimated using the level 3 PRA results and is defined as 1 La unit for this analysis.
2. The maximum containment leakage for Class 3a sequences is 10 times the class 1 sequences the previously approved methodology [2,3].
3. The maximum containment leakage for Class 3b sequences is 35 times the class 1 sequences based on references [2,3].
4. Containment leakage due to Classes 4 and 5 are considered negligible based on references [2,3].
5. The containment releases are not impacted with time.
6. The containment releases for Classes 2, 6, 7, and 8 are not impacted by the ILRT Type A test frequency. These classes already include containment failure with release consequences equal or greater than those impacted by Type A.
7. Because Class 8 sequences are containment bypass sequences, potential releases are directly to the environment. Therefore, the containment structure will not impact the release magnitude.
8. The IPE results will be used for following two reasons. First, the level 1 model is under revision and to incorporate comments from WOG certification. Second, the level 2 PRA for IPE is extensive and has enough information to support the calculation. The IPE CDF value is 6.27E-5/year.

5.0 CALCULATION

The current SGS PRA is a non-safety-related tool and is intended to provide "best-estimate" results which can be used as input when making risk-informed decisions. The SGS IPE [9] is an earlier version of the PRA submitted to NRC in response to Generic Letter 88-20. The current PRA is under revision. Neither the PRA nor the IPE is considered as design basis information. Other inputs to this calculation include ILRT test data from NUREG-1493 [7], EPRI Interim Guideline [11] and the EPRI report [6], and are referenced in the body of the calculation.

	CALCULATION CONTINUATION SHEET	SHEET: 7 of 25				
CALC. NO.: S-C-ZZ-MEE-1613		REFERENCE:				
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

Step 1 - Calculate the Level 3 release category population dose frequencies.

Table 1 provides release categories with descriptions and person-rem for each category. The release category and its description come from the information documented in the SGS IPE [9]. The person-rem comes from a Salem specific Level 3 PSA study [11]. The Level 3 study used the MACCS2 computer code to develop person-rem dose results. The study also used site-specific inputs for meteorological and population data.

Table 1 Level 3 PRA Person-Rem Estimates By Release Category [10]

Release Category ID	Description	Person-Rem
NOMLTNR[2]	No core melt, or release	3.34E03
NOSTFL	No containment structural failure, no release	3.34E03
LGLTDI	Large, late containment failure with direct release	1.22E06
LGLTSS	Large, late containment failure with subsoil release	1.96E05
SMLATE	Small, controlled late containment failure	4.00E05
LGERDI	Large, early containment failure with direct release	3.46E06
LGERSS	Large, early containment failure with subsoil release	1.20E06
SGTRVO	SGTR with unlimited release (stuck open SG valve)	4.23E06
VSMUS	V-sequence with small, unscrubbed release	0[3]
VSMSC	V-sequence with small, scrubbed (fire spray) release	0[4]
BMMT	Very late containment basemat melt through	0[5]
VLGUS	V-sequence with large, unscrubbed release	3.75E06
VLGCS	V-sequence with large, scrubbed release	2.50E06
SMERLY	Small, controlled early containment failure	4.84E06
SGTRVC	SGTR with small release (SG valves close)	0[6]

[2] No population dose was calculated for this category. The population dose was conservatively assumed to be the same as the NOSTFL category.
[3] Very low frequency and the release has been conservatively added to the large release category VLGUS.
[4] Very low frequency and the release has been conservatively added to the large release category VLGCS.
[5] The basemat melt through category is traditionally not assessed for population dose. In addition, the frequency of the category is low (9.06E-8/year).

	CALCULATION CONTINUATION SHEET	SHEET: 8 of 25				
CALC. NO.: S-C-ZZ-MEE-1613		REFERENCE:				
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE		Tom Carrier				

For comparison, the IP3 analysis [3] assumed that the doses were a function of the DBA LOCA leakage (La) using the following factors listed in Table 2.

Table 2 Indian Point Assumed Dose Factors [3][7]

Class	Dose Factor
1	1 La
2	35 La
3a	10 La
3b	35 La
4	0
5	0
6	35 La
7	100 La

To be able to derivē the population dose, the frequency of the release category is needed and is summarized in table 3 below. The information is in SGS IPE, Table 4.10-6.

Table 3 Release Category Frequencies Based on IPE Results

Release Category	Frequency
NOMLTNR	1.42E-5
NOSTFL	1.52E-5
LGLTDI	1.48E-5
LGLTSS	8.33E-6
SMLATE	4.41E-6
LGERDI	3.70E-6

[6] Very low frequency and the release has been conservatively added to the large release category SGTRVO.
[7] In cases that the level 3 does not provide the release dose for a category, this table will be used.

	CALCULATION CONTINUATION SHEET				SHEET: 9 of 25		
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:				
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1						
REVIEWER/VERIFIER, DATE				Tom Carrier			

LGERSS	1.13E-6
SGTRVO	2.00E-7
VLGUS	1.01E-7
VLGSC	1.01E-7
SMERLY	6.13E-8
VSMUS	1.80E-7
VSMSC	1.80E-7
BMMT	9.06E-8
SGTRVC	4.56E-8
Total	**6.27E-5**

By combining the above tables 1 and 3, the population dose can be derived for each release category.

Step 2: Map IPE release categories into the 8 release classes defined by the EPRI Report [6]

EPRI Report TR-104285 defines eight (8) release classes as follows:

Table 4 EPRI Containment Failure Classifications

Class 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 La, under Appendix J for that plant. The allowable leakage rates (La), are typically 0.1 weight percent of containment volume per day for PWRs and 0.5 weight percent per day for BWRs (all measured at Pac, calculated peak containment pressure related to the design basis accident). Changes to leak rate testing frequencies do not affect this classification.
Class 2	Containment isolation failures (as reported in the IPEs) include those accidents in which the pre-existing leakage is due to failure to isolate the containment. These include those that are dependent on the core damage accident in progress (e.g., initiated by common cause failure or support system failure of power) and random failures to close a containment path. Changes in Appendix J testing requirements do not impact these accidents.
Class 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. This accident class is applicable to sequences involving ILRTs (Type A tests) and potential failures not detectable by LLRTs.

	CALCULATION CONTINUATION SHEET				SHEET: 10 of 25	
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

Class 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.
Class 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.
Class 6	Containment isolation failures include those leak paths not identified by the LLRTs. The type of penetration failures considered under this class includes those covered in the plant test and maintenance requirements or verified per in service inspection and testing (ISI/IST) program. This failure to isolate is not typically identified in LLRT. Changes in Appendix J LLRT test intervals do not impact this class of accidents.
Class 7	Accidents involving containment failure induced by severe accident phenomena. Changes in Appendix J testing requirements do not impact these accidents.
Class 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 typically impact these accidents, particularly for PWRs.

Table 5 presents the SGS release category mapping for these eight accident classes. Person-Rem per year is the product of the frequency and the Person-Rem.

Table 5 EPRI Classification of SGS Release Category Data

Category	Frequency/yr	Person-Rem	Person-Rem/Yr	EPRI Class
NOMLTNR	1.42E-5	3.34E03	4.75E-02	1
NOSTFL	1.52E-5	3.34E03	5.08E-02	1
LGLTDI	1.48E-5	1.22E06	1.81E01	7
LGLTSS	8.33E-6	1.96E05	1.63E00	7

	CALCULATION CONTINUATION SHEET				SHEET: 11 of 25
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:		
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1				
REVIEWER/VERIFIER, DATE			Tom Carrier		

SMLATE	4.41E-6	4.00E05	1.76E00	7
LGERDI.I[8]	1.88E-6	3.46E06	6.51E00	2
LGERDI.F	1.81E-6	3.46E06	6.27E00	7
LGERSS	1.13E-6	1.20E06	1.35E00	7
SGTRVO	2.00E-7	4.23E06	8.46E-01	8
VSMUS	1.80E-7	0	0	8
VSMSC	1.80E-7	0	0	8
BMMT	9.06E-8	N/A	N/A	N/A
VLGUS	1.01E-7	3.75E06	3.79E-1	8
VLGSC	1.01E-7	2.50E06	2.53E-1	8
SMERLY	6.13E-8	4.84E06	2.97E-1	7
SGTRVC	4.56E-8	0	0	8

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

As displayed in Table 5, the SGS IPE did not identify release categories specifically associated with EPRI Classes 3, 4, 5, or 6. Therefore, each of these classes are evaluated for applicability to SGS.

Class 3:

Containment failures in this class are due to leaks such as liner breaches which would be detected by performing a Type A ILRT or visual inspection (IWE) as required by ASME code. For this estimation, the question on containment isolation was modified consistent with the previously approved methodology [2,3], to include the probability of a liner breach (due to excessive leakage) at the time of core damage. Using this methodology, Class 3 is divided into two classes. These are Class 3a (small liner breach) and Class 3b (large liner breach).

To calculate the probability that a liner leak will be large (Class 3b), use was made of the data presented in NUREG-1493 [7] and new data presented by the EPRI Interim Guidance[11]. One data set found in NUREG-1493 reviewed 144 ILRTs and the EPRI Interim Guidance reviewed additional 38 ILRTs. The largest reported leak rate from those 144 tests was 21 times the allowable leakage rate (La). Since 21 La does not constitute a large release, no large releases have occurred based on the 144

[8] The release category LGERDI contains EPRI categories 2 and 7. Thus, it is separated into LGERDI.I and LGERDI.F with respective frequencies (section 4.10.1 of the IPE contains more detailed information).

	CALCULATION CONTINUATION SHEET				SHEET: 12 of 25	
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

ILRTs reported in NUREG-1493. One failure was found in 38 ILRTs and was discussed in EPRI Interim Guidance and this failure was not considered large.

Because no class 3b failure has occurred in 182 ILRT tests, the EPRI Interim Guidance suggested that the Jeffery's non-informative prior distribution would be appropriate for the class 3b distribution (The rational for using the Jeffery's non-informative prior distribution was discussed in reference 11.)

Failure probability = (# of failures (0) + ½)/(Number of tests (182) + 1) = 0.5/183 = 0.0027

As discussed in the previously approved methodology [2,3], only Class 3 sequences have the potential to result in large releases if a pre-existing leak (related with Type A test) is present. The frequency of release due to Class 3b failures is considered as the product of this large failure probability and the portion of the CDF that can be impacted by the type A test. Based on reference [13], additional sequences that are not associated with the LERF due:to a Type A containment leakage path include

1. Predominant release path does not go through the containment, e.g., steam generator tube rupture initiators and induced failures
2. Releases that would not meet the criteria for early releases
3. Release scrubbing that would prevent a large release despite the presence of a pre-existing leak. Such releases could include a successful actuation of containment sprays

Salem IPEEE divides release into four groups:

1. Large, early containment failures and large bypasses
2. Small, early containment failures and bypasses
3. Late containment failure
4. Containment intact

The first two groups are LERF contributors that will not be impacted by Type A test. The 4th group contains two categories. The first one is no core melt or no release. The second one is vessel failures at a very late stage (>6 hours). Therefore, this group is not impacted by the Type A test.

There are four releases in the 3rd group. The first one is "large, late containment failure with direct release." With no additional information, this one will is considered to be impacted by the Type A test. The second one is "large, late containment failure with subsoil release." Based on the description provided in Salem IPE, this release is not likely to be impacted by the Type A test. As stated in section 4.9.3.2 of Salem IPE, to become airborne, radio nuclide must traverse about 50 feet radially and about 40 feet upward to reach plant grade. To be on the conservative side, 50% of the frequency of this release is considered to be impacted by the Type A test. The third release is "small, controlled late containment failure." This one is judged to be impacted by the Type A test. The

	CALCULATION CONTINUATION SHEET			SHEET: 13 of 25		
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

fourth release is "very late containment basement melt through." Given the insignificant frequency, this release is included as to be impacted by the Type A test.

For SGS, the core damage sequences that will be impacted by the Type A test are about 2.35E-5/year. [See section 4.10 of SGS IPE for detailed information]. Therefore, the frequency of release due to Class 3b is calculated as:

$$FREQ_{class3b} = PROB_{class3b} \times CDF = 0.0027 \times 2.35E\text{-}05/yr = 6.35E\text{-}08/yr$$

To calculate the probability that a liner leak will be small (Class 3a), use was made of the data presented in NUREG-1493 [7] and the EPRI Interim Guidance. The NUREG-1493 states that 144 ILRTs were conducted. The data reported that 23 of 144 tests had allowable leak rates in excess of 1.0La. However, of these 23 'failures,' only 4 were found by an ILRT. The others were found by Type B and C testing or errors in test alignments. Therefore, the number of failures considered for 'small releases' are 4 of 144. The EPRI Interim Guidance stated that one failure found by an ILRT was found in 38 ILRTs. Thus, the best estimate of the probability of a small leak is calculated as 5/182 = 0.027 [reference 11].

Therefore the frequency of release due to Class 3a failures is calculated as:

$$FREQ_{class3a} = PROB_{class3a} \times CDF = 0.027 \times 3.25E\text{-}05/yr = 6.35E\text{-}07/yr$$

Class 4:

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

Class 5:

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

Class 6:

This group is similar to Class 2, and addresses additional failure modes not typically modeled in PSAs due to the low probability of occurrence. The low failure probabilities are based on the need for multiple failures, the presence of automatic closure signals, and control room indication. Based on the purpose of this calculation, and

	CALCULATION CONTINUATION SHEET		SHEET: 14 of 25			
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

the fact that this failure class is not impacted by Type A testing, no further evaluation is needed. This is consistent with the EPRI guidance. However, in order to maintain consistency with the previously approved methodology (i.e.– $PROB_{class6} > 0$), a conservative screening value of 1.0E-03 will be used to evaluate this class[9].

$$FREQ_{class6} = (\text{screening value}) \times CDF = 1.00E\text{-}03 \times 6.27E\text{-}05/yr = 6.27E\text{-}08/yr$$

Class 1:

Although the frequency of this class is not directly impacted by Type A testing, the SGS IPE did not model Class 3 or Class 6 type failures, and the frequency for Class 1 should be reduced by the estimated frequencies in the new Class 3a, Class 3b, and Class 6 in order to preserve the total CDF. The revised Class 1 frequency is therefore:

$$FREQ_{class1} = FREQ_{PSAclass1} - (FREQ_{class3a} + FREQ_{class3b} + FREQ_{class6})$$

$$FREQ_{class1} = 2.94E\text{-}05 - (6.35E\text{-}07 + 6.35E\text{-}08 + 6.27E\text{-}08) = 2.87E\text{-}05/yr$$

Class 2:

The frequency of Class 2 is the sum of those release categories identified in Table 5 as Class 2.

$$FREQ_{class2} = 1.88E\text{-}06/yr$$

Class 7:

The frequency of Class 7 is the sum of those release categories identified in Table 5 as Class 7.

$$FREQ_{class7} = 3.05E\text{-}05/yr$$

Class 8:

The frequency of Class 8 is the sum of those release categories identified in Table 5 as Class 8.

$$FREQ_{class8} = 8.98E\text{-}07/yr$$

[9] Reference [11] suggested not including this category. The overall conclusion is not sensitive to this class.

	CALCULATION CONTINUATION SHEET				SHEET: 15 of 25
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:		
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1				
REVIEWER/VERIFIER, DATE			Tom Carrier		

Table 6 summarizes the above information by the EPRI defined classes. This table also presents exposures using the results of the SGS Level 3 analysis or the IP3 assumed La multipliers. For the Level 3 exposures, the weighted average[10] was used for each EPRI classification.

Table 6 Release Data Summarized by EPRI Class

Class	Description	Frequency (per year)	Person-Rem (Level 3)	Person-Rem (La Multiplier)
1	No Containment Failure	2.87E-05	3.34E03	
2	Large Containment Isolation Failures (failure to close)	1.88E-06	3.46E06	
3a*	Small Isolation Failures (Type A test)	6.35E-07		3.34E04
3b*	Large Isolation Failures (Type A test)	6.35E-08		1.17E05 :
4	Small Isolation Failures - failure-to-seal (Type B test)			
5	Small Isolation Failures - failure-to-seal (Type C test)			
6	Other Isolation Failures (dependent failures)	6.27E-08		1.17E05
7	Failure Induced by Phenomena (Early and late failures)	3.05E-05	9.62E05	
8	Containment Bypasses (SGTR)	8.98E-07	1.65E06	
CDF	All Classes	6.27E-5		

Based on the above table, it can be seen that the SGS Level 3 results do not contain specific dose results for Classes 3a, 3b, and Class 6. Therefore the dose factors for these classes from the previously approved methodology (see Table 2) will be applied for this calculation. The class 3a equals 10 times the class 1 release and classes 3b and 6 each equals 35 times class 1 release.

Table 7 presents the person-rem frequency data determined by multiplying the frequency for each failure class by the corresponding exposure.

Table 7 Baseline Mean Consequence Measures for 3-Year Test Interval

Class	Description	Frequency	Person-Rem	Person-Rem [illegible]

[10] The weighted average is the summation of the person-rem for the class divided by the total frequency of the class. An alternative approach is to use the largest release for the class. If we use the largest release, for instance, the class 7 will be overweighted results in a big total release. The changes in Class 3a and Class 3b will be masked. Thus, the weighted average is considered a better measurement.

	CALCULATION CONTINUATION SHEET				**SHEET:** 16 **of** 25	
CALC. NO.: S-C-ZZ-MEE-1613			**REFERENCE:**			
ORIGINATOR, DATE **Wei He, 03/19/02**	**REV: 1**					
REVIEWER/VERIFIER, DATE			Tom Carrier			

		[illegible]	[illegible]	
1	No Containment Failure	2.87E-05	3.34E+03	9.57E-02
2	Large Containment Isolation Failures (failure to close)	1.88E-06	3.46E+06	6.51E+00
3a*	Small Isolation Failures (Type A test)	6.35E-07	3.34E+04	2.12E-02
3b*	Large Isolation Failures (Type A test)	6.35E-08	1.17E+05	7.42E-03
4	Small Isolation Failures - failure-to-seal (Type B test)			
5	Small Isolation Failures - failure-to-seal (Type C test)			
6	Other Isolation Failures (dependent failures)	6.27E-08	1.17E+05	7.33E-03
7	Failure Induced by Phenomena (Early and late failures)	3.05E-05	9.62E+05	2.94E+01
8	Containment Bypasses (SGTR)	8.98E-07	1.65E+06	1.48E+00
CDF	All Classes	**6.27E-05**		**37.50**

The percent Risk Contribution due to release classes affected by the Type A Test interval is as follows:

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

Where:

$Class3a_{BASE}$ = Class 3a person-rem/year = 0.0212 person-rem/year

$Class3b_{BASE}$ = Class 3b person-rem/year = 0.00742 person-rem/year

$Total_{BASE}$ = total person-rem year for baseline interval = 37.50 person-rem/year

$\%Risk_{BASE} = [(0.0212+0.00742) / 37.50] \times 100 = 0.076\%$

Step 4: Calculate the Type A leakage estimate to address the current inspection interval

The current surveillance testing requirements as proposed in NEI 94-01 [5] for Type A testing and allowed by 10 CFR 50, Appendix J [1] is at least once per 10 years based on an acceptable performance history (defined as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than 1.0La).

According to NUREG-1493 [7], extending the Type A ILRT interval from 3 in 10 years to 1 in 10 years will increase the average time that a leak detectable only by an ILRT goes undetected from 18 to 60 months. The average time for undetection is calculated by multiplying the test interval by 0.5 and multiplying by 12 to convert

	CALCULATION CONTINUATION SHEET			SHEET: 17 of 25		
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

from "years" to "months." The recent EPRI Guidance suggested use the factor of 3.33 (60/18) to estimate the increase of Class 3b population dose increase. This is very conservative and will be used here for population dose calculation. The ASME required visual inspection (IWE) on liner will likely to detect the large liner breach (3b). For small liner breaches (3a), the likelihood of detection from the visual inspection is probably low.

Risk Impact Due to 10-year Test Interval

Based on the previously approved methodology [2,3], the increased probability of not detecting excessive leakage due to Type A tests directly impacts the frequency of the Class 3 sequences. Using the EPRI Guidance for a 10-year interval, there is a factor of 3.33 increase in the overall probability of leakage. The results of this calculation are presented in Table 8 below. As with the baseline case, the IPE frequency of Class 1 has been reduced by the frequency of Class 3a, 3b, and Class 6 in order to preserve total CDF

Table 8 Mean Consequence Measures for 10-Year Test Interval

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	No Containment Failure	2.70E-05	3.34E+03	9.03E-02
2	Large Containment Isolation Failures (failure to close)	1.88E-06	3.46E+06	6.51E+00
3a*	Small Isolation Failures (Type A test)	2.11E-06	3.34E+04	7.06E-02
3b*	Large Isolation Failures (Type A test)	2.11E-07	1.17E+05	2.47E-02
4	Small Isolation Failures - failure-to-seal (Type B test)			
5	Small Isolation Failures - failure-to-seal (Type C test)			
6	Other Isolation Failures (dependent failures)	6.27E-08	1.17E+05	7.33E-03
7	Failure Induced by Phenomena (Early and late failures)	3.05E-05	9.62E+05	2.94E+01
8	Containment Bypasses (SGTR)	8.98E-07	1.65E+06	1.48E+00
CDF	All Classes	**6.27E-05**		**37.56**

Using the same methods as for the baseline, and using the data in Table 8, the percent Risk Contribution due to release classes affected by the Type A Test interval is as follows:

$\%Risk_{10} = [(Class3a_{10} + Class3b_{10}) / Total_{10}] \times 100$

Where:

	CALCULATION CONTINUATION SHEET		SHEET: 18 of 25			
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

$Class3a_{10}$ = Class 3a person-rem/year = 0.0706 person-rem/year

$Class3b_{10}$ = Class 3b person-rem/year = 0.0247 person-rem/year

$Total_{10}$ = total person-rem year for baseline interval = 37.56 person-rem/year

$\%Risk_{10} = [(0.0706 + 0.0247) / 37.56] \times 100 = 0.254\%$

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

$\Delta\%Risk_{10} = [(Total_{10} - Total_{BASE}) / Total_{BASE}] \times 100$

Where: $Total_{BASE}$ = total person-rem/year for baseline interval = 37.50 person-rem/year

$Total_{10}$ = total person-rem/year for 10-year interval = 37.56 person-rem/year

$\Delta\%Risk_{10} = [(37.56 - 37.50) / 37.50] \times 100 = 0.16\%$

Step 5: Calculate the Type A leakage estimate to address extended inspection intervals

Risk Impact due to 15-year Test Interval

If the test interval is extended to 1 in 15 years, the mean time that a leak detectable only by an ILRT test goes undetected increases to 90 months (0.5 * 15 * 12). The reference 11 suggested to use a factor of 5 (90/18) to account for the increased likelihood of fail to detect, which will be implemented here. The results for this calculation are presented in Table 9. Same as the baseline case, the PSA frequency of Class 1 has been reduced by the frequency of Class 3a, 3b, and Class 6 in order to preserve total CDF.

Table 9 Mean Consequence Measures for 15-Year test Interval

Class	Description	Frequency (per Rx-yr)	Person-Rem (50 miles)	Person-Rem (per Rx-yr)
1	No Containment Failure	2.59E-05	3.34E+03	8.64E-02
2	Large Containment Isolation Failures (failure to close)	1.88E-06	3.46E+06	6.51E+00
3a*	Small Isolation Failures (Type A test)	3.17E-06	3.34E+04	1.06E-01
3b*	Large Isolation Failures (Type A test)	3.17E-07	1.17E+05	3.71E-02
4	Small Isolation Failures - failure-to-seal (Type B test)			

	CALCULATION CONTINUATION SHEET	SHEET: 19 of 25
CALC. NO.: S-C-ZZ-MEE-1613	REFERENCE:	
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1	
REVIEWER/VERIFIER, DATE	Tom Carrier	

5	Small Isolation Failures - failure-to-seal (Type C test)			
6	Other Isolation Failures (dependent failures)	6.27E-08	1.17E+05	7.33E-03
7	Failure Induced by Phenomena (Early and late failures)	3.05E-05	9.62E+05	2.94E+01
8	Containment Bypasses (SGTR)	8.98E-07	1.65E+06	1.48E+00
CDF	All Classes	**6.27E-05**		**37.60**

Using the same methods as for the baseline, and the data in Table 9, the percent Risk Contribution due to release classes affected by the Type A Test interval is as follows:

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

where:

$Class3a_{15}$ = Class 3a person-rem/year = 0.106 person-rem/year

$Class3b_{15}$ = Class 3b person-rem/year = 0.0371 person-rem/year

$Total_{15}$ = total person-rem year for baseline interval = 37.60 person-rem/year

$\%Risk_{15} = [(0.106+0.0371) /37.60] \times 100 = 0.38\%$

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

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

Where:

$Total_{BASE}$ = total person-rem/year for baseline interval = 37.50 person-rem/year

$Total_{15}$ = total person-rem/year for 15-year interval = 37.60 person-rem/year

$\Delta\%Risk_{15} = [(37.60–37.50) /37.50] \times 100.0 = 0.28\%$

Step 6: Calculate increase in risk due to extending Type A inspection intervals

Extension of interval from 10 years to 15 years

	CALCULATION CONTINUATION SHEET			**SHEET:** 20 **of** 25		
CALC. NO.: S-C-ZZ-MEE-1613			**REFERENCE:**			
ORIGINATOR, DATE Wei He, 03/19/02	**REV: 1**					
REVIEWER/VERIFIER, DATE			Tom Carrier			

Based on the previously approved methodology [2,3], the percent increase in risk (in terms of person-rem/yr) of these associated specific classes affected by the Type A test interval is computed as follows.

$\%Risk_{10\text{-}15} = [(PER\text{-}REM_{15} - PER\text{-}REM_{10}) / PER\text{-}REM10] \times 100$

where:

$PER\text{-}REM_{10}$ = person-rem/year for ten-year interval (for classes 1, 3a, and 3b)
= (0.0903+ 0.0706 +0.0247) person-rem/yr = 0.186 person-rem/yr [Table 8]

$PER\text{-}REM_{15}$ = person-rem/year for fifteen-year interval (for classes 1, 3a, and 3b)
= (0.0864+0.106+0.0371) person-rem/yr = 0.229 person-rem/yr [Table 9]

$\%Risk_{10\text{-}15}$ = $[(0.229 - 0.186) / 0.186] \times 100 = 23.6\%$

The percent increase on the total integrated plant risk for these accident sequences is computed as follows.

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

where:

$Total_{10}$ = total person-rem/year for ten-year interval = 37.56 person-rem/year [Table 8]

$Total_{15}$ = total person-rem/year for fifteen-year interval = 37.60 person-rem/year [Table 9]

$\% Total_{10\text{-}15}$ = $[(37.60-37.56) /37.56] \times 100 = 0.12\%$

The percent increase on the total integrated plant risk from the baseline of three years for these accident sequences is computed as follows.

$\%Total_{3\text{-}15} = [(Total_{15} - Total_{3}) / Total_{3}] \times 100$

where:

$Total_{3}$ = total person-rem/year for three-year interval = 37.50 person-rem/year [Table 7]

$Total_{15}$ = total person-rem/year for fifteen-year interval = 37.60 person-rem/year [Table 9]

	CALCULATION CONTINUATION SHEET				SHEET: 21 of 25	
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

% $Total_{3\text{-}15}$ = [(37.60–37.50) /37.50] x 100 = 0.28%

Step 7: Calculate the change in risk in terms of Large Early Release Frequency (LERF)

The risk impact associated with extending ILRT interval involves the potential that a core damage event that normally would result in only a small radioactive release from containment could result in a larger release, due to failure to detect a pre-existing leak during the relaxation period. Using the LERF equation suggested in Ref [13]

> Frequency 3b=(3b Failure probability)*(CDF minus CDF with independent LERF minus CDF that cannot cause LERF)

Thus, the base LERF value (related with changes of ILRT interval] is equal to:

$$LERF_{baseline} = 2.35E\text{-}5 \times 0.0027 = 6.345E\text{-}8/year$$

Based on the past inspection experience, the visual inspection (IWE) [12] will detect large liner failures in the accessible areas. For this Salem unit, a 100% IWE was performed in 2000 and will be performed in 2003. This three-year interval is similar to the ILRT. Therefore, if the IWE is as effective as the ILRT, risk increase due to ILRT extension should be zero. However, there are concerns about the IWE effectiveness in the inaccessible area. For this analysis, it is assumed that the IWE is as effective as the ILRT in accessible area and has no effect in inaccessible area. Therefore, the failure to detect the large liner failure for the IWE is equivalent to the percentage of inaccessible area. Based on Salem specific information, the inaccessible area is about 34% (24% below ground and 10% above ground) of the liner. Thus, the likelihood of failure to detect a large liner failure is estimated to be 0.34[11]. Therefore, LERFs for 10 years and 15 years test intervals are:

$$LERF_{10year} = LERF_{baseline} \times 3.333 \times 0.34 = 7.190E\text{-}8$$

$$LERF15year = LERF_{baseline} \times 5.00 \times 0.34 = 1.079E\text{-}7$$

Thus, the estimation for LERF changes from the 10 year interval to the 15 year test interval is 3.60E-08/year. Similarly, the LERF changes from the 3 year interval to the 15 year test interval is 4.44E-08/year. The following table summarizes the results:

Table 10 Change in LERF Due to Extending Type A testing Intervals

[11] A more consistent approach is to modify the multiplication factors of 3.333 and 5.000 at the very beginning of the calculation.

	3-Year Interval (baseline)	10-Year Interval	15-Year Interval
Type A LERF (Class 3b)	6.34E-08/yr	7.19E-08/yr	1.08E-07/yr
ΔLERF (10- to 15-year interval)			3.60E-08/yr
ΔLERF (3-- to 15-year interval)			4.44E-08/yr

Reg. Guide 1.174 [8] provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 1E-6/yr and increases in LERF below 1E-7/yr. Since the ILRT does not impact CDF, the relevant metric is LERF. As indicated by the above table, increasing the ILRT interval from 10 to 15 years (3.60E-08/yr) is non-risk-significant. In addition, increasing the ILRT interval from 3 to 15 years (4.44E-08/yr) is non-risk-significant.

Step 8: Calculate the change in Conditional Containment Failure Probability (CCFP)

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

$$CCFP = 1 - [f(ncf)/CDF]$$

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

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

$$\Delta CCFP_{10-15} = \left[\frac{f_{Class1} + f_{Class3a}}{CDF}\right]_{10} - \left[\frac{f_{Class1} + f_{Class3a}}{CDF}\right]_{15}$$

Using the data from Table 8 and Table 9:

	CALCULATION CONTINUATION SHEET			SHEET: 23 of 25		
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

$$\Delta CCFP_{10-15} = \left[\frac{(2.70E-05)+(2.11E-06)}{6.27E-05}\right]_{10} - \left[\frac{(2.59E-05)+(3.17E-06)}{6.27E-05}\right]_{15} = 0.17\%$$

Using the data from Table 7 and Table 9 provide the change in CCFP from the baseline case:

$$\Delta CCFP_{3-15} = \left[\frac{(2.87E-05)+(6.35E-07)}{6.27E-05}\right]_{3} - \left[\frac{(2.59E-05)+(3.17E-06)}{6.27E-05}\right]_{15} = 0.40\%$$

6.0 RESULTS

The specific results are summarized in Table 11 below. The Type A contribution to LERF is calculated in Step 7. Based on the data:

1. The person-rem/year increase in risk contribution from extending the ILRT test frequency from the current once every 10 years to once every 15 years is 0.04 person-rem/yr.
2. The total integrated increase in risk contribution from extending the ILRT test frequency from the current once every 10 years to once every 15 years is 0.12%.
3. The risk increase in LERF from extending the ILRT test frequency from the current once every 10 years to once every 15 years is 3.60 x 10^{-8}/yr.

The change in CCFP from the current 10-year interval to a 15-year interval is 0.17%.

Based on the above results, the following are conclusions regarding the assessment of the plant risk associated with extending the Type A ILRT test interval from ten years to fifteen years.

The change in Type A test frequency from once every ten years to once every fifteen years increases the risk impact on the total integrated plant risk by only 0.12%. Also, the change in Type A test frequency from the original every three years to once every fifteen years increases the risk only 0.28%. Therefore, the risk impact when compared to other severe accident risks is negligible.

Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of CDF below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test frequency from the current once every 10 years to once every 15 years is 3.60E-8/yr. Since guidance in Reg. Guide 1.174 defines very small changes in LERF as below 10^{-7}/yr, increasing the ILRT interval from 10 to 15 years is therefore considered non-risk significant. The LERF increase is

	CALCULATION CONTINUATION SHEET			**SHEET:** 24 **of** 25		
CALC. NO.: S-C-ZZ-MEE-1613			**REFERENCE:**			
ORIGINATOR, DATE Wei He, 03/19/02	**REV: 1**					
REVIEWER/VERIFIER, DATE			Tom Carrier			

4.44E-8 for the cumulative change of going from a test frequency of three every ten years to once every fifteen years, which is still non-risk significant.

R.G. 1.174 also encourages the use of risk analysis techniques to help ensure and show that the proposed change is consistent with the defense-in-depth philosophy. Consistency with defense-in-depth philosophy is maintained by demonstrating that the balance is preserved among prevention of core damage, prevention of containment failure, and consequence mitigation. The change in conditional containment failure probability was estimated to be 0.17% for the proposed change and 0.40% for the cumulative change of going from a test frequency of three every ten years to once every fifteen years. These changes are small and that the defense-in-depth philosophy is maintained.

Table 11 Summary of Risk Impact on Extending Type A ILRT Test Frequency

	Risk Impact for 3-year interval (baseline)	**Risk Impact for 10-year interval (current requirement)**	**Risk Impact for 15-year interval (proposed)**
Total Integrated Risk (Person-Rem/yr)	37.50	37.56	37.60
Type A Testing Risk (Person-Rem/yr)	0.0286	0.0953	0.143
% Total Risk (Type A / Total)	0.076%	0.25%	0.38%
Type A LERF (Class 3b) (per year)	6.35E-08	7.19E-08	1.08E-07
Changes due to extension from 10 years (current)			
Δ Risk from current (Person-rem/yr)			0.04
% Increase from current (Δ Risk / Total Risk)			0.12%
Δ LERF from current (per year)			3.60E-08
Δ CCFP from current			0.17%
Changes due to extension from 3 years (baseline)			

	CALCULATION CONTINUATION SHEET	SHEET: 25 of 25				
CALC. NO.: S-C-ZZ-MEE-1613			REFERENCE:			
ORIGINATOR, DATE Wei He, 03/19/02	REV: 1					
REVIEWER/VERIFIER, DATE			Tom Carrier			

Δ Risk from baseline (Person-rem/yr)			0.10
% Increase from baseline (Δ Risk / Total Risk)			0.28%
Δ LERF from baseline (per year)			4.44E-08
Δ CCFP from baseline			0.40%