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PSEG
Nuclear LLC

OCT 0 9 2002

LR-N02-0319
LCR H02-013

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Gentlemen:

REQUEST FOR CHANGE TO TECHNICAL SPECIFICATIONS
ONE-TIME EXTENSION TO INCREASE THE INTERVAL OF THE INTEGRATED LEAK RATE TEST FROM TEN TO TWENTY YEARS
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

Pursuant to 10 CFR 50.90, PSEG Nuclear LLC (PSEG) hereby requests a revision to the Technical Specifications (TS) for the Hope Creek Generating Station. In accordance with 10CFR50.91(b)(1), a copy of this submittal has been sent to the State of New Jersey.

The proposed amendment revises Technical Specifications 6.8.4.f, "Primary Containment Leakage Rate Testing Program." This will allow a one-time interval extension for the Hope Creek Generating Station - Type A, Integrated Leakage Rate Test (ILRT) for no more than ten (10) years.

PSEG has evaluated in Attachment 1 the proposed changes in accordance with 10CFR50.91(a)(1), using the criteria in 10CFR50.92(c), and has determined that the request involves no significant hazards considerations. In addition, there is no significant increase in the amounts or types of any effluents that may be released offsite, and there is no significant increase in individual or cumulative occupational radiation exposure. Consequently, the proposed amendment satisfies the criteria of 10CFR51.22 (c)(9) for categorical exclusion from the requirement for an environmental assessment. The marked up Technical Specification page affected by the proposed change is provided in Attachment 2.

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A plant-specific, risk-based evaluation (Attachment 3, Calculation H-1-ZZ-RZZ-0036 Rev. 0, "PRA Analysis of HCGS ILRT Extension") has been performed in support of the one-time extension to extend the Type A test from once in 10 years to once in 20 years. PSEG requests NRC approval of the proposed License Amendment by February 2003 to be implemented within 30 days. The requested approval date and implementation period will allow sufficient time to reschedule the remaining outage activities to achieve optimum effectiveness of Refueling Outage 11 (RF11), scheduled to begin on April, 2003. The reason for this request is to save critical path time in RF11 and move the ILRT to one of the three subsequent refueling outages where it can be performed off critical path. Removing the ILRT from RF11 will reduce the critical path by approximately 44 hours with no significant effect on safety.

If you have any questions or require additional information, please contact Mr. Michael Mosier at (856) 339-5434.

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

Executed on 10/9/02

Sincerely,

D.F. Garchow

D. F. Garchow
Vice President - Operations

Attachments (3)

OCT 0 9 2002

C: Mr. H. Miller, Administrator – Region I
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REQUEST FOR CHANGE TO TECHNICAL SPECIFICATIONS ONE-TIME EXTENSION TO INCREASE THE INTERVAL OF THE INTEGRATED LEAK RATE TEST FROM TEN TO TWENTY YEARS

1. DESCRIPTION

This letter is a request to amend Facility Operating License NPF-57 for the Hope Creek Generating Station (HCGS). The proposed change would revise Technical Specification 6.8.4.f, "Primary Containment Leakage Rate Testing Program" to permit a one-time extension to the maximum ten-year interval to twenty years to perform the Type A test. The proposed change will provide an economic benefit by eliminating the Integrated Leak Rate Test (ILRT) from Refueling Outage 11 (RF11), reducing the critical path by approximately 44 hours with no significant impact on safety.

Approval of this proposed change is being requested by the end of February 2003 to support the scheduled implementation date of April 2003.

2. PROPOSED CHANGE

The proposed changes to the Technical Specifications (TS) are included in Attachment 2 of this submittal. In summary, it is requested that:

Section 6.8.4.f, "Primary Containment Leakage Rate Testing Program," be amended to permit a one-time extension to the maximum ten-year frequency to be increased to twenty years to perform the ILRT. The proposed TS change is based on past successful Type A, B, and C tests, and American Society of Mechanical Engineers (ASME) Section XI inspections (reference 7.12) at HCGS. The results for HCGS are shown in Table 1. Further justification is based on research documented in NUREG-1493 (reference 7.7) which generically shows that very few potential containment leakage paths fail to be identified by Type B and C tests. In fact, an analysis of 144 ILRT test results, including 23 failures, found that no failures were due to containment liner breach. The NUREG concluded that reducing the Type A (ILRT) testing frequency to once per twenty years would lead to an imperceptible increase in risk. A plant specific calculation provided in Attachment 3 demonstrates that the risk impact of the proposed change when compared to other severe accident risks is negligible. The purpose of this submittal is to request a one-time deferral of the Type A (ILRT) from April 12, 2004 to no later than April 12, 2014.

3. BACKGROUND

ILRTs have been required of operating nuclear power plants to ensure the public health and safety in the case of an accident that would release radioactivity to the containment. Conservative design and construction have led to very few ILRTs exceeding their required leakage. The NRC has extended the allowable ILRT test period from three times in ten years to once in ten years based on past successful tests. NUREG-1493 that supported the change to the ten-year interval also stated that test periods of up to twenty years would lead to an imperceptible increase in risk.

Section 3.8.2 of the Hope Creek Updated Final Safety Analysis Report (UFSAR) describes the primary containment. The steel containment is an ASME B&PV Code

Class MC vessel designed to house the Nuclear Steam Supply System (NSSS). The steel containment is a part of the Primary Containment System, which limits the postulated release of radioactivity from the NSSS. This section describes the structural design considerations for the primary containment and includes information that provides the bases for design, construction, and testing of the steel containment, except as modified by the plant unique analysis report, submitted to the NRC under separate cover (letter from R.L. Mittl to Albert Schwencer, dated February 10, 1984.).

The primary containment consists of a drywell, a pressure suppression chamber, and an interconnecting vent system. The drywell is a steel pressure vessel with a spherical lower portion 68 feet inside diameter, a cylindrical upper portion 40 feet 6 inches inside diameter, and a removable, flanged, hemi-ellipsoidal top head, 33 feet 2 inches inside diameter. Its overall height is 114 feet 9 inches. The bottom elevation of the spherical portion is 77 feet 10 inches. Inner and outer steel cylindrical skirts that are encased in concrete and anchored to a concrete pedestal support the drywell. The suppression chamber consists of 16-mitered cylindrical shell segments joined together to form a torus shaped pressure vessel located below and encircling the drywell. The suppression chamber has a major diameter of 112 feet 8 inches, a minor or chamber diameter of 30 feet 8 inches, and contains water to an approximate depth of 14 feet. Eight equally spaced vent pipes connect the drywell and the suppression chamber, each with an internal diameter of 6 feet 2 inches. These vent pipes are connected to a common mitered header within the suppression chamber with a major diameter of 112 feet 8 inches and a minor diameter of 4 feet 3 inches.

The satisfactory results from previous integrated leakage rate tests at HCGS, as well as continued satisfactory results of local leak rate tests, and containment inspections, support deferral of the RF11 test. The reactor containment will continue to be inspected under the requirements of ASME Section XI Subsections IWE and IWL. The existing Type B and C containment penetration-testing program will continue to be performed in accordance with previous regulatory approvals.

PSEG has performed three operational ILRT tests. All tests passed the as-found acceptance criteria of 1.0 L_a, where L_a is the maximum allowable accident leakage rate. The results are shown in Table 1.

Structural degradation of containment is a gradual process that occurs due to the effects of pressure, temperature, radiation, chemical, or other such effects. Such effects would be identified and corrected when the containment structure is periodically tested and inspected to verify structural integrity under ASME Section XI Subsections IWE and IWL. The most recent 100% IWE inspection performed was during refueling outage RFO9, in Spring 2000. The next scheduled 100% IWE is RF11, Spring 2003 These surveillances provide a high degree of assurance that any degradation of the containment structure will be detected and corrected before it can produce a containment leakage path. The tests and inspections conducted to date have not identified degradation that threatens the integrity of the HCGS containment.

The NRC has approved similar changes in Amendment No. 197 for Crystal River Unit 3. Also, in Amendment No. 206 for Entergy Nuclear Operations, Inc.'s Indian Point Nuclear Generating Unit 3 the NRC approved a one-time increase 10 to 15 years for the ILRT interval. In addition the NRC approved a similar change in Amendment No. 234 for Salem Unit 2.

4. TECHNICAL ANALYSIS

The purpose of this analysis is to demonstrate that extending the Type A Integrated Leak Rate Test (ILRT) interval from the current 10 years required by 10 CFR 50, Appendix J (reference 7.1) at Hope Creek Generating Station (HCGS) to 20 years has a negligible impact on risk. The risk in this analysis is defined in terms of population dose (person-rem) per reactor year, large early release frequency (LERF) and conditional containment failure probability (CCFP). Consequently, the impact of Type A extension is evaluated against the person-rem, LERF and CCFP.

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 20 years.

- 3 years - interval based on the original requirements of 3 tests per 10 years
- 10 years – current test interval required for HCGS
- 20 years – interval extension proposed for HCGS

4.1 Methodology

The evaluation for HCGS follows the guidelines set forth in NEI 94-01 (reference 7.5), the methodology used in EPRI TR-104285 (reference 7.6), NUREG-1493 (reference 7.7), EPRI Interim Guidance (reference 7.11), and the regulatory guidance on the use of Probabilistic Safety Assessment (PRA) findings in support of a licensee request to a plant's licensing basis, RG 1.174 (reference 7.8). The calculation applies the HCGS Individual Plant Examination (IPE) release categories, current core damage frequency (CDF), 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 HCGS IPE (reference 7.9), HCGS PRA, Revision 1.3 (reference 7.14), and a Level 3 PRA study (reference 7.10) performed by SCIENTECH for HCGS.

In addition to the references mentioned above, improvements suggested in references (7.11 and 7.13) are implemented in this evaluation. The previous methodology for LERF (Class 3b frequency) calculation involved 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, 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.

The analysis steps performed are listed below:

- Calculate the Level 3 release category population doses.
- Map the Level 3 release categories into the 8 release classes defined by the EPRI report.
- Calculate the Type A leakage estimate to define the analysis baseline.
- Calculate the Type A leakage to address the current inspection frequency.
- Calculate the Type A leakage estimates to address extension of the Type A test interval.
- Calculate the change in population dose due to extending Type A inspection intervals.
- Calculate the change in LERF due to extending Type A inspection intervals.
- Calculate the change in CCFP due to extending Type A inspection intervals.

4.2 Assumptions/Bases

- 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.
- The maximum containment leakage for Class 3a sequences is 10 times the class 1 sequences based on the previously approved methodology. (references 7.2, 7.3, and 7.11)
- The maximum containment leakage for Class 3b sequences is 35 times the class 1 sequences based on the previously approved methodology. (references 7.2, 7.3, and 7.11)
- Containment leakage due to Classes 4, 5 and 6 are considered negligible based on references 7.2 and 7.3.
- The containment releases are not impacted by time.
- 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.
- This calculation uses the CDF from the latest HCGS PRA (Revision 1.3) and the release categories and frequency distribution in the HCGS IPE. This approach is used for the following two reasons. First, the latest Level 1 PRA revision reflects the plant configuration more accurately, but the Level 2 PRA, except LERF, has not been updated. Second, the Level 2 PRA in the HCGS IPE is extensive and has enough information for distributing the latest CDF to various release categories. The CDF value used in this calculation is 8.89E-6/year, which is the CDF in the latest HCGS PRA.

4.3 Calculation

The inputs for this calculation come from the information documented in the HCGS IPE (reference 7.9), HCGS PRA, Revision 1.3 (reference 7.14), and a Level 3 PRA study (reference 7.10) performed by SCIENTECH for HCGS. 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.

The current HCGS PRA is a non-safety-related tool and is intended to provide "best-estimate" results that can be used as input when making risk-informed decisions. The HCGS IPE (reference 7.9) is an earlier version of the PRA submitted to NRC in response to Generic Letter 88-20. Neither the PRA nor the IPE is considered as design basis information. Other inputs to this calculation include ILRT test data from NUREG-1493 (reference 7.7), EPRI interim Guideline (reference 7.11) and the EPRI report (reference 7.6) are referenced in the body of the calculation.

4.4 Risk Impact

The change in Type A test frequency from once every ten years to once every twenty years increases the total integrated plant risk by only 0.19%. Also, the change in Type A test frequency from the original every three years to once every twenty years increases the risk only 0.32%. 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 the increase in 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 in every 20 years is 4.382E-8/yr. It meets the guidance in Reg. Guide 1.174 as very small changes in LERF; therefore, increasing the ILRT interval from 10 to 20 years is considered non-risk significant. The LERF increase for the cumulative change from a test frequency of three times in every ten years to once in every twenty years is 7.439E-8/yr, which is still non-risk significant.

R.G. 1.174 also encourages the use of risk analysis techniques to ensure 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 is estimated to be 0.49% for the proposed change and 0.83% for the cumulative change of going from a test frequency of three times in every ten years to once in every twenty years. These changes are small and demonstrate that the defense-in-depth philosophy is maintained.

Table 1
Hope Creek Generating Station
ILRT Results

Test Date	Total Time Method Leakage Rate (%/day)	Test Duration (Hours)	TS 3.3.3 Acceptance Criteria
January 2, 1986	0.175* 0.180**	24	0.75 L_a
November 9, 1989	0.084* 0.087**	24	0.75 L_a
April 12, 1994	0.200* 0.217**	11hours 10 minutes	0.75 L_a

* Measured leakage

** Leakage with 95% upper confidence

Table 2

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 20-year interval (proposed)
Total Integrated Risk (Person-Rem/yr)	15.67	15.69	15.72
Type A Testing Risk (Person-Rem/yr)	0.010	0.034	0.068
% Total Risk (Type A / Total)	0.065%	0.216%	0.432%
Type A LERF (Class 3b) (per year)	1.312E-08	4.369E-08	8.751E-08
Changes due to extension from 10 years (current)			
Δ Risk from current (Person-rem/yr)			0.03
% Increase from current (Δ Risk / Total Risk)			0.19%
Δ LERF from current (per year)			4.382E-08
Δ CCFP from current			0.49%
Changes due to extension from 3 years (baseline)			
Δ Risk from baseline (Person-rem/yr)			0.05
% Increase from baseline (Δ Risk / Total Risk)			0.32%
Δ LERF from baseline (per year)			7.439E-08
Δ CCFP from baseline			0.83%

5. REGULATORY SAFETY ANALYSIS

5.1 No Significant Hazards Consideration Determination

PSEG Nuclear LLC (PSEG) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10CFR50.92, "Issuance of amendment," as discussed below:

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

   Response: No.

   The proposed revision to Section 6.8.4.f adds a one-time extension to the current interval for containment integrated leak rate test (ILRT). The current test interval of 10 years, based upon past performance, would be extended on a one-time basis to 20 years from the last ILRT. The proposed extension to ILRT testing cannot increase the probability of an accident previously evaluated since the containment ILRT testing extension is not a modification to plant systems, nor a change to plant operation that could initiate an accident. The proposed extension to Type A testing does not involve a significant increase in the consequences of an accident since research documented in NUREG-1493, "Performance-Based Containment Leak-Test Program," found that very few potential containment leakage paths fail to be identified by Type B and C tests. The NUREG concluded that reducing the ILRT testing frequency to once per twenty years would lead to an imperceptible increase in risk. Containment performance monitoring is performed in accordance with the Maintenance Rule (10CFR50.65) and inspections required by American Society of Mechanical Engineers (ASME) code are performed in order to identify indications of containment degradation that could affect leak tightness. Type B and C testing required by the technical specifications (TS) will identify any containment opening, such as valves, that would otherwise be detected by the ILRT. Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. It also recommends the use of risk analysis techniques to ensure and show that the proposed change is consistent with the defense-in-depth philosophy. The increase in large early release frequency (LERF) resulting from a change in the ILRT test frequency from the current once in every 10 years to once in every 20 years is less than 10^{-7} per year, thereby meeting Regulatory Guide 1.174 definition of a very small change in risk. The change in conditional containment failure probability (CCFP) is estimated to be 0.49% for the proposed change. These factors show that an ILRT test extension will not represent a significant increase in the consequences of an accident.

Therefore, this proposed amendment does not involve a significant increase in the probability of occurrence or consequences of an accident previously analyzed.

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

   Response: No

   The proposed revision to Section 6.8.4.f adds a one-time exception to the current interval for the ILRT. The current test interval of 10 years, based upon past performance, would be extended on a one-time basis to 20 years from the last Type A test. Primary containment is designed to contain energy and fission products during and after an event. The Individual Plant Examination (IPE) identifies events that lead to containment failure. Revision to the ILRT test interval does not change this list of events. There are no physical changes being made to the plant and there are no changes to the operation of the plant that could introduce a new failure mode creating a new or different kind of accident. Therefore, this proposed amendment does not create the possibility of a new or different kind of accident from any previously analyzed.

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

   Response: No

   The proposed revision to Section 6.8.4.f adds a one-time extension to the current interval for the ILRT. The current test interval of 10 years, based upon past performance, would be extended on a one-time basis to 20 years from the last ILRT. The proposed extension to ILRT testing interval will not significantly reduce the margin of safety. The NUREG-1493 generic study of the effects of extending containment leakage testing found that a 20-year exception in ILRT leakage testing resulted in an imperceptible increase in risk to the public. NUREG-1493 found that the containment leakage rate contributes a very small amount to the individual risk, and that the decrease in Type A testing frequency would have a minimal affect on this risk since most potential leakage paths are detected by Type C testing. Type B and Type C testing will continue to be performed at a frequency currently required by the Technical Specifications (TS). The containment inspections being performed in accordance with ASME, Section XI, and Maintenance Rule (10CFR50.65) provide a high degree of assurance that the containment will not degrade in a manner that is only detectable by Type A testing.

   Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. It also recommends the use of risk analysis techniques to ensure and show that the proposed change is consistent with the defense-in-depth philosophy. The increase in large early release fraction (LERF) resulting from a change in the ILRT test frequency from the current once in every 10 years to once in every 20 years is less than 10^{-7} per year, thereby meeting Regulatory Guide 1.174 definition of a very small change in risk. The change in conditional containment failure probability (CCFP) is estimated to be 0.49% for the proposed change.

Therefore, these changes do not involve a significant reduction in margin of safety.

Based on the above, PSEG concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10CFR50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

5.2.1 Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," September 1995 (RG 1.163).

5.2.2 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.

5.2.3 NUREG-1493, "Performance-Based Containment Leak-Test Program," Final Report, September 1995 (NUREG-1493).

5.2.4 Title 10, Code of Federal Regulations, Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors".

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

6. ENVIRONMENTAL IMPACT EVALUATION

PSEG has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7. REFERENCES

7.1. Title 10, Code of Federal Regulations, Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors".

7.2. 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.

7.3. 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.

7.4. 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.

7.5. NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J", July 26, 1995, Revision 0

7.6. EPRI TR-104285, "Risk Assessment of Revised Containment Leak Rate Testing Intervals" August 1994.

7.7. NUREG-1493, "Performance-Based Containment Leak-Test Program", July 1995.

7.8. 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.

7.9. HCGS Probabilistic Risk Assessment Individual Plant Examination Submittal, Revision 0, March 1994.

7.10. SCIENTECH 17268-001, "Hope Creek MACCS2 Model," 9/2002.

7.11. EPRI Interim Guidance for Performing Risk Impact Assessments In Support of One-Time Extensions for Containment Integrated Leakage Rate Test Surveillance Intervals", November 2001.

7.12. 1998 Edition of Subsection IWE and IWL, "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).

7.13. NEI Memo to the USNRC, 'One-time extensions of containment integrated leak rate test interval – additional information.' November 30, 2001

7.14. HCGS Probabilistic Safety Assessment, Revision 1.3, November 3, 2000.

7.15. HCGS Technical Specifications

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-54
DOCKET NO. 50-354
REVISIONS TO THE TECHNICAL SPECIFICATIONS (TS)

TECHNICAL SPECIFICATION PAGE WITH PROPOSED CHANGE

The following Technical Specification for Facility Operating License NPF-57 are affected by this change request:

Technical Specification	Page
6.8.4.f	6-16b

6.8.4.f **Primary Containment Leakage Rate Testing Program**

A program shall be established, implemented, and maintained to comply with the leakage rate testing of the containment as required by 10CFR50.54(o) and 10CFR50, Appendix J, Option B, as modified by approved exemptions. This program shall be in accordance with the guidelines contained in Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program", dated September 1995, as modified by the following exception:

The peak calculated containment internal pressure for the design basis loss of coolant accident, P_a, is 48.1 psig.

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

Leakage Rate Acceptance Criteria are:

a. Primary containment leakage rate acceptance criterion is less than or equal to 1.0 L_a. During the first unit startup following testing in accordance with this program, the leakage rate acceptance criteria are less than or equal to 0.6 L_a for Type B and Type C tests and less than or equal to 0.75 L_a for Type A tests;

b. Air lock testing acceptance criteria are:

   1) Overall air lock leakage rate is less than or equal to 0.05 L_a when tested at greater than or equal to P_a,

   2) Door seal leakage rate less than or equal to 5 scf per hour when the gap between the door seals is pressurized to greater than or equal to 10.0 psig.

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

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

6.8.4.g. **Radioactive Effluent Controls Program**

A program shall be provided conforming with 10 CFR 50.36a for the control of radioactive effluents and for maintaining the doses to MEMBER(S) OF THE PUBLIC from radioactive effluents as low as reasonably achievable. The program (1) shall be contained in the ODCM, (2) shall be implemented by operating procedures, and (3) shall include remedial actions to be taken whenever the program limits are exceeded. The program shall include the following elements:

a. NEI 94-01-1995, Section 9.2.3: The first Type A test performed after April 12, 1994 shall be performed no later than April 12, 2014.

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

Calculation H-1-ZZ-RZZ-0036, Rev. 0
PRA Analysis of HCGS ILRT Extension

CALC NO.: H-1-ZZ-RZZ-0036 REVISION: 0			CALCULATION COVER SHEET			Page 1 of 1	
CALC. TITLE:	PRA Analysis of HCGS ILRT Extension						
# SHTS (CALC):	28	# ATT / # SHTS:	11	# IDV/50.59 SHTS:	16	# TOTAL SHTS:	55

CHECK ONE:

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

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

HOPE CREEK ONLY: ☐Q ☐Qs ☐Qsh ☐F ☐R

☐ STATION PROCEDURES IMPACTED, IF SO CONTACT SYSTEM MANAGER

☐ CDs/ADs 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 current 10 years required by 10 CFR 50, Appendix J at Hope Creek Generating Station (HCGS) to 20 years. This calculation is used to support LCR H02-013.

CONCLUSIONS:

The change in Type A test frequency from once in every ten years to once in every twenty years increases the risk impact on the total integrated plant risk by only 0.19%. Also, the change in Type A test frequency from the original three times in every ten years to once in every twenty years increases the risk by only 0.32% 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 the increase in 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 in every 20 years is 4.382E-8/yr. It meets the guidance in Reg. Guide 1.174 as very small changes in LERF; therefore increasing the ILRT interval from 10 to 20 years is considered non-risk significant. The LERF increase for the cumulative change from a test frequency of three times in every ten years to once in every twenty years is 7.439E-8/yr which is still non-risk significant.

R.G 1.174 also encourages the use of risk analysis techniques to ensure 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 is estimated to be 0 49% for the proposed change and 0.83% for the cumulative change of going from a test frequency of three times in every ten years to once in every twenty years. These changes are small and that the defense-in-depth philosophy is maintained.

	Printed Name / Signature	Date
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REVIEWER/COMPANY NAME:	N/A	
VERIFIER/COMPANY NAME:	Tom Carrier / T.K. Carrier	09/24/02
PSEG SUPERVISOR APPROVAL:	Tom Carrier / T.K. Carrier	09/24/02

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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 Hope Creek Generating Station (HCGS) to 15 years or to 20 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 or 20 years.

- 3 years - interval based on the original requirements of 3 tests per 10 years
- 10 years – current test interval required for HCGS
- 15 years – interval extension proposed for HCGS
- 20 years – interval extension proposed for HCGS

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. HCGS Probabilistic Risk Assessment Individual Plant Examination Submittal, Revision 0, March 1994.
10. Scientech 17268-001, "Hope Creek MACCS2 Model," 9/2002.
11. EPRI Interim Guidance for Performing Risk Impact Assessments In Support of One-Time Extensions for Containment Integrated Leakage Rate Test Surveillance Intervals", November 2001.

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
14. HCGS Probabilistic Safety Assessment, Revision 1.3, November 3, 2000
15. HCGS Technical Specifications
16. Calculation S-C-ZZ-MEE-1613, "PRA Analysis of Salem Generation Station ILRT Extension"

3.0 METHODOLOGY

The evaluation for HCGS follows the guidelines set forth in NEI 94-01 [5], the methodology used in EPRI TR-104285 [6], NUREG-1493 [7] and EPRI Interim Guidance [11], 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 HCGS 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 HCGS IPE [9] and a Level 3 PRA study [10] performed by SCIENTECH for HCGS.

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)

HCGS has in place additional programs to provide for defense in depth relative to containment failure, including IWE/IWL and maintenance inspections of the containment. People familiar with the containment inspection program suggested that the visual inspection ought to detect concrete and liner failures. To be on the conservative side, this analysis does not credit detection of large 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.

[1] This point is noted in CR3 and IP3 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."

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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.
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 based on the previously approved methodology [2,3,11].
3. The maximum containment leakage for Class 3b sequences is 35 times the class 1 sequences based on the previously approved methodology [2,3,11].
4. Containment leakage due to Classes 4, 5 and 6 are considered negligible based on references [11].
5. The containment releases are not impacted with time.
6. 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.
7. This calculation uses the CDF from the latest HCGS PRA (Revision 1.3) and the release categories and frequency distribution in the HCGS IPE. This approach is used for following two reasons. First, the latest Level 1 PRA revision reflects the plant configuration more accurately, but the Level 2 PRA, except LERF, has not been updated. Second, the Level 2 PRA in the HCGS IPE is extensive and has enough information for distributing the latest CDF to various release categories. The CDF value used in this calculation is 8.89E-6/year, which is the CDF in the latest HCGS PRA.

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5.0 CALCULATION

The current HCGS PRA is a non-safety-related tool and is intended to provide "best-estimate" results that can be used as input when making risk-informed decisions. The HCGS IPE [9] is an earlier version of the PRA submitted to NRC in response to Generic Letter 88-20. The current PSA, Revision 1.3, is under revision. Neither the PSA 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] are referenced in the body of the calculation.

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 HCGS IPE [9]. The person-rem comes from a HCGS specific Level 3 PSA study [10]. 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
E1	Release is assumed to occur within four hours. High iodine (>6 %), and high tellurium (>6 %)	1.23E+07
E2	Release is assumed to occur within four hours. High iodine (>6 %), and Medium tellurium (10^{-1} % to 6 %), or Medium iodine (10^{-1} % to 6 %), and high tellurium (> 6 %)	1.47E+06
E3	Release is assumed to occur within four hours. At least one of medium iodine (>6 %) and medium tellurium (>6 %), and no high iodine (>6 %) or high tellurium (>6 %)	7.26E+05
E4	Release is assumed to occur within four hours. Low iodine (10^{-3} % to 10^{-1} %), and low tellurium (10^{-7} % to 10^{-1} %)	1.65E+05
L1	Late release. High iodine (>6 %), and high tellurium (>6 %)	1.06E+07
L2	Late release. High iodine (>6 %) and Medium tellurium (10^{-1} % to 6%), or Medium iodine (10^{-1} % to 6%) and high tellurium (> 6%)	1.38E+06
L3	Late release. At least one of medium iodine (10^{-1} % to 6%) and medium tellurium (10^{-1} % to 6%), and no high iodine (>6%) or high tellurium (>6%)	2.60E+05
L4	Late release. Low iodine (10^{-3} % to 10^{-1} %), and low tellurium (10^{-7} % to 10^{-1} %)	1.61E+04
L5	Late release. Low-low iodine (<10^{-3} %), and low-low tellurium (<10^{-7} %)	5.74E+03

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To be able to derive the population dose, the frequency of the release category is needed. The release category frequencies in HCGS IPE, Table 4.7-19 and release category fractions in Table 4.7-20 are listed in Table 2. These frequencies were based on a CDF value of 4.45E-05 and five initiators considered in the HCGS Level II IPE [9]. The release category distribution fractions in Table 2 are used to distribute the latest HCGS PRA CDF of 8.89E-06.

As described in the HCGS IPE, Section 4.7.2.2, the LT-SBO initiating event contains all sequences which can be represented by a loss of offsite power with the high pressure coolant injection, the reactor core isolation, and automatic depressurization system available for four hours. This initiating event also contains unrecovered loss of HVAC, since such an event eventually results in loss of the switchgear rooms and causes a station blackout. The Transient initiating event contains all transient sequences with RHR available while the TW initiating event contains all other transient sequences with loss of RHR. The LOCA initiating events include both medium and large LOCA sequences. There were no small break LOCA sequences that met the Level II screening criterion of 1.0E-07. The ATWS initiating event contains all the sequences in which the reactor is critical. It also includes sequences in which the reactor is critical and the plant experiences a coincident station blackout.

Table 2: Release Category Frequencies and Fractions for Each Accident Initiator (from HCGS IPE Table 4.7-19 and 4.7-20)

Initiator	Frequency	Release Category Frequencies for Each Accident Initiator								
		E1	E2	E3	E4	L1	L2	L3	L4	L5
LT-SBO	Fraction	2.43E-01	1.63E-01	1.78E-01	1.02E-01	8.12E-02	3.27E-02	2.10E-02	1.12E-01	6.71E-02
	3.46E-05	8.41E-06	5.64E-06	6.16E-06	3.53E-06	2.81E-06	1.13E-06	7.25E-07	3.87E-06	2.32E-06
TW	Fraction	3.74E-01	1.62E-01	1.95E-01	1.36E-02	1.09E-01	3.73E-04	5.88E-02	2.87E-02	5.88E-02
	2.37E-06	8.85E-07	3.84E-07	4.61E-07	3.21E-08	2.57E-07	8.82E-10	1.39E-07	6.78E-08	1.39E-07
Trans	Fraction	1.27E-04	1.63E-02	4.34E-02	3.08E-01	1.56E-05	2.60E-04	8.04E-03	2.33E-01	3.91E-01
	4.38E-06	5.54E-10	7.12E-08	1.90E-07	1.35E-06	6.83E-11	1.14E-09	3.52E-08	1.02E-06	1.71E-06
LOCA	Fraction	4.45E-02	1.36E-02	5.28E-02	6.11E-02	4.49E-02	3.49E-05	4.18E-01	3.85E-02	3.27E-01
	2.54E-06	1.13E-07	3.44E-08	1.34E-07	1.55E-07	1.14E-07	8.86E-11	1.06E-06	9.77E-08	8.30E-07
ATWS	Fraction	1.47E-02	1.71E-02	4.15E-02	3.01E-01	5.11E-03	0.00E+00	5.91E-03	2.39E-01	3.75E-01
	6.14E-07	9.04E-09	1.05E-08	2.55E-08	1.85E-07	3.14E-09	0.00E+00	3.63E-09	1.47E-07	2.30E-07
Total	Fraction	2.12E-01	1.38E-01	1.57E-01	1.18E-01	7.16E-02	2.54E-02	4.41E-02	1.17E-01	1.18E-01
	4.45E-05	**9.42E-06**	**6.14E-06**	**6.97E-06**	**5.25E-06**	**3.18E-06**	**1.13E-06**	**1.96E-06**	**5.20E-06**	**5.23E-06**

The latest CDF is distributed to five initiators. Then, the frequency in each initiator is further distributed to the nine release categories based on the fractions in table 2. In order to correctly distribute the latest CDF among the five initiators in HCGS IPE, the frequencies of all dominant Plant Damage Class (PDC), obtained from the latest HCGS PRA model, are mapped to match with one of the five initiators in the Level II IPE. The process of obtaining PDC frequencies from HCGS PSA, Rev. 1.3, is discussed below.

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1. Open the HCGS PSA Rev. 1.3 base model with WinNUPRA program,
2. Go to Results Module,
3. Select Integrated Results under Analysis,
4. Select SEQ Files, then open hcgs.seq file,
5. Display the result by Status Class.

The frequencies for dominant Plant Damage Class (PDC) obtained, using above steps, from the HCGS PSA Rev. 1.3 are listed in Table 3. The PDCs is a subset of those plant damage classes defined in Table 4.3.2 of HCGS PSA, Rev. 1. The PDCs not shown in Table 3 are cut off (less than 1E-10) in the WinNUPRA model and have insignificant contribution, in terms of frequency, to the total CDF. An initiator is assigned to for each PDC in Table 3 based on PDCs definitions and the discussion of each Level II initiating event in Section 4.7.2.2 of HCGS IPE.

Table 3: Plant Damage Class Frequencies and Initiators (from HCGS PSA Rev. 1.3)

PDC Class	Sum of Frequencies	Percentage	Definition	Initiator (Assigned)
C1A	4.959e-06	55.798	Accident sequences involving loss of inventory makeup in which the reactor pressure remains high.	Transient
C2C	1.214e-06	13.659	Accident sequences involving loss of containment heat removal with injection from external sources terminated prior to containment failure. RPV failure before or about the time of containment failure	TW
C1B	7.764e-07	8.737	Accident sequences involving loss of off-site and on-site power (SBO).	LT-SBO
C3B	6.481E-07	7.293	Accident sequences initiated by or resulting in small or medium LOCAs for which the reactor cannot be depressurized prior to core damage occuring.	LOCA
C1D	5.927E-07	6.669	Accident sequences involving loss of coolant makeup in which reactor pressure has been successfully reduced to 300psi.	Transient
C2A	5.359E-07	6.031	Accident sequences involving loss of containment heat removal with the RPV initially intact; core damage induced post containment failure.	TW
C3D	9.631E-08	1.084	Accident sequences which are initiated by a LOCA or RPV failure and for which the vapor suppression system is inadequate, challenging the containment integrity with subsequent failure of makeup systems.	LOCA
C3C	2.907E-08	0.327	Accident sequences initiated by or resulting in large or medium LOCAs for which the reactor is at a low pressure and no effective injection is available.	LOCA
C4A	2.480E-08	0.279	Accident sequences involving failure of adequate shutdown	ATWS

			reactivity with the RPV initially intact, core damage induced post containment failure. (MSIVs are closed)	
C4B	1.060E-08	0.119	Accident sequences initiated by ATWS sequences involving a loss of containment heat removal. (Condenser is available)	ATWS
C3A	2.500E-10	0.003	Accident sequences leading to core damage conditions initiated by vessel rupture where the containment integrity is not breached in the initial time phase of the accident.	LOCA

These frequencies are regrouped by the initiators, then redistributed, using the weighted fraction of each release category derived from Table 2, to each release category of every initiator. The results are listed in Table 4.

Table 4: Release Category frequencies for Each Accident Initiator (use CDF in PSA Rev. 1.3 and weighted fraction in IPE)

Initiator	Freq	Release Category Frequencies for Each Accident Initiator								
		E1	E2	E3	E4	L1	L2	L3	L4	L5
LT-SBO	Fraction	2.43E-01	1.63E-01	1.78E-01	1.02E-01	8.12E-02	3.27E-02	2.10E-02	1.12E-01	6.71E-02
	7.76E-07	1.89E-07	1.27E-07	1.38E-07	7.92E-08	6.31E-08	2.54E-08	1.63E-08	8.68E-08	5.21E-08
TW	Fraction	3.74E-01	1.62E-01	1.95E-01	1.36E-02	1.09E-01	3.73E-04	5.88E-02	2.87E-02	5.88E-02
	1.75E-06	6.53E-07	2.84E-07	3.40E-07	2.37E-08	1.90E-07	6.51E-10	1.03E-07	5.01E-08	1.03E-07
Trans	Fraction	1.27E-04	1.63E-02	4.34E-02	3.08E-01	1.56E-05	2.60E-04	8.04E-03	2.33E-01	3.91E-01
	5.55E-06	7.02E-10	9.02E-08	2.41E-07	1.71E-06	8.66E-11	1.44E-09	4.46E-08	1.29E-06	2.17E-06
LOCA	Fraction	4.45E-02	1.36E-02	5.28E-02	6.11E-02	4.49E-02	3.49E-05	4.18E-01	3.85E-02	3.27E-01
	7.74E-07	3.44E-08	1.05E-08	4.08E-08	4.72E-08	3.47E-08	2.70E-11	3.23E-07	2.98E-08	2.53E-07
ATWS	Fraction	1.47E-02	1.71E-02	4.15E-02	3.01E-01	5.11E-03	0.00E+00	5.91E-03	2.39E-01	3.75E-01
	3.54E-08	5.21E-10	6.05E-10	1.47E-09	1.07E-08	1.81E-10	0.00E+00	2.09E-10	8.48E-09	1.33E-08
Total	Fraction	9.88E-02	5.75E-02	8.57E-02	2.11E-01	3.24E-02	3.09E-03	5.48E-02	1.65E-01	2.91E-01
	8.89E-06	**8.78E-07**	**5.11E-07**	**7.62E-07**	**1.87E-06**	**2.88E-07**	**2.75E-08**	**4.87E-07**	**1.47E-06**	**2.59E-06**

Table 5 summarized the release category frequencies based on the CDF in the IPE and latest PSA. The frequencies, in the third column of Table 5, are used throughout this calculation because it is proper to use the updated CDF to assess the risk. By combining the data in Table 1 (person-rem) and Table 5 (frequency), the population dose can be derived for each release category.

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Table 5 Summary of Release Category Frequencies

HCGS IPE Release Category	Frequency Based on IPE Results from Table 4.7-19	Frequency Based on Rev. 1.3 Results
E1	9.42E-06	**8.78E-07**
E2	6.14E-06	**5.11E-07**
E3	6.97E-06	**7.62E-07**
E4	5.25E-06	**1.87E-06**
L1	3.18E-06	**2.88E-07**
L2	1.13E-06	**2.75E-08**
L3	1.96E-06	**4.87E-07**
L4	5.20E-06	**1.47E-06**
L5	5.23E-06	**2.59E-06**
Total	4.45E-05	**8.89E-06**

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 6: 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.

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.

All the sequences in HCGS IPE have been recreated in Attachment 1 (HCGS IPE Sequences in Containment Event Tree) to this calculation. Every sequence is mapped with one EPRI class based on the following rules:

1) Any sequence that involves containment failure (CFE or CFL) is assigned to Class 7 "Accidents involving containment failure...."
2) None of the sequences involve pre-existing failures to seal containment (eg. liner breach) or pre-existing type –B or C components failure to seal, or failure of penetrations, so no sequences are mapped to Classes 3, 4, 5 or 6.
3) None of the sequences involve containment bypass, so none are mapped to Class 8.
4) Any sequence that does not involve either CFE or CFL is mapped to Class 1, which is described as, "Containment remains intact."
5) All others that have "Vent" in CFE or CFL are considered as containment isolation failure and is mapped to Class 2.

The result of mapping is summarized in Table 7.1. It presents the sum of frequencies of sequences in HCGS IPE with the nine release categories mapping onto EPRI eight accident classes. The Table also lists the fractions of EPRI classes in each IPE release category. These fractions are needed so that the frequency of each release category, based on the latest CDF, in third column of Table 5, can be distributed to EPRI classes.

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Table 7.1: Frequencies of IPE Release Category Mapped with EPRI Class

IPE RC / EPRI Class		E1	E2	E3	E4	L1	L2	L3	L4	L5	SUM
1	Frequency							2.83E-10	0	5.23E-06	5.23E-06
	Fraction							1.44E-04	0.00E-00	1.00E+00	
2	Frequency	1.74E-09	1.99E-08	4.42E-08	1.66E-06	1.21E-08	1.17E-08	6.31E-08	4.55E-06	0	6.36E-06
	Fraction	1.84E-04	3.24E-03	6.35E-03	3.16E-01	3.79E-03	1.03E-02	3.22E-02	8.75E-01		
3											0
4											0
5											0
6											0
7	Frequency	9.42E-06	6.12E-06	6.92E-06	3.59E-06	3.17E-06	1.12E-06	1.90E-06	6.52E-07	0	3.29E-05
	Fraction	1.00E-00	9.97E-01	9.94E-01	6.84E-01	9.96E-01	9.90E-01	9.68E-01	1.25E-01		
8											0
SUM		9.42E-06	6.14E-06	6.97E-06	5.24E-06	3.18E-06	1.13E-06	1.96E-06	5.20E-06	5.23E-06	4.45E-05

Using the fractions in Table 7.1, the frequencies of each release category is distributed to applicable EPRI classes related to the release category. This step is required so that the person-rem for EPRI classes 1, 2, and 7 can be calculated based on frequency fractions of EPRI classes associated with each IPE release category. The frequencies of EPRI classes are tabulated in Table 7.2. The data, including frequency, person-rem and person-rem per year are listed in Table 8 for release categories with EPRI classification.

Table 7.2: Frequency of EPRI Class for Each Release Category

RC	Frequency (from Table 5)	EPRI 1 Fraction	EPRI 1 Frequency	EPRI 2 Fraction	EPRI 2 Frequency	EPRI 7 Fraction	EPRI 7 Frequency
E1	8.78E-07	0	0	1.84E-04	Negligible	1.00E-00	8.78E-07
E2	5.11E-07			3.24E-03	1.66E-09	9.97E-01	5.10E-07
E3	7.62E-07			6.35E-03	4.84E-09	9.94E-01	7.57E-07
E4	1.87E-06			3.16E-01	5.92E-07	6.84E-01	1.28E-06
L1	2.88E-07			3.79E-03	1.09E-09	9.96E-01	2.87E-07
L2	2.75E-08			1.03E-02	2.84E-10	9.90E-01	2.72E-08
L3	4.87E-07	1.44E-04	7.03E-11	3 22E-02	1.57E-08	9.68E-01	4.71E-07
L4	1.47E-06	0	0	8.75E-01	1.28E-06	1.25E-01	1.84E-07
L5	2.59E-06	1.00E+00	2.59E-06	0	0	0	0
Sum	8.89E-06						

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Table 8 : EPRI Classification of HCGS Release Category Data
(Person-Rem per/yr is the product of the frequency/yr and the Person-Rem)

Release Category	EPRI Class	Frequency per year	Person-Rem	Person-Rem/Yr	Sum of Frequency by EPRI Class	Sum of Person-rem/ Yr by EPRI Class	Weighted average Person-rem by EPRI Class
L3	1	7.03E-11	2.60E+05	1.828E-05			
L5	1	2.59E-06	5.74E+03	1.486E-02	2.588E-06	1.487E-02	**5.747E+03**
E2	2	1.66E-09	1.47E+06	2.435E-03			
E3	2	4.84E-09	7.26E+05	3.512E-03			
E4	2	5.92E-07	1.65E+05	9.773E-02			
L1	2	1.09E-09	1.06E+07	1.157E-02			
L2	2	2.84E-10	1.38E+06	3.922E-04			
L3	2	1.57E-08	2.60E+05	4.074E-03			
L4	2	1.28E-06	1.61E+04	2.067E-02	1.900E-06	1.404E-01	**7.389E+04**
E1	7	8.78E-07	1.23E+07	1.079E+01			
E2	7	5.10E-07	1.47E+06	7.493E-01			
E3	7	7.57E-07	7.26E+05	5.495E-01			
E4	7	1.28E-06	1.65E+05	2.111E-01			
L1	7	2.87E-07	1.06E+07	3.039E+00			
L2	7	2.72E-08	1.38E+06	3.753E-02			
L3	7	4.71E-07	2.60E+05	1.224E-01			
L4	7	1.84E-07	1.61E+04	2.963E-03	4.393E-06	1.551E+01	**3.530E+06**

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

As displayed in Table 7.1, the HCGS IPE did not identify release categories specifically associated with EPRI Classes 3, 4, 5, 6 or 8. Therefore, each of these classes is evaluated for applicability to HCGS.

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).

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To calculate the probability of a large liner leak (Class 3b), the data presented in NUREG-1493 [7] and new data presented by the EPRI Interim Guidance [11] were used. 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 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
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 pre-existing release path through suppression pool

HCGS IPE divides release into nine groups as defined in Table 1. The first four groups, E1 to E4, are LERF contributors that will not be impacted by Type A test. The remaining five groups, L1 through L5, are considered that can be impacted by the Type A test. For HCGS, the core damage sequences that will be impacted by the Type A test are about 4.858E-6/year, sum of CDF for L1 through L5. Therefore, the frequency of release due to Class 3b is calculated as:

$$FREQ_{class3b} = PROB_{class3b} \times CDF = 0.0027 \times 4.86E\text{-}06/yr = 1.312E\text{-}08/yr$$

To calculate the probability of a small liner leak (Class 3a), the data presented in NUREG-1493 [7] and the EPRI Interim Guidance were used. 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 were 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:

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$FREQ_{class3a} = PROB_{class3a}$ x CDF = 0.027 x 4.86E-06/yr = 1.312-07/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, the likelihood of this failure class 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, the likelihood of this failure class 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 consists of all core damage accident sequences in which the containment isolation function is failed due to 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 would not be identifiable by containment leak rate tests. This failure class is not impacted by Type A testing frequency, no further evaluation is needed. This is consistent with the NEI Interim Guidance.

Class 8:

This group consists of all core damage accidents in which containment is bypassed. As indicated in HCGS PSA Revision 1.3, the CDF of interfacing system LOCA is about 0.02% of the total CDF, and the frequency, 1.70E-09, is negligible.

Class 1:

Although the frequency of this failure class is not directly impacted by Type A testing, the HCGS IPE did not model Class 3 failures, and the frequency for Class 1, as shown in sixth column of Table 8, should be reduced by the estimated frequencies in the new Class 3a and Class 3b in order to preserve the total CDF. This is consistent with the NEI Interim Guidance. The revised Class 1 frequency is therefore:

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

$FREQ_{class1}$ = 2.588E-06 – (1.312E-07 + 1.312E-08) = 2.444E-06/yr

Class 2:

The frequency of Class 2 is the sum of those release categories identified in sixth column of Table 8 as Class 2.

$FREQ_{class2}$ = 1.900E-06/yr

Class 7:

The frequency of Class 7 is the sum of those release categories identified in sixth column of Table 8 as Class 7.

$FREQ_{class7}$ = 4.393E-06/yr

Table 9 summarizes the above information by the EPRI defined classes. This table also presents exposures using the results of the HCGS Level 3 analysis or the La multiples recommended in the EPRI interim guidance [11]. For the Level 3 exposures, the weighted average[2] was used for each EPRI classification.

Table 9: Release Data Summarized by EPRI Class

Class	Description	Frequency (per year)	Person-Rem (from Table 8)	Person-Rem (La Multiplier)
1	No Containment Failure	2.444E-06	5.747E+03	
2	Large Containment Isolation Failures (Failure to close)	1.900E-06	7.389E+05	
3a*	Small Isolation Failures (Type A test)	1.312E-07		5.747E+04
3b*	Large Isolation Failures (Type A test)	1.312E-08		2.011E+05
4	Small Isolation Failures - failure-to-seal (Type B test)	N/A		
5	Small Isolation Failures - failure-to-seal (Type C test)	N/A		
6	Other Isolation Failures (dependent failures)	N/A		
7	Failure Induced by Phenomena (Early and late failures)	4.393E-06	3.530E+06	
8	Containment Bypasses (ISLOCA)	Negligible		
CDF	All Classes	8.887E-06		

Based on the above table, it can be seen that the HCGS Level 3 results do not contain specific dose results for Classes 3a and 3b. The NEI Guidance recommends containment leakage rates of 10 La and 35 La for category 3a and 3b

[2] 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 over-weighted and 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.

respectively. La is the plant Technical Specification maximum allowable primary containment leakage rate. For HCGS, La is 0.5% of primary containment air weight per day as defined in HCGS Technical Specifications Section 6.8.4.f [15]. The Class 3a equals 10 times the Class 1 release and Classes 3b equals 35 times Class 1 release.

Table 10 presents the person-rem frequency data determined by multiplying the frequency for each failure class by the corresponding exposure.

Table 10: Baseline Mean Consequence Measures for 3-Year Test Interval

Class	Description	Frequency (per year)	Person-rem (Level 3)	Person-rem per year
1	No Containment Failure	2.444E-06	5.747E+03	1.405E-02
2	Large Containment Isolation Failures (failure to close)	1.900E-06	7.389E+04	1.404E-01
3a*	Small Isolation Failures (Type A test)	1.312E-07	5.747E+04	7.540E-03
3b*	Large Isolation Failures (Type A test)	1.312E-08	2.011E+05	2.639E-03
4	Small Isolation Failures - failure-to-seal (Type B test)	NA		
5	Small Isolation Failures - failure-to-seal (Type C test)	NA		
6	Other Isolation Failures (dependent failures)	NA		
7	Failure Induced by Phenomena (Early and late failures)	4.393E-06	3.530E+06	1.551E+01
8	Containment Bypasses (ISLOCA)	Negligible		
Total	Sum of All Classes	8.887E-06		1.5673E+01

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 = 7.540E-03 person-rem/year

$Class3b_{BASE}$ = Class 3b person-rem/year = 2.639E-03 person-rem/year

$Total_{BASE}$ = total person-rem year for baseline interval = 1.567E+01 person-rem/year

$\%Risk_{BASE} = [(7.540E\text{-}03+2.639E\text{-}03) / 1.567E\text{+}01] \times 100\% = 0.0650\%$

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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 then multiplying by 12 to convert 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 would 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 11 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 11: Mean Consequence Measures for 10-Year Test Interval

Class	Description	Frequency (per year)	Person-Rem (Level 3)	Person-Rem per year
1	No Containment Failure	2.108E-06	5.747E+03	1.211E-02
2	Large Containment Isolation Failures (failure to close)	1.900E-06	7.389E+05	1.404E-01
3a*	Small Isolation Failures (Type A test)	4.369E-07	5.747E+04	2.511E-02
3b*	Large Isolation Failures (Type A test)	4.369E-08	2.011E+05	8.788E-03
4	Small Isolation Failures - failure-to-seal (Type B test)	NA		
5	Small Isolation Failures - failure-to-seal (Type C test)	NA		
6	Other Isolation Failures (dependent failures)	NA		
7	Failure Induced by Phenomena (Early and late failures)	4 393E-06	3.530E+06	1.551E+01
8	Containment Bypasses (ISLOCA)	Negligible		
Total	Sum of All Classes	8.887E-06		1.569E+01

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Using the same methods as for the baseline, and using the data in Table 11, 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: $Class3a_{10}$ = Class 3a person-rem/year = 2.511E-02 person-rem/year

$Class3b_{10}$ = Class 3b person-rem/year = 8.788E-03 person-rem/year

$Total_{10}$ = total person-rem year for baseline interval = 1.569E+01 person-rem/year

$\%Risk_{10}$ = [(2.511E-02 + 8.788E-03) / 1.569E+01] x 100% = 0.216%

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 = 1.569E+01 person-rem/year

$Total_{10}$ = total person-rem/year for 10-year interval = 1.567E+01 person-rem/year

$\Delta\%Risk_{10}$ = [(1.569E+01 – 1.567E+01) / 1.567E+01] x 100%= 0.13%

<u>Step 5: Calculate the Type A leakage estimate to address extended inspection intervals</u>

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 12. 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 12: Mean Consequence Measures for 15-Year test Interval

Class	Description	Frequency (per year)	Person-Rem (Level 3)	Person-Rem per year
1	No Containment Failure	1.867E-06	5.747E+03	1.073E-02
2	Large Containment Isolation Failures (failure to close)	1.900E-06	7.389E+04	1.404E-01
3a*	Small Isolation Failures (Type A test)	6.560E-07	5.747E+04	3.770E-02
3b*	Large Isolation Failures (Type A test)	6.560E-08	2.011E+05	1.319E-02

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4	Small Isolation Failures - failure-to-seal (Type B test)	NA		
5	Small Isolation Failures - failure-to-seal (Type C test)	NA		
6	Other Isolation Failures (dependent failures)	NA		
7	Failure Induced by Phenomena (Early and late failures)	4.393E-06	3.530E+06	1.551E+01
8	Containment Bypasses (ISLOCA)	Negligible		
Total	Sum of All Classes	8.885E-06		1.571E+01

Using the same methods as for the baseline, and the data in Table 12, 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 = 3.770E-02 person-rem/year

$Class3b_{15}$ = Class 3b person-rem/year = 1.319E-02 person-rem/year

$Total_{15}$ = total person-rem year for baseline interval = 1.571E+01 person-rem/year

$\%Risk_{15} = [(3.770E\text{-}02 + 1.319E\text{-}02) / 1.571E{+}01] \times 100\% = 0.324\ \%$

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

$\Delta\%Risk_{15} = [(Total_{15} - Total_{BASE}) / Total_{BASE}] \times 100\%$

Where: $Total_{BASE}$ = total person-rem/year for baseline interval = 1.567E+01 person-rem/year

$Total_{15}$ = total person-rem/year for 15-year interval = 1.571E+01 person-rem/year

$\Delta\%Risk_{15} = [(1.571E{+}01 - 1.567E{+}01) / 1.567E{+}01] \times 100\% = 0.255\%$

Risk Impact due to 20-year Test Interval

If the test interval is extended to 1 in 20 years, the mean time that a leak detectable only by an ILRT test goes undetected increases to 120 months (0.5 * 20 * 12). The reference 11 suggested to use a factor of 6.67 (120/18) to account for the increased likelihood of fail to detect, which will be implemented here. The results for this calculation are presented in Table 13. Same as the baseline case, the PSA frequency of Class 1 has been reduced by the frequency of Class 3a and 3b in order to preserve total CDF.

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Table 13: Mean Consequence Measures for 20-Year test Interval

Class	Description	Frequency (per year)	Person-Rem (Level 3)	Person-Rem per year
1	No Containment Failure	1.626E-06	5.747E+03	9.343E-03
2	Large Containment Isolation Failures (failure to close)	1.900E-06	7.389E+04	1.404E-01
3a*	Small Isolation Failures (Type A test)	8.751E-07	5.747E+04	5.029E-02
3b*	Large Isolation Failures (Type A test)	8.751E-08	2.011E+05	1.760E-02
4	Small Isolation Failures - failure-to-seal (Type B test)	NA		
5	Small Isolation Failures - failure-to-seal (Type C test)	NA		
6	Other Isolation Failures (dependent failures)	NA		
7	Failure Induced by Phenomena (Early and late failures)	4.393E-06	3.5306E+06	1.551E+01
8	Containment Bypasses (ISLOCA)	Negligible		
Total	Sum of All Classes	8.885E-06		1.572E+01

Using the same methods as for the baseline, and the data in Table 13, the percent Risk Contribution due to release classes affected by the Type A Test interval is as follows:

$\%Risk_{20} = [(Class3a_{20} + Class3b_{20}) / Total_{20}] \times 100\%$

where: $Class3a_{20}$ = Class 3a person-rem/year = 5.029E-02 person-rem/year

$Class3b_{20}$ = Class 3b person-rem/year = 1.760E-02 person-rem/year

$Total_{20}$ = total person-rem year for baseline interval = 1.572E+01 person-rem/year

$\%Risk_{20}$ = [(5.029E-02 + 1.760E-02) /1.572E+01] x 100% = 0.43 %

The percent risk increase ($\Delta\%Risk_{20}$) due to a twenty-year ILRT over the baseline case is as follows:

$\Delta\%Risk_{20} = [(Total_{20} - Total_{BASE}) / Total_{BASE}] \times 100\%$

Where: $Total_{BASE}$ = total person-rem/year for baseline interval = 1.567E+01 person-rem/year

$Total_{20}$ = total person-rem/year for 20-year interval = 1.572E+01 person-rem/year

$\Delta\%Risk_{20}$ = [(1.572E+01–1.567E+01) /1.567E+01] x 100.0 = 0.319%

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

Extension of interval from 10 years to 15 years

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)
= (1.211E-02+ 2.511E-02+8.788E-03) person-rem/yr = 4.601E-02 person-rem/yr [Table 11]

$PER\text{-}REM_{15}$ = person-rem/year for fifteen-year interval (for classes 1, 3a, and 3b)
= (1.073E-2+3.770E-2+1.319E-2) person-rem/yr = 6.162E-2 person-rem/yr [Table 12]

$\%Risk_{10\text{-}15}$ = [(6.162E-2 – 4.601E-2) / 4.601E-2] x 100% = 33.93%

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 = 1.569E+1 person-rem/year [Table 11]

$Total_{15}$ = total person-rem/year for fifteen-year interval = 1.571E+1 person-rem/year [Table 12]

$\% Total_{10\text{-}15}$ = [(1.571E+1–1.569E+1) /1.569E+1] x 100 = 0.13%

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 = 1.567E+1 person-rem/year [Table 10]

$Total_{15}$ = total person-rem/year for fifteen-year interval = 1.571E+1 person-rem/year [Table 12]

$\% Total_{3\text{-}15}$ = [(1.571E+1–1.5673E+1) /1.5673E+1] x 100 = 0.26 %

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Extension of interval from 10 years to 20 years

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.

$\%Risk_{10\text{-}20} = [(PER\text{-}REM_{20} - PER\text{-}REM_{10}) / PER\text{-}REM10] \times 100$

where: $PER\text{-}REM_{10}$ = person-rem/year for ten-year interval (for classes 1, 3a, and 3b)
= (1.211E-2 + 2.511E-2+8.788E-3) person-rem/yr = 4.601E-2 person-rem/yr [Table 11]

$PER\text{-}REM_{20}$= person-rem/year for fifteen-year interval (for classes 1, 3a, and 3b)
= (9.343E-3+5.029E-2+1.760E-2) person-rem/yr = 7.724E-2 person-rem/yr [Table 13]

$\%Risk_{10\text{-}20}$ = [(7.724E-2 – 4.601E-2) / 4.601E-2] x 100 = 67.87%

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

$\%Total_{10\text{-}20} = [(Total_{20} - Total_{10}) / Total_{10}] \times 100\%$

where: $Total_{10}$ = total person-rem/year for ten-year interval = 1.569E+1 person-rem/year [Table 11]

$Total_{20}$ = total person-rem/year for twenty-year interval = 1.572E+1 person-rem/year [Table 13]

$\% Total_{10\text{-}20}$ = [(1.572E+1 – 1.569E+1) /1.569E+1] x 100% = 0.19%

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

$\%Total_{3\text{-}20} = [(Total_{20} - Total_3) / Total_3] \times 100\%$

where: $Total_3$ = total person-rem/year for three-year interval = 1.567E+1 person-rem/year [Table 10]

$Total_{20}$ = total person-rem/year for fifteen-year interval = 1.572E+1 person-rem/year [Table 13]

$\% Total_{3\text{-}20}$ = [(1.572E+1–1.567E+1) /1.567E+1] x 100 = 0.32 %

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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:

$$LERF_{baseline} = 0.0027 \times 4.858E\text{-}6/yr = 1.312E\text{-}8/year$$

The visual inspection (IWE) will very likely detect large liner failure. For HCGS, a 100% IWE was performed in RF09 in 2000 and will be performed in RF11 in 2003. For this analysis, to be conservative, this analysis does not credit the detection of large liner failures. Thus, the likelihood of failure to detect a large liner failure is assumed to be 1.00. Therefore, LERFs for 10, 15 and 20 year test intervals are:

$$LERF_{10year} = LERF_{baseline} \times 3.33 \times 1.00 = 4.369E\text{-}8$$

$$LERF_{15year} = LERF_{baseline} \times 5.00 \times 1.00 = 6.560E\text{-}8$$

$$LERF_{20year} = LERF_{baseline} \times 6.67 \times 1.00 = 8.751E\text{-}8$$

Thus, the estimation for LERF changes from the 10-year interval to the 15-year test interval is 2.191E-08/year. The LERF change from the 3-year interval to the 15-year test interval is 5.248E-08/year. Similarly, the estimation for LERF changes from the 10-year interval to the 20-year test interval is 4.382E-08/year. The LERF change from the 3-year interval to the 20-year test interval is 7.439E-08/year. The following table summarizes the results:

Table 14: Change in LERF Due to Extending Type A testing Intervals

	3-Year Interval (baseline)	10-Year Interval	15-Year Interval	20-Year Interval
Type A LERF (Class 3b)	1.312E-08/yr	4.369E-08/yr	6.560E-08/yr	8.751E-08/yr
ΔLERF (from 10-Year interval)			2.191E-08/yr	4.382E-08/yr
ΔLERF (from 3-Year interval)			5.248E-08/yr	7.439E-08/yr

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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 in the above table, increasing the ILRT interval from 10 to 20 years (4.382E-08/yr) is non-risk-significant. In addition, increasing the ILRT interval from 3 to 20 years (7.439E-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 11 and Table 12:

$$\Delta CCFP_{10-15} = \left[\frac{(2.108E-06)+(4.369E-07)}{8.89E-06}\right]_{10} - \left[\frac{(1.867E-06)+(6.560E-07)}{8.89E-06}\right]_{15} = 0.25\%$$

Using the data from Table 10 and Table 12 provide the change in CCFP from the baseline case:

$$\Delta CCFP_{3-15} = \left[\frac{(2.444E-06)+(1.312E-07)}{8.89E-06}\right]_{3} - \left[\frac{(1.867E-06)+(6.560E-07)}{8.89E-06}\right]_{15} = 0.59\%$$

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Similarly, the change in CCFP for this analysis is the CCFP using the results for 20 years (CCFP20) minus the CCFP using the results for 10 years ($CCFP_{10}$). This can be expressed by the following:

$$\Delta CCFP_{10-20} = \left[\frac{f_{Class1} + f_{Class3a}}{CDF}\right]_{10} - \left[\frac{f_{Class1} + f_{Class3a}}{CDF}\right]_{20}$$

Using the data from Table 11 and Table 13:

$$\Delta CCFP_{10-20} = \left[\frac{(2.108E-06)+(4.369E-07)}{8.89E-06}\right]_{10} - \left[\frac{(1.626E-06)+(8.751E-07)}{8.89E-06}\right]_{20} = 0.49\%$$

Using the data from Table 10 and Table 13 provide the change in CCFP from the baseline case:

$$\Delta CCFP_{3-20} = \left[\frac{(2.444E-06)+(1.312E-07)}{8.89E-06}\right]_{3} - \left[\frac{(1.626E-06)+(8.751E-07)}{8.89E-06}\right]_{20} = 0.83\%$$

6.0 RESULTS

The specific results are summarized in Table 15 below. In summary:

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 0.02 person-rem/yr, and from the current once every 10 years to once every 20 years is 0.03 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 0.13%, and from the current once every 10 years to once every 20 years is 0.19%
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 2.191 x 10^{-8}/yr, and from the current once every 10 years to once every 20 years is 4.382 x 10^{-8}/yr.
4. The change in CCFP from the current 10-year interval to a 15-year interval is 0.25%, and from the current 10-year interval to a 20-year interval is 0.49%.

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 twenty years.

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The change in Type A test frequency from once in every ten years to once in every twenty years increases the risk impact on the total integrated plant risk by only 0.19%. Also, the change in Type A test frequency from the original three times in every ten years to once in every twenty years increases the risk by only 0.32%. 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 the increase in 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 in every 20 years is 4.382E-8/yr. It meets the guidance in Reg. Guide 1.174 as very small changes in LERF therefore increasing the ILRT interval from 10 to 20 years is considered non-risk significant. The LERF increase for the cumulative change from a test frequency of three times in every ten years to once in every twenty years is 7.439E-8/yr which is still non-risk significant.

R.G. 1.174 also encourages the use of risk analysis techniques to ensure 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 is estimated to be 0.49% for the proposed change and 0.83% for the cumulative change of going from a test frequency of three times in every ten years to once in every twenty years. These changes are small and that the defense-in-depth philosophy is maintained.

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Table 15: Summary of Risk Impact on Extending Type An 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)	Risk Impact for 20-year interval (proposed)
Total Integrated Risk (Person-Rem/yr)	15.67	15.69	15.71	15.72
Type A Testing Risk (Person-Rem/yr)	0.010	0.034	0.051	0.068
% Total Risk (Type A / Total)	0.065%	0.216%	0.324%	0.432%
Type A LERF (Class 3b) (per year)	1.312E-08	4.369E-08	6.560E-08	8.751E-08
Changes due to extension from 10 years (current)				
Δ Risk from current (Person-rem/yr)			0.02	0.03
% Increase from current (Δ Risk / Total Risk)			0.13%	0.19%
Δ LERF from current (per year)			2.191E-08	4.382E-08
Δ CCFP from current			0.25%	0.49%
Changes due to extension from 3 years (baseline)				
Δ Risk from baseline (Person-rem/yr)			0.04	0.05
% Increase from baseline (Δ Risk / Total Risk)			0.26%	0.32%
Δ LERF from baseline (per year)			5.248E-08	7.439E-08
Δ CCFP from baseline			0.59%	0.83%

FORM 2
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CALCULATION CONTINUATION SHEET

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Attachment 1: HCGS IPE Sequences in Containment Event Tree

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
ATWS	5.51E-08	Y	N	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
ATWS	3.34E-11	Y	N	Y	N	Y	Y	Y	Y	N	N	IRR	IRR	L5	1
ATWS	6.49E-09	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
ATWS	5.93E-10	Y	N	Y	N	Y	Y	Y	N	VT	Y	Y	N	L4	2
ATWS	1.14E-11	Y	N	Y	N	Y	Y	Y	N	VT	N	Y	N	L3	2
ATWS	1.23E-11	Y	N	Y	N	Y	N	Y	Y	Y	N	Y	Y	L4	7
ATWS	5.15E-10	Y	N	Y	N	Y	N	Y	Y	VT	Y	Y	N	L4	2
ATWS	1.30E-11	Y	N	Y	N	Y	N	Y	Y	VT	N	Y	N	L3	2
ATWS	4.88E-10	Y	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
ATWS	3.69E-11	Y	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
ATWS	3.53E-11	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
ATWS	2.01E-10	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	E4	7
ATWS	5.08E-09	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	E4	7
ATWS	2.12E-10	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	N	E3	7
ATWS	3.56E-11	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
ATWS	1.05E-09	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
ATWS	1.40E-09	Y	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
ATWS	9.59E-11	Y	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
ATWS	5.89E-09	Y	N	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2
ATWS	1.98E-10	Y	N	Y	VT	Y	Y	Y	Y	N	N	Y	N	E4	2
ATWS	4.14E-11	Y	N	Y	VT	Y	Y	Y	N	N	Y	Y	N	E4	2
ATWS	6.70E-10	Y	N	Y	VT	Y	Y	Y	N	Y	N	Y	Y	E4	7
ATWS	4.71E-11	Y	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
ATWS	3 80E-11	Y	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
ATWS	4.20E-11	Y	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
ATWS	6.77E-11	Y	N	Y	VT	N	Y	Y	Y	N	N	Y	N	E3	2
ATWS	1.75E-07	N	N	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
ATWS	9.83E-11	N	N	Y	N	Y	Y	Y	Y	N	N	IRR	IRR	L5	1
ATWS	9.90E-08	N	N	Y	N	Y	Y	Y	Y	VT	Y	Y	N	L4	2
ATWS	6 21E-09	N	N	Y	N	Y	Y	Y	Y	VT	N	Y	N	L4	2
ATWS	2.81E-08	N	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
ATWS	2.66E-09	N	N	Y	N	Y	Y	Y	N	VT	Y	Y	N	L4	2
ATWS	1.16E-10	N	N	Y	N	Y	Y	Y	N	VT	N	Y	N	L3	2
ATWS	1.25E-10	N	N	Y	N	Y	N	Y	Y	Y	N	Y	Y	L4	7
ATWS	3.01E-09	N	N	Y	N	Y	N	Y	Y	VT	Y	Y	N	L4	2

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IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
ATWS	1.43E-10	N	N	Y	N	Y	N	Y	Y	VT	N	Y	N	L3	2
ATWS	2.80E-09	N	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
ATWS	2.48E-10	N	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
ATWS	3.36E-11	N	N	Y	N	N	Y	Y	Y	N	N	IRR	IRR	L5	1
ATWS	2.10E-11	N	N	Y	N	N	Y	Y	Y	VT	N	Y	N	L3	2
ATWS	1.01E-10	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	E4	7
ATWS	9.78E-09	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	E4	7
ATWS	9.96E-08	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	E4	7
ATWS	5.30E-10	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	E4	7
ATWS	7.96E-09	N	N	Y	Y	Y	Y	Y	N	N	N	Y	N	E3	7
ATWS	1.09E-09	N	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
ATWS	1.42E-08	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
ATWS	8.72E-11	N	N	Y	Y	Y	N	Y	N	N	N	Y	Y	E3	7
ATWS	9.12E-09	N	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
ATWS	1.36E-10	N	N	Y	Y	N	Y	Y	Y	N	N	Y	N	E3	7
ATWS	5.27E-08	N	N	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2
ATWS	2.05E-09	N	N	Y	VT	Y	Y	Y	Y	N	N	Y	N	E4	2
ATWS	5.03E-10	N	N	Y	VT	Y	Y	Y	N	N	Y	Y	N	E4	2
ATWS	5.38E-09	N	N	Y	VT	Y	Y	Y	N	Y	N	Y	Y	E4	7
ATWS	6.03E-10	N	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
ATWS	4.62E-10	N	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
ATWS	2.48E-11	N	N	Y	VT	Y	N	Y	N	N	Y	Y	N	E4	2
ATWS	5.21E-10	N	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
ATWS	6.47E-10	N	N	Y	VT	N	Y	Y	Y	N	N	Y	N	E3	2
ATWS	6.07E-11	N	N	Y	VT	N	Y	Y	N	Y	N	Y	Y	E3	7
ATWS	2.92E-09	N	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
ATWS	2.19E-10	N	N	Y	N	Y	N	N	N	Y	N	N	N	L1	7
ATWS	2.38E-11	N	N	Y	Y	Y	N	N	N	N	N	Y	N	E1	7
ATWS	8.91E-09	N	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
LOCA	6.83E-07	Y	N	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
LOCA	8.33E-08	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
LOCA	9.63E-11	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	N	L3	7
LOCA	8.07E-09	Y	N	Y	N	Y	Y	Y	N	VT	Y	Y	N	L4	2
LOCA	4.57E-10	Y	N	Y	N	Y	Y	Y	N	VT	N	Y	N	L3	2
LOCA	2.14E-08	Y	N	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1
LOCA	1.89E-08	Y	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
LOCA	1.01E-11	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	L2	7

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

	Attachment 1	SHEET: 3 of 11

CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension			REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02	
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02	

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
LOCA	1.80E-09	Y	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
LOCA	7.85E-11	Y	N	Y	N	Y	N	Y	N	VT	N	Y	N	L2	2
LOCA	9 26E-07	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
LOCA	4.36E-09	Y	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
LOCA	9.80E-08	Y	N	Y	N	Y	N	N	N	Y	N	N	N	L1	7
LOCA	4.53E-09	Y	N	Y	N	Y	N	N	N	VT	Y	Y	N	L4	2
LOCA	2.40E-10	Y	N	Y	N	Y	N	N	N	VT	N	Y	N	L1	2
LOCA	6.49E-10	Y	N	Y	N	N	Y	Y	Y	N	N	IRR	IRR	L5	1
LOCA	4.95E-11	Y	N	Y	N	N	Y	Y	N	Y	N	Y	Y	L3	7
LOCA	1.25E-07	Y	N	Y	N	N	N	Y	Y	N	N	IRR	IRR	L5	1
LOCA	1.11E-07	Y	N	Y	N	N	N	Y	N	Y	N	Y	Y	L3	7
LOCA	1.37E-10	Y	N	Y	N	N	N	Y	N	Y	N	Y	N	L1	7
LOCA	1.14E-08	Y	N	Y	N	N	N	Y	N	VT	N	Y	N	L1	2
LOCA	3.41E-09	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	E4	7
LOCA	6.56E-08	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	E4	7
LOCA	3.57E-09	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	N	E3	7
LOCA	1.34E-10	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
LOCA	3.48E-09	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
LOCA	3.36E-10	Y	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
LOCA	3.97E-10	Y	N	Y	Y	Y	N	N	N	N	N	Y	Y	E3	7
LOCA	1.50E-11	Y	N	Y	Y	Y	N	N	N	N	N	N	Y	E3	7
LOCA	9.70E-08	Y	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
LOCA	3.41E-10	Y	N	Y	Y	N	Y	Y	Y	N	N	Y	N	E3	7
LOCA	9.77E-10	Y	N	Y	Y	N	N	Y	Y	N	N	Y	Y	E3	7
LOCA	1.96E-08	Y	N	Y	Y	N	N	Y	Y	N	N	Y	N	E2	7
LOCA	1.02E-11	Y	N	Y	Y	N	N	Y	N	N	N	Y	Y	E3	7
LOCA	2.35E-09	Y	N	Y	Y	N	N	Y	N	N	N	Y	N	E1	7
LOCA	4.56E-10	Y	N	Y	Y	N	N	N	N	N	N	N	N	E1	7
LOCA	7.34E-08	Y	N	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2
LOCA	9.47E-10	Y	N	Y	VT	Y	Y	Y	N	N	Y	Y	N	E4	2
LOCA	8.90E-09	Y	N	Y	VT	Y	Y	Y	N	Y	N	Y	Y	E4	7
LOCA	2.28E-09	Y	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
LOCA	6.89E-10	Y	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
LOCA	2.00E-10	Y	N	Y	VT	Y	N	Y	N	N	Y	Y	N	E4	2
LOCA	2.05E-09	Y	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
LOCA	5.37E-10	Y	N	Y	VT	Y	N	N	N	N	Y	Y	N	E4	2
LOCA	1.00E-07	Y	N	Y	VT	Y.	N	N	N	Y	N	Y	Y	E3	7

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

	Attachment 1	SHEET: 4 of 11
CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension		REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
LOCA	4.45E-10	Y	N	Y	VT	Y	N	N	N	Y	N	Y	N	E1	7
LOCA	1.06E-08	Y	N	Y	VT	Y	N	N	N	Y	N	N	N	E1	7
LOCA	3.89E-09	Y	N	Y	VT	N	Y	Y	Y	N	N	Y	N	E3	2
LOCA	3.61E-11	Y	N	Y	VT	N	Y	Y	N	N	N	Y	N	E3	2
LOCA	4.31E-10	Y	N	Y	VT	N	Y	Y	N	Y	N	Y	Y	E3	7
LOCA	1.43E-08	Y	N	Y	VT	N	N	Y	Y	N	N	Y	N	E2	2
LOCA	1.33E-09	Y	N	Y	VT	N	N	Y	N	N	N	Y	N	E1	2
LOCA	1.27E-08	Y	N	Y	VT	N	N	Y	N	Y	N	Y	Y	E3	7
LOCA	2.54E-11	Y	N	Y	VT	N	N	N	N	N	N	Y	N	E1	2
LOCA	5.23E-09	Y	N	Y	VT	N	N	N	N	Y	N	Y	Y	E3	7
LOCA	1.25E-11	Y	N	Y	VT	N	N	N	N	Y	N	Y	N	E1	7
LOCA	5.37E-10	Y	N	Y	VT	N	N	N	N	Y	N	N	N	E1	7
SBO	1.37E-10	Y	Y	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
SBO	1.09E-11	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
SBO	1.12E-10	Y	Y	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1
SBO	1.21E-11	Y	Y	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2
SBO	1.82E-07	Y	Y	N	N	Y	Y	Y	IRR	N	Y	IRR	IRR	L5	1
SBO	1.51E-07	Y	Y	N	N	Y	N	Y	IRR	N	Y	IRR	IRR	L5	1
SBO	1.13E-11	Y	Y	N	Y	Y	Y	Y	IRR	N	Y	IRR	Y	E4	7
SBO	1.50E-10	Y	Y	N	Y	Y	Y	Y	IRR	N	Y	IRR	N	E4	7
SBO	1.23E-10	Y	Y	N	Y	Y	N	Y	IRR	N	Y	IRR	N	E4	7
SBO	1.22E-11	Y	Y	N	Y	Y	N	N	IRR	N	Y	IRR	Y	E4	7
SBO	2.96E-10	Y	Y	N	Y	Y	N	N	IRR	N	Y	IRR	N	E3	7
SBO	5.15E-11	Y	Y	N	Y	Y	N	N	IRR	N	N	IRR	N	E3	7
SBO	2.54E-08	Y	Y	N	VT	Y	Y	Y	IRR	N	Y	IRR	N	E4	2
SBO	2.11E-08	Y	Y	N	VT	Y	N	Y	IRR	N	Y	IRR	N	E4	2
SBO	2.31E-10	Y	Y	N	VT	Y	N	Y	IRR	N	N	IRR	N	E3	2
SBO	1.00E-10	Y	Y	N	VT	Y	N	N	IRR	Y	N	IRR	Y	E3	7
SBO	7.88E-11	Y	Y	N	VT	Y	N	N	IRR	Y	N	IRR	N	E3	7
SBO	4.34E-08	Y	N	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1
SBO	2.68E-11	Y	N	Y	N	Y	N	Y	Y	N	N	IRR	IRR	L5	1
SBO	1.02E-09	Y	N	Y	N	Y	N	Y	Y	VT	Y	Y	N	L4	2
SBO	4.24E-11	Y	N	Y	N	Y	N	Y	Y	VT	N	Y	N	L3	2
SBO	2.31E-08	Y	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
SBO	1.70E-08	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	L2	7
SBO	3.91E-09	Y	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
SBO	2.11E-10	Y	N	Y	N	Y	N	Y	N	VT	N	Y	N	L2	2

	Attachment 1	SHEET: 5 of 11
CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension		REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
SBO	2.78E-11	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
SBO	8.01E-08	Y	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
SBO	8.42E-09	Y	N	Y	N	Y	N	N	N	Y	N	N	N	L1	7
SBO	2.70E-10	Y	N	Y	N	Y	N	N	N	VT	Y	Y	N	L4	2
SBO	4.04E-09	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
SBO	8.20E-08	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
SBO	1.40E-11	Y	N	Y	Y	Y	N	Y	N	N	N	Y	Y	E3	7
SBO	1.09E-07	Y	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
SBO	8.78E-11	Y	N	Y	Y	Y	N	N	N	N	N	Y	N	E1	7
SBO	1.96E-07	Y	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
SBO	3.41E-09	Y	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
SBO	1.85E-10	Y	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
SBO	3.27E-10	Y	N	Y	VT	Y	N	Y	N	N	Y	Y	N	E4	2
SBO	1.84E-09	Y	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
SBO	1.35E-09	Y	N	Y	VT	Y	N	Y	N	Y	N	Y	N	E2	7
SBO	1.14E-11	Y	N	Y	VT	Y	N	N	N	N	Y	Y	N	E4	2
SBO	6.52E-09	Y	N	Y	VT	Y	N	N	N	Y	N	Y	N	E1	7
SBO	6.59E-10	Y	N	Y	VT	Y	N	N	N	Y	N	N	N	E1	7
SBO	7.41E-07	N	N	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
SBO	4.84E-10	N	N	Y	N	Y	Y	Y	Y	N	N	IRR	IRR	L5	1
SBO	2.37E-06	N	N	Y	N	Y	Y	Y	Y	VT	Y	Y	N	L4	2
SBO	1.51E-07	N	N	Y	N	Y	Y	Y	Y	VT	N	Y	N	L4	2
SBO	3.31E-07	N	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
SBO	3.77E-10	N	N	Y	N	Y	Y	Y	N	Y	N	Y	N	L3	7
SBO	3.20E-08	N	N	Y	N	Y	Y	Y	N	VT	Y	Y	N	L4	2
SBO	1.82E-09	N	N	Y	N	Y	Y	Y	N	VT	N	Y	N	L3	2
SBO	1.20E-06	N	N	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1
SBO	8.03E-10	N	N	Y	N	Y	N	Y	Y	N	N	IRR	IRR	L5	1
SBO	8 04E-07	N	N	Y	N	Y	N	Y	Y	VT	Y	Y	N	L4	2
SBO	5.09E-08	N	N	Y	N	Y	N	Y	Y	VT	N	Y	N	L3	2
SBO	6.45E-07	N	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
SBO	1.10E-06	N	N	Y	N	Y	N	Y	N	Y	N	Y	N	L2	7
SBO	1.70E-07	N	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
SBO	1.04E-08	N	N	Y	N	Y	N	Y	N	VT	N	Y	N	L2	2
SBO	2.49E-09	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
SBO	2.46E-06	N	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
SBO	2.59E-07	N	N	Y	N	Y	N	N	N	Y	N	N	N	L1	7

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

	Attachment 1	SHEET: 6 of 11
CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension		REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
SBO	8.82E-09	N	N	Y	N	Y	N	N	N	VT	Y	Y	N	L4	2
SBO	4.00E-10	N	N	Y	N	Y	N	N	N	VT	N	Y	N	L1	2
SBO	1.50E-10	N	N	Y	N	N	Y	Y	Y	N	N	IRR	IRR	L5	1
SBO	6.07E-10	N	N	Y	N	N	Y	Y	Y	VT	N	Y	N	L3	2
SBO	4.98E-11	N	N	Y	N	N	Y	Y	N	Y	N	Y	Y	L3	7
SBO	4.86E-10	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	E4	7
SBO	3.59E-09	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	E4	7
SBO	2.19E-07	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	E4	7
SBO	1.85E-06	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	E4	7
SBO	2.33E-11	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	E4	7
SBO	3.60E-10	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	N	E4	7
SBO	1.46E-08	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	E4	7
SBO	1.72E-07	N	N	Y	Y	Y	Y	Y	N	N	N	Y	N	E3	7
SBO	7.14E-11	N	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	E4	7
SBO	1.07E-09	N	N	Y	Y	Y	N	Y	Y	N	Y	Y	N	E4	7
SBO	3.23E-07	N	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
SBO	5.75E-06	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
SBO	2.15E-11	N	N	Y	Y	Y	N	Y	N	N	Y	Y	Y	E4	7
SBO	1.04E-09	N	N	Y	Y	Y	N	Y	N	N	Y	Y	N	E4	7
SBO	1.77E-08	N	N	Y	Y	Y	N	Y	N	N	N	Y	Y	E3	7
SBO	5.33E-06	N	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
SBO	1.11E-10	N	N	Y	Y	Y	N	N	N	N	Y	Y	N	E4	7
SBO	1.59E-09	N	N	Y	Y	Y	N	N	N	N	Y	N	N	E3	7
SBO	8.48E-10	N	N	Y	Y	Y	N	N	N	N	N	Y	Y	E3	7
SBO	7.17E-08	N	N	Y	Y	Y	N	N	N	N	N	Y	N	E1	7
SBO	4.45E-10	N	N	Y	Y	Y	N	N	N	N	N	N	Y	E3	7
SBO	7.72E-06	N	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
SBO	3.18E-10	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	E3	7
SBO	4.14E-09	N	N	Y	Y	N	Y	Y	Y	N	N	Y	N	E3	7
SBO	2.59E-11	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y	E3	7
SBO	2.82E-10	N	N	Y	Y	N	Y	Y	N	N	N	Y	N	E3	7
SBO	2.17E-10	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	E3	7
SBO	1.00E-08	N	N	Y	Y	N	N	Y	Y	N	N	Y	N	E2	7
SBO	9.08E-09	N	N	Y	Y	N	N	Y	N	N	N	Y	N	E1	7
SBO	6.71E-11	N	N	Y	Y	N	N	N	N	N	N	Y	N	E1	7
SBO	1.16E-08	N	N	Y	Y	N	N	N	N	N	N	N	N	E1	7
SBO	6.13E-07	N	N	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2

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

	Attachment 1	**SHEET: 7 of 11**
CALC. NO.: H-1-ZZ-RZZ-0036 **PRA Analysis of HCGS ILRT Extension**		**REFERENCE:**
ORIGINATOR, DATE	**REV: 0**	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
SBO	2.43E-08	N	N	Y	VT	Y	Y	Y	Y	N	N	Y	N	E4	2
SBO	6.66E-09	N	N	Y	VT	Y	Y	Y	N	N	Y	Y	N	E4	2
SBO	2.23E-10	N	N	Y	VT	Y	Y	Y	N	N	N	Y	N	E3	2
SBO	6.41E-08	N	N	Y	VT	Y	Y	Y	N	Y	N	Y	Y	E4	7
SBO	3.89E-11	N	N	Y	VT	Y	Y	Y	N	Y	N	Y	N	E3	7
SBO	3.15E-07	N	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
SBO	1.94E-08	N	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
SBO	2.92E-08	N	N	Y	VT	Y	N	Y	N	N	Y	Y	N	E4	2
SBO	1.18E-09	N	N	Y	VT	Y	N	Y	N	N	N	Y	N	E2	2
SBO	9.20E-08	N	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
SBO	1.86E-07	N	N	Y	VT	Y	N	Y	N	Y	N	Y	N	E2	7
SBO	1.70E-09	N	N	Y	VT	Y	N	N	N	N	Y	Y	N	E4	2
SBO	1.01E-11	N	N	Y	VT	Y	N	N	N	N	N	Y	N	E1	2
SBO	5.30E-10	N	N	Y	VT	Y	N	N	N	Y	N	Y	Y	E3	7
SBO	3.51E-07	N	N	Y	VT	Y	N	N	N	Y	N	Y	N	E1	7
SBO	3.68E-08	N	N	Y	VT	Y	N	N	N	Y	N	N	N	E1	7
SBO	8.26E-09	N	N	Y	VT	N	Y	Y	Y	N	N	Y	N	E3	2
SBO	6.58E-11	N	N	Y	VT	N	Y	Y	N	N	N	Y	N	E3	2
SBO	7.64E-10	N	N	Y	VT	N	Y	Y	N	Y	N	Y	Y	E3	7
SBO	4.24E-09	N	N	Y	VT	N	N	Y	Y	N	N	Y	N	E2	2
SBO	3.70E-10	N	N	Y	VT	N	N	Y	N	N	N	Y	N	E1	2
SBO	1.11E-09	N	N	Y	VT	N	N	Y	N	Y	N	Y	Y	E3	7
SBO	2.36E-09	N	N	Y	VT	N	N	Y	N	Y	N	Y	N	E1	7
SBO	4.39E-09	N	N	Y	VT	N	N	N	N	Y	N	Y	N	E1	7
SBO	3.96E-10	N	N	Y	VT	N	N	N	N	Y	N	N	N	E1	7
Trans	2.87E-10	Y	Y	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
Trans	1.39E-11	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
Trans	1.55E-11	Y	Y	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2
Trans	3.63E-07	Y	Y	N	N	Y	Y	Y	IRR	N	Y	IRR	IRR	L5	1
Trans	1.99E-08	Y	Y	N	N	Y	N	Y	IRR	N	Y	IRR	IRR	L5	1
Trans	1.44E-11	Y	Y	N	Y	Y	Y	Y	IRR	N	Y	IRR	Y	E4	7
Trans	3.16E-10	Y	Y	N	Y	Y	Y	Y	IRR	N	Y	IRR	N	E4	7
Trans	2.57E-11	Y	Y	N	Y	Y	N	N	IRR	N	Y	IRR	Y	E4	7
Trans	3.42E-10	Y	Y	N	Y	Y	N	N	IRR	N	Y	IRR	N	E3	7
Trans	6.10E-11	Y	Y	N	Y	Y	N	N	IRR	N	N	IRR	N	E3	7
Trans	5.06E-08	Y	Y	N	VT	Y	Y	Y	IRR	N	Y	IRR	N	E4	2
Trans	2.77E-09	Y	Y	N	VT	Y	N	Y	IRR	N	Y	IRR	N	E4	2

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

	Attachment 1	SHEET: 8 of 11
CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension		REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
Trans	3.16E-10	Y	Y	N	VT	Y	N	Y	IRR	N	N	IRR	N	E3	2
Trans	1.71E-10	Y	Y	N	VT	Y	N	N	IRR	Y	N	IRR	Y	E3	7
Trans	1.18E-11	Y	Y	N	VT	Y	N	N	IRR	Y	N	IRR	N	E3	7
Trans	1.31E-06	N	N	Y	N	Y	Y	Y	Y	N	Y	IRR	IRR	L5	1
Trans	9.03E-10	N	N	Y	N	Y	Y	Y	Y	N	N	IRR	IRR	L5	1
Trans	6.44E-07	N	N	Y	N	Y	Y	Y	Y	VT	Y	Y	N	L4	2
Trans	1.42E-07	N	N	Y	N	Y	Y	Y	Y	VT	N	Y	N	L4	2
Trans	2.03E-07	N	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	L4	7
Trans	8.93E-09	N	N	Y	N	Y	Y	Y	N	Y	N	Y	N	L3	7
Trans	1.78E-08	N	N	Y	N	Y	Y	Y	N	VT	Y	Y	N	L4	2
Trans	3.57E-09	N	N	Y	N	Y	Y	Y	N	VT	N	Y	N	L3	2
Trans	1.52E-08	N	N	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1
Trans	8.52E-09	N	N	Y	N	Y	N	Y	Y	VT	Y	Y	N	L4	2
Trans	1.80E-09	N	N	Y	N	Y	N	Y	Y	VT	N	Y	N	L3	2
Trans	2.07E-08	N	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
Trans	8.16E-10	N	N	Y	N	Y	N	Y	N	Y	N	Y	N	L2	7
Trans	1.78E-09	N	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
Trans	3.22E-10	N	N	Y	N	Y	N	Y	N	VT	N	Y	N	L2	2
Trans	4.43E-11	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
Trans	6.83E-11	N	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
Trans	2.83E-10	N	N	Y	N	N	Y	Y	Y	N	N	IRR	IRR	L3	1
Trans	1.53E-10	N	N	Y	N	N	Y	Y	Y	VT	N	Y	N	L3	2
Trans	3.47E-11	N	N	Y	N	N	Y	Y	N	Y	N	Y	Y	L3	7
Trans	1.08E-10	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	E4	7
Trans	1.03E-09	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	E4	7
Trans	7.53E-08	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	E4	7
Trans	7.50E-07	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	E4	7
Trans	8.06E-11	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	N	E4	7
Trans	4.20E-09	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	E4	7
Trans	6.18E-08	N	N	Y	Y	Y	Y	Y	N	N	N	Y	N	E3	7
Trans	9 34E-09	N	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
Trans	1.09E-07	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
Trans	7.79E-10	N	N	Y	Y	Y	N	Y	N	N	N	Y	Y	E3	7
Trans	7.08E-08	N	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
Trans	4 64E-10	N	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
Trans	8.15E-11	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	E3	7
Trans	1.51E-09	N	N	Y	Y	N	Y	Y	Y	N	N	Y	N	E3	7

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ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
Trans	6.89E-11	N	N	Y	Y	N	Y	Y	N	N	N	Y	N	E3	7
Trans	1.51E-10	N	N	Y	Y	N	N	Y	Y	N	N	Y	N	E2	7
Trans	8.99E-11	N	N	Y	Y	N	N	Y	N	N	N	Y	N	E1	7
Trans	3.93E-07	N	N	Y	VT	Y	Y	Y	Y	N	Y	Y	N	E4	2
Trans	1.55E-08	N	N	Y	VT	Y	Y	Y	Y	N	N	Y	N	E4	2
Trans	4.19E-09	N	N	Y	VT	Y	Y	Y	N	N	Y	Y	N	E4	2
Trans	1.34E-10	N	N	Y	VT	Y	Y	Y	N	N	N	Y	N	E3	2
Trans	3.92E-08	N	N	Y	VT	Y	Y	Y	N	Y	N	Y	Y	E4	7
Trans	1.64E-09	N	N	Y	VT	Y	Y	Y	N	Y	N	Y	N	E3	7
Trans	4.75E-09	N	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
Trans	4.06E-09	N	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
Trans	3.85E-10	N	N	Y	VT	Y	N	Y	N	N	Y	Y	N	E4	2
Trans	4.28E-09	N	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
Trans	1.47E-10	N	N	Y	VT	Y	N	Y	N	Y	N	Y	N	E2	7
Trans	5.22E-09	N	N	Y	VT	N	Y	Y	Y	N	N	Y	N	E3	2
Trans	2.70E-11	N	N	Y	VT	N	Y	Y	N	N	N	Y	N	E3	2
Trans	4.13E-10	N	N	Y	VT	N	Y	Y	N	Y	N	Y	Y	E3	7
Trans	7.71E-11	N	N	Y	VT	N	N	Y	Y	N	N	Y	N	E2	2
Trans	2.74E-11	N	N	Y	VT	N	N	Y	N	Y	N	Y	Y	E3	7
TW	2.63E-11	Y	Y	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1
TW	4.08E-08	Y	Y	N	N	Y	N	Y	IRR	N	Y	IRR	IRR	L5	1
TW	7.90E-11	Y	Y	N	Y	Y	N	Y	IRR	N	Y	IRR	Y	E4	7
TW	5.31E-10	Y	Y	N	Y	Y	N	Y	IRR	N	Y	IRR	N	E4	7
TW	3.77E-11	Y	Y	N	Y	Y	N	Y	IRR	N	N	IRR	N	E3	7
TW	1.14E-10	Y	Y	N	Y	Y	N	N	IRR	N	Y	IRR	Y	E4	7
TW	7.64E-10	Y	Y	N	Y	Y	N	N	IRR	N	Y	IRR	N	E3	7
TW	1.02E-10	Y	Y	N	Y	Y	N	N	IRR	N	N	IRR	N	E3	7
TW	1.90E-09	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
TW	2.31E-08	Y	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
TW	2.59E-09	Y	N	Y	N	Y	N	N	N	Y	N	N	N	L1	7
TW	1.09E-10	Y	N	Y	N	Y	N	N	N	VT	Y	Y	N	L4	2
TW	1.52E-07	Y	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
TW	2.10E-10	Y	N	Y	VT	Y	N	N	N	N	Y	Y	N	E4	2
TW	4.04E-08	Y	N	Y	VT	Y	N	N	N	Y	N	Y	Y	E3	7
TW	2.62E-09	Y	N	Y	VT	Y	N	N	N	Y	N	Y	N	E1	7
TW	4.51E-09	Y	N	Y	VT	Y	N	N	N	Y	N	N	N	E1	7
TW	9.77E-08	N	N	Y	N	Y	N	Y	Y	N	Y	IRR	IRR	L5	1

CALCULATION CONTINUATION SHEET

	Attachment 1	SHEET: 10 of 11
CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension		REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
TW	5.45E-11	N	N	Y	N	Y	N	Y	Y	N	N	IRR	IRR	L5	1
TW	5.48E-08	N	N	Y	N	Y	N	Y	Y	VT	Y	Y	N	L4	2
TW	3.41E-09	N	N	Y	N	Y	N	Y	Y	VT	N	Y	N	L3	2
TW	1.33E-07	N	N	Y	N	Y	N	Y	N	Y	N	Y	Y	L3	7
TW	2.09E-10	N	N	Y	N	Y	N	Y	N	Y	N	Y	N	L2	7
TW	1.19E-08	N	N	Y	N	Y	N	Y	N	VT	Y	Y	N	L4	2
TW	6.73E-10	N	N	Y	N	Y	N	Y	N	VT	N	Y	N	L2	2
TW	2.02E-10	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	L3	7
TW	2.10E-07	N	N	Y	N	Y	N	N	N	Y	N	Y	N	L1	7
TW	2.20E-08	N	N	Y	N	Y	N	N	N	Y	N	N	N	L1	7
TW	9.87E-10	N	N	Y	N	Y	N	N	N	VT	Y	Y	N	L4	2
TW	3.61E-11	N	N	Y	N	Y	N	N	N	VT	N	Y	N	L1	2
TW	5.22E-11	N	N	Y	Y	Y	N	Y	Y	N	Y	Y	N	E4	7
TW	2.26E-08	N	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	E4	7
TW	4.09E-07	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	E3	7
TW	5.50E-11	N	N	Y	Y	Y	N	Y	N	N	Y	Y	N	E4	7
TW	3.37E-09	N	N	Y	Y	Y	N	Y	N	N	N	Y	Y	E3	7
TW	3.84E-07	N	N	Y	Y	Y	N	Y	N	N	N	Y	N	E2	7
TW	9.83E-11	N	N	Y	Y	Y	N	N	N	N	Y	N	N	E3	7
TW	6.88E-10	N	N	Y	Y	Y	N	N	N	N	N	Y	Y	E3	7
TW	5.18E-09	N	N	Y	Y	Y	N	N	N	N	N	Y	N	E1	7
TW	1.13E-11	N	N	Y	Y	Y	N	N	N	N	N	N	Y	E3	7
TW	6.73E-07	N	N	Y	Y	Y	N	N	N	N	N	N	N	E1	7
TW	2.12E-10	N	N	Y	Y	N	N	Y	Y	N	N	Y	N	E2	7
TW	1.92E-10	N	N	Y	Y	N	N	Y	N	N	N	Y	N	E1	7
TW	1.34E-09	N	N	Y	Y	N	N	N	N	N	N	N	N	E1	7
TW	7.58E-09	N	N	Y	VT	Y	N	Y	Y	N	Y	Y	N	E4	2
TW	2.87E-10	N	N	Y	VT	Y	N	Y	Y	N	N	Y	N	E3	2
TW	7.00E-10	N	N	Y	VT	Y	N	Y	N	N	Y	Y	N	E4	2
TW	6.62E-09	N	N	Y	VT	Y	N	Y	N	Y	N	Y	Y	E3	7
TW	2.11E-10	N	N	Y	VT	Y	N	N	N	N	Y	Y	N	E4	2
TW	9.10E-11	N	N	Y	VT	Y	N	N	N	Y	N	Y	Y	E3	7
TW	4.13E-08	N	N	Y	VT	Y	N	N	N	Y	N	Y	N	E1	7
TW	4.31E-09	N	N	Y	VT	Y	N	N	N	Y	N	N	N	E1	7
TW	9.50E-11	N	N	Y	VT	N	N	Y	Y	N	N	Y	N	E2	2
TW	8.46E-11	N	N	Y	VT	N	N	Y	N	Y	N	Y	Y	E3	7
TW	4.83E-10	N	N	Y	VT	N	N	N	N	Y	N	Y	N	E1	7

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

	Attachment 1	SHEET: 11 of 11
CALC. NO.: H-1-ZZ-RZZ-0036 PRA Analysis of HCGS ILRT Extension		REFERENCE:
ORIGINATOR, DATE	REV: 0	Jin Lin 09/11/02
REVIEWER/VERIFIER, DATE		Tom Carrier 09/24/02

IE	Freq.	DP	INJ	VF	CFE	EPOOL	L-DWSpray	L-INJ	DCOOL	CFL	LPOOL	FPR	RB	RC	EPRI Class
TW	5.37E-11	N	N	Y	VT	N	N	N	N	Y	N	N	N	E1	7

Note: Y = Yes
N = No
VT = Vent
IRR = Irrelevant

CERTIFICATION FOR DESIGN VERIFICATION

Reference No. H-1-ZZ-RZZ-0036 Rev. 0

SUMMARY STATEMENT

This was a line –by line review/check of the entire document including:

- Verification of applicability/correct references
- Verification that inputs (data) from other sources were correct
- Checked all calculations by verifying excel formulas were correct and/or using a hand calculator.
- Compared methodology to referenced methods, especially our previously approved Salem ILRT Extension Calculation (ref. 16), and validated all differences.

This was an "independent" review.

Note: Since much of the calculation was done on excel and other parts were done with a hand calculator, there are slight differences in the least significant digits at various places in the calculation, depending on whether you are comparing results using excel or a calculator. The slight differences were reviewed and verified to be caused by round off error, and do not significantly affect the results or conclusions.

The undersigned hereby certifies (in the right column) that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated.

Design Verifier Assigned By (signature of Manager/Director)*	T. K. Cannis 9/24/02 Signature of Design Verifier* / Date
Design Verifier Assigned By (signature of Manager/Director)*	N/A Signature of Design Verifier* / Date
Design Verifier Assigned By (signature of Manager/Director)*	N/A Signature of Design Verifier* / Date
Design Verifier Assigned By (signature of Manager/Director)*	N/A. Signature of Design Verifier* / Date

*If the Manager/Supervisor acts as the Design Verifier, the signature of the next higher level of technical management is required in the left column

Page 1 of 1

FORM-2

COMMENT / RESOLUTION FORM FOR DESIGN DOCUMENT REVIEW/CHECKING OR DESIGN VERIFICATION

REFERENCE DOCUMENT NO. /REV. __H-1-ZZ-RZZ-0036 Rev.0________

COMMENTS	RESOLUTION	
See attached pages 1 thru 9	All comments have been adequately addressed and resolved.	All comments/ resolutions accepted TKC 9/24/02
T.K. Cannis 9/24/02 SUBMITTED BY DATE	9/24/02 RESOLVED BY DATE	Acceptance of Resolution

COMMENT RESOLUTION FORM

TO: Jin Lin Dept: NSG CC:

FROM: Tom Carrier Dept: NSG Comment Due Date: August 23, 2002

DOCUMENT NO., REVISION AND TITLE: **HC ILRT Ext. Calculation**

Page/Para Number	Comments or Recommendations (Technical comments require justification)	Accepted		Comment Disposition (A negative disposition requires justification)
		Yes	No	
Cover	Use RZZ instead of MEE for calculation #	Yes		The calculation ID is H-1-ZZ-RZZ-0036
Sht 4	"Experience suggests that the visual inspection would detect concrete and liner failures." This is a bit stronger than the position taken for Salem where we stated that we were likely to detect failures, and then made a conservative assumption that we would only detect large liner failures. Can we substantiate this?	Yes		Same statement was used in Salem ILRT extension Calculation Rev.1. " People familiar with the containment inspection program suggested that the visual inspection ought to detect concrete and liner failures. To be on the conservative side, this analysis does not credit detection of large liner failures." is to replace the current statement.
Sht 4 last paragraph	Needs paragraph separation x2. see Salem calc.	Yes		Separated.
Sht 5	Assumption #8 contains an incomplete sentence.	Yes		Revised.

COMMENT RESOLUTION FORM

?	I had expected that this calc would reference the Salem calc. Was there no innovation in the Salem calc that we are copying?	Yes		Salem ILRT Extension calculation has been added as a referenced.
Table 1	For the Salem Calc we used the level 3 data corresponding to year 2000 data- 95% effective EVAC. For the Hope Creek calc you are using year 2000 data – 100% effective EVAC. Why? Which is correct? (I realize there is very little numerical difference, but it seems that we should be consistent if nothing else.	Yes		Year 2000-100% EVAC whole body doses were used based on the recommendation from Jim Fulford, the author of the HCGS Level 3 calculation. The difference between 95% EVAC and 100%.EVAC is so minor that it would not change the result.
Sheet 7	Last sentence before Table 2 has two typos. 2nd sentence following Table 2 – the word dominated should be "dominant".	Yes		Corrected
Table 3	This table shows an "assignment" of an initiator to each PDC. The PDCs come from HCGS PSA, Rev 1 Table 4.3.2. I'd like to see the calculation be more specific in referencing this particular table, rather than just the "HCGS PSA Rev 1"	Yes		Table 4.3.2 is referenced.
Table 3	There are several PDCs in the HCGS PSA Rev 1 Table 4.3.2 that don't appear in Table 3. It appears that these "missing" PDCs have insignificant contribution in terms of frequency. I suggest that more detail be added to the "discussion" following Table 2 that describes the process of obtaining the	Yes		Table 3 lists the dominant PDCs in Revision 1.3 of HCGS PSA. Table 4.3.2 lists all PDCs. Table 4.3.3, which lists all PDCs in Revision 1, shows that some PDCs (C1C, C2B and C4B) have insignificant contributions, in terms of frequency, to the total CDF. A brief discussion about the "missing" PDCs is added in the calculation.

	release categories. It is quite hard to recreate that process. It should be better documented, such as providing the above reason for leaving out certain PDCs.			
Table 3	Why isn't PDC C3A assigned to ATWS initiator? The PSA sequence descriptor is Tat*RPT? This leads to a philosophical question about these "assignments: In some cases the "Definition" of the PDC is not sufficient and we go to the "Sequence Descriptor" for clarification. In this case the "Description" seems to be clear, as long as we ignore the "Sequence Descriptor"!? If we map the PDC to the wrong initiator, then in the next step the sub-totals of the frequencies of the sequences associated with these PDCs will be binned to the wrong initiators and Table 4 will be incorrect. Note: Some of these PDCs have zero or very low contribution in terms of frequency, so you could avoid the above issue for those PDCs by screening them out as low significance, prior to assigning them to an initiator.	Yes		PDC C3A is assigned to LOCA initiator in accordance with the functional class definition in Table 4.3.1 and 4.3.2 of HCGS PSA Revision 1. The PDC C3A, obtained in the latest HCGS PSA model, has a frequency of 2.5E-10, and a weighted percentage of 0.003%. The assignment of proper initiator in this case, one way or the other, would not make a significant on the result because of its negligible frequency.
Table 3	After assigning ATWS & LOCA and LT-SBO, it is assumed that all the other PDCs can be assigned to either Tw or Trans. How do you know that these PDCs are not associated with some other initiator? And if this assumption is valid, how do you know which is which?	Yes		After assigning PDCs that belong to ATWS, LOCA and LT-SBO initiators, we have C1A, C1D, C2A and C2C left. Both C1A and C1D are accident sequences involving a loss of inventory makeup, while C2A and C2C are accident sequences involving a loss of containment heat removal capability. Containment heat removal should be performed by RHR

				containment spray mode to reduce containment pressure following a LOCA. Therefore, both C2A and C2C are assigned to TW, in which RHR is unavailable. In HCGS IPE, all transient initiators are divided into two classes: with or without RHR. C1A and C1D are assigned to Transient initiator because there is no loss of heat removal associated with them.
Table 4	The frequencies for the 5 initiators come from the xls file (Sht "Release cat." Cells A41 – D52) These frequencies come from a WINNUPRA generated report based on the HCGS PSA rev. 1.3 "Display by Status Class". We need to document what WINNUPRA is doing for us. How does the software know what sequences are associated with the various PDCs?	Yes		The sequences were assigned by PSA analyst to link to proper PDCs in WinNUPRA. It is assumed that the WinNUPRA model in follow-up minor revisions, 1.1, 1.2, 1 and 1.3, did not deviate the definitions of PDCs in Table 4.3.2 of PSA Revision 1.
Table 7.x	The apparent "Rules" for Assigning IPE Release Categories to EPRI Classes are as follows: 1) Any sequence that involves containment failure (CFE or CFL) is assigned to Class 7 "Accidents involving containment failure…." 2) None of the sequences involve pre-existing failures to seal containment (eg. liner breach) or pre-existing type – B or C components failure to seal, or failure of penetrations, so no sequences are binned to Classes 3, 4, 5 or 6.	Yes		Description is provided.

COMMENT RESOLUTION FORM

	3) None of the sequences involve containment bypass, so none are binned to Class 8. 4) Any sequence that does not involve either CFE or CFL is binned to Class 1 which is described as, "Containment remains intact." 5) All others must be Class 2. <u>Recommendation:</u> Explain your logic/thought process in the calc. for all this binning. If there are references, reference them.			
New Spread Sheet ILRT rc.xls	I summed the freqs. For all the ATWS sequences and got 6.11E-7, but Table 4.7-11 in the IPE says total ATWS is 6.42E-7. All the others are correct, and, if you sum all freqs for all 5 IEs on your xls file, you get the same sum as when you sum the subtotals for all five IEs in the IPE. It appears to me that the IPE has an error and it is negligible. Do you agree? Or did you leave out one or more ATWS sequences? You have 66-3+1 =64 ATWS sequences and there are 64 ATWS sequences (including four "AT-SB" sequences.???	Yes		Further verification identified some errors in typos in generating the new spreadsheet. After correction the CDF for ATWS is 6.14E-07, consistent with the value in Table 4.7-19. I believe the ATWS CDF in Table 4.7-11 is not correct. I checked all other CDFs in the spreadsheet and in Table 4.7-19, and found only one minor difference for LOCA initiator, where Table has 2.54e-06, and the spreadsheet has 2.53E-06 while the real value in the spreadsheet is 2.5346936E-06 if not rounded off.
Ditto	What do you mean by, "Release Categories are assigned to Yellowed rows"??	Yes		It has been deleted. The original purpose was to find out the difference between the old assignment using judgment and the computer printout.

COMMENT RESOLUTION FORM

Ditto	The new RC binning rules appear to be as follows and should be documented in the calc. 1) Any sequence that involves containment failure (CFE or CFL) is assigned to Class 7 "Accidents involving containment failure...." 2) Any sequence that does not involve both CFE or CFL but includes early or late containment VT is binned to Class 2 " Containment Isolation failures in which the pre-existing leakage is due to failure to isolate the containment." 3) Any sequence that does not involve either CFE or CFL, including VT, is binned to Class 1 which is described as, "Containment remains intact." 4) None of the sequences involve pre-existing failures to seal containment (eg. liner breach) or pre-existing type – B or C components failure to seal, or failure of penetrations, so no sequences are binned to Classes 3, 4, 5 or 6. 5) None of the sequences involve containment bypass, so none are binned to Class 8.	Yes		Comments incorporated.

Table 8	I verified the results of Table 8 using the personrem.xls file that Jin gave me on Friday 8/30/02. I will need to verify that the calc is updated to agree with this file. TKC Action			Done on 9/22/02. All OK/tkc
Sht 14	For the 3 categories of additional sequences that are not associated with the LERF due to a Type A containment leakage path, the 1st and third refer to PWR things (stm gen tube rupture and containment sprays).	Yes		Corrected.
Sht 14 Last parag. And assump-tion 4.6	States that L1 through L4 are considered as being impacted by the Type A test. This contradicts the RC to EPRI Class binning that you did in tables 7.x. RCs L1,2,4 were binned to Class 7 which involves containment failure induced by severe accident phenomena and changes in testing reqts. Don't impact these. RCs L3a & L3b are binned to Classes 1 & 2 which also are by definition not impacted by the testing Type A testing requirements.??? Assumption 4.6 states that Classes 2,6,7 & 8, to which L1-L4 are binned, are not impacted by ILRT Type A frequency. You need to bin L1-L4 to Class 3 or forget about this partitioning of the CDF.	Yes		The calculation has been revised to use the computer printout, which is not in the IPE report but regenerated as Attachment 1. The printout has release categories assigned to each sequence already. The calculation has been revised to include CDF for L1 through L5 be considered as being impacted by the Type A test because E1 CDFs for E1 through E4 are considered as "already cause a LERF". Step 7 uses the methodology recommended in Reference [13] that involves conservatively multiplying the CDF by the failure probability for Class 3b of accident. The methodology suggests that individual sequences that cause a LERF (E1 through E4) and could never cause a LERF (estimated about 10% in L5) can be removed from Class 3b in the calculation of LERF by multiplying the Class 3b probability by only that portion of CDF that may be impacted by Type A leakage. Assumption 4.6 is deleted.

				TKC's note: The thought process invoked on page 14 is that RCs E1 – E4 are LERF, independent of the ILRT test interval, and L1 - L5 could become LERF due to the test interval extension. Obviously this is not necessarily true for all L1 – L2, but it is a conservative approach, adequate for partitioning the total CDF, in order to subtract out the CDF that can't be impacted by the test extension. I would recommend that Assumption 4.6 be replaced by this explanation. I would also recommed that on page 14 change the wording from being definitive that L1 – L5 <u>will be</u> impacted, to <u>may be</u> impacted, etc.
Sht 16 Under Class2 & class 7	These should both refer to Table 8, not Table 5.	Yes		Corrected
Sht 16 Under Class 7	Add the words, "…or the IP3 assumed La multipliers."	Yes		" ,or La multiples recommended in the EPRI interim guidance [11]" is added.
3rd sentenc e Sht. 20	Typo – 1st sentence under Risk Impact due to 20-year Test Interval should say if the test interval is extended <u>to 1 in 20 years.</u>	Yes		Agree, Corrected.

COMMENT RESOLUTION FORM

Sht 22	Equation for PER-REM15 , 3b should be 1.319E-2, not E-3	Yes		Corrected.
Sht 28	2^{nd} row; 4^{th} column is a typo. 0.051 should be 0.041. comes from sht 20 and is the sum of class 3a15 and 3b15.		N	0.051 is correct. [You are correct/tkc]

* REVIEWER (Print): Tom Carrier (Sign): T.K. Carrier DATE: 9/24/02

* DISPOSITIONED BY (Print): Jin Lin (Sign): Jin Lin DATE: 9/24/02

* Only required to sign the first page.

FORM-3
(Page 1 of 2)

GENERIC VERIFICATION CHECKLIST	REFERENCE DOCUMENT NUMBER/REVISION _H-1-ZZ-RZZ-00036__________/_Rev. 0		
	YES NO N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
1. WERE DESIGN INPUTS CORRECTLY SELECTED AND INCORPORATED INTO DESIGN?	☒ ☐ ☐	Ref. 10 NC level 3 Ref 9 NC IPE Ref 14 NC PSA Rev 1.3	N
2. ARE ASSUMPTIONS NECESSARY TO PERFORM THE DESIGN ACTIVITY ADEQUATELY DESCRIBED AND REASONABLE? WHERE NECESSARY, ARE THE ASSUMPTIONS IDENTIFIED FOR SUBSEQUENT RE-VERIFICATION WHEN THE DETAILED DESIGN ACTIVITIES ARE COMPLETED? Not necessary	☒ ☐ ☐	Sheet 5	Old # 4.6 challenged (Y) pg 7 of 9 Bottom Comment
3. ARE THE APPROPRIATE QUALITY AND QUALITY ASSURANCE REQUIREMENTS SPECIFIED?	☒ ☐ ☐	cover sheet (NSR)	N
4. ARE THE APPLICABLE CODES, STANDARDS AND REGULATORY REQUIREMENTS INCLUDING ISSUES AND ADDENDA PROPERLY IDENTIFIED AND ARE THEIR REQUIREMENTS FOR DESIGN MET?	☒ ☐ ☐	References 1, 4, 5, 6, 7, 8, 11, 13 see section 3.0	N
5. HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCE BEEN CONSIDERED?	☒ ☐ ☐	see section 3.0 Sht 4	(Y) pg 2 of 9 1st comment. Re: Salem Calc.
6. HAVE THE DESIGN INTERFACE REQUIREMENTS BEEN SATISFIED?	☐ ☐ ☒	—	—
7. WAS AN APPROPRIATE DESIGN METHOD USED?	☐ ☐ ☒	—	—
8. IS THE OUTPUT REASONABLE COMPARED TO INPUTS?	☒ ☐ ☐	sheets 26, 27, 28	N
9. ARE THE SPECIFIED PARTS, EQUIPMENT, AND PROCESSES SUITABLE FOR THE REQUIRED APPLICATION?	☐ ☐ ☒	—	—
10. ARE THE SPECIFIED MATERIALS COMPATIBLE WITH EACH OTHER AND THE DESIGN ENVIRONMENTAL CONDITIONS TO WHICH THE MATERIAL WILL BE EXPOSED?	☐ ☐ ☒	—	—
11. HAVE ADEQUATE MAINTENANCE FEATURES AND REQUIREMENTS BEEN SPECIFIED?	☐ ☐ ☒	—	—

FORM-3
(Page 2 of 2)

GENERIC VERIFICATION CHECKLIST	REFERENCE DOCUMENT NUMBER/REVISION _H-1-ZZ-RZZ-00036__________/_Rev. 0		
	YES NO N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
12. ARE ACCESSIBILITY AND OTHER DESIGN PROVISIONS ADEQUATE FOR PERFORMANCE OF NEEDED MAINTENANCE AND REPAIR?	☐ ☐ ☒	—	—
13. HAS ADEQUATE ACCESSIBILITY BEEN PROVIDED TO PERFORM THE IN-SERVICE INSPECTION EXPECTED TO BE REQUIRED DURING THE PLANT LIFE?	☐ ☐ ☒	—	—
14. HAS THE DESIGN PROPERLY CONSIDERED RADIATION EXPOSURE TO THE PUBLIC AND PLANT PERSONNEL? HAVE ALARA CONSIDERATIONS BEEN ADDRESSED?	☒ ☐ ☐ ☐ ☐ ☒	Based partly on LERF. see Purpose/Scope + Methodology sheets 3 and 4	—
15. ARE THE ACCEPTANCE CRITERIA INCORPORATED IN THE DESIGN DOCUMENTS SUFFICIENT TO ALLOW VERIFICATION THAT DESIGN REQUIREMENTS HAVE BEEN SATISFACTORILY ACCOMPLISHED?	☒ ☐ ☐	Ref. 8 RG 1.174 sheet 27	N
16. HAS VERIFICATION OF THE ELECTRIC LOAD CONTROL PROGRAM [DE-TS.ZZ-2908(Q)] BEEN PERFORMED?	☐ ☐ ☒	—	—
17. HAS THE EFFECT ON THE DIESEL GENERATOR LOAD SEQUENCE STUDY BEEN ANALYZED?	☐ ☐ ☒	—	—
18. HAVE ADEQUATE PRE-OPERATIONAL AND SUBSEQUENT PERIODIC TEST REQUIREMENTS BEEN APPROPRIATELY SPECIFIED?	☐ ☐ ☒	—	—
19. ARE ADEQUATE HANDLING, STORAGE, CLEANING AND SHIPPING REQUIREMENTS SPECIFIED?	☐ ☐ ☒	—	—
20. ARE ADEQUATE IDENTIFICATION REQUIREMENTS SPECIFIED?	☐ ☐ ☒	—	—
21. ARE REQUIREMENTS FOR RECORD PREPARATION REVIEW , APPROVAL, RETENTION, ETC. ADEQUATELY SPECIFIED?	☐ ☐ ☒	—	—

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: Calculation H-1-ZZ-RZZ-0036 Revision: 0

Title: PRA Analysis of HCGS ILRT Extension (Supporting LCR H02-013)

Activity Description:

The purpose of this calculation is to estimate the risk associated with extending the Type A Integrated Leak Rate Test (ILRT) interval from current 10 years required by 10 CFR 50, Appendix J at Hope Creek Generating Station (HCGS) to 20 years. This calculation is used to support LCR H02-013.

Note that more than one process may apply. If unsure of any answer, contact the cognizant department for guidance.

Activities Affected	No	Yes	Action
1. Does the proposed activity involve a change to the Technical Specifications or the Operating License?	☐	☒	If Yes, contact Licensing; process in accordance with NC.NA-AP.ZZ-0035(Q) LCR No. H02-013
2. Does the proposed activity involve a change to the Quality Assurance Plan? Examples: • Changes to Chapter 17.2 of UFSAR	☒	☐	If Yes, contact Quality Assessment; process in accordance with ND.QN-AP.ZZ-0003(Q)
3. Does the proposed activity involve a change to the Security Plan? Examples: • Change program in NC.NA-AP.ZZ-0033(Q) • Change indoor/outdoor security lighting • Placement of component or structure (permanent or temporary) within 20 feet of perimeter fence • Obstruct field of view from any manned post • Interfere with security monitoring device capability • Change access to any protected or vital area •	☒	☐	If Yes, contact Security Department; process in accordance with NC.NA-AP.ZZ-0033(Q)
4. Does the proposed activity involve a change to the Emergency Plan? Examples: • Change ODCM/accident source term • Change liquid or gaseous effluent release path • Affect radiation monitoring instrumentation or EOP/AOP setpoints used in classifying accident severity • Affect emergency response facilities or personnel, including control rm • Affect communications, computers, information systems or Met tower	☒	☐	If Yes, contact Emergency Preparedness
5. Does the proposed activity involve a change to the ISI Program Plan? Examples: • Affect Nuclear Class 1, 2, or 3 Piping, Vessels, or Supports (Guidance in NC.DE-AP.ZZ-0007(Q) Form-11)	☒	☐	If Yes, contact Reliability Programs ISI/IST; process in accordance with NC.NA-AP.ZZ-0027(Q)
6. Does the proposed activity involve a change to the IST Program Plan? Examples: • Affect the design or operating parameters of a Nuclear Class 1, 2, or 3 Pump or Valve (Guidance in NC.DE-AP.ZZ-0007(Q) Form-15)	☒	☐	If Yes, contact Reliability Programs ISI/IST; process in accordance with NC.NA-AP.ZZ-0070(Q)

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: Calculation H-1-ZZ-RZZ-0036 Revision: 0

Title: PRA Analysis of HCGS ILRT Extension (Supporting LCR H02-013)

Activities Affected	No	Yes	Action
7. Does the proposed activity involve a change to the Fire Protection Program? Examples: • Change program in NC.DE-PS.ZZ-0001(Q) • Change combustible loading of safety related space • Change or affect fire detection system • Change or affect fire suppression system/component • Change fire doors, dampers, penetration seal or barriers • See NC.DE-AP.ZZ-0007, Forms 3, 4 and 14 for details	☒	☐	If Yes, contact Design Engineering; process in accordance with NC.DE-PS.ZZ-0001(Q)
8. Does the proposed activity involve Maintenance which restores SSCs to their original design and configuration? Examples: • CM or PM activity • Implements an approved Design Change? • Troubleshooting (which does not require 50.59 screen per SH.MD-AP.ZZ-0002)	☒	☐	If Yes, process in accordance with NC.WM-AP.ZZ-0001(Q)
9. Is the proposed activity a temporary change (T-Mod) which ***meets all the following conditions***? • Directly supports maintenance and is NOT a compensatory measure to ensure SSC operability. • Will be in effect at power operation **less than 90 days.** • Plant will be restored to design configuration upon completion. • SSCs will NOT be operated in a manner that could impact the function or operability of a safety related or Important-to-Safety system.	☒	☐	If Yes, contact Engineering; process in accordance with NC.DE-AP.ZZ-0030(Q)
10. Does the proposed activity consist of changes to maintenance procedures which do NOT affect SSC design, performance, operation or control? **Note:** Procedure information affecting SSC design, performance, operation or control, including Tech Spec required surveillance and inspection, ***require 50.59 screening***. Examples include acceptance criteria for valve stroke times or other SSC function, torque values, and types of materials (e.g., gaskets, elastomers, lubricants, etc.)	☒	☐	If Yes, process in accordance with NC.NA-AP.ZZ-0001(Q)
11. Does the proposed activity involve a *minor* UFSAR change (including documents incorporated by reference)? Examples: • Reformatting, simplification or clarifications that do not change the meaning or substance of information • Removes obsolete or redundant information or excessive detail • Corrects inconsistencies within the UFSAR • Minor correction of drawings (such as mislabeled ID)	☒	☐	If Yes, process in accordance with NC.NA-AP.ZZ-0035(Q)
12. Does the proposed activity involve a change to an Administrative Procedure (NAP, SAP or DAP) governing the conduct of station operations? Examples: • Organization changes/position titles • Work control/ modification processes	☒	☐	If Yes, process in accordance with NC.NA-AP.ZZ-0001(Q) and NC.DM-AP.ZZ-0001(Q)

FORM-1
REGULATORY CHANGE PROCESS DETERMINATION

Document I.D.: Calculation H-1-ZZ-RZZ-0036 Revision: 0
Title: PRA Analysis of HCGS ILRT Extension (Supporting LCR H02-013)

Activities Affected	No	Yes	Action
13. Does the proposed activity involve a change to a regulatory commitment?	☒	☐	If Yes, contact Licensing and process in accordance with NC.NA-AP.ZZ-0030(Q)
14. Does the activity impact other programs controlled by regulations, operating license or Tech Spec? Examples: • Chemical Controls Program • NJ "Right-to-know" regulations • OSHA regulations • NJPDES Permit conditions • State and/or local building, electrical, plumbing, storm water management or "other" codes and standards • 10CFR20 occupational exposure	☒	☐	If Yes, process in accordance with applicable procedures such as: NC.NA-AP.ZZ-0038(Q) NC.LR-AP.ZZ-0037(Q)
15. Has the activity already received a **10CFR50.59 Screen or Evaluation** under another process? Examples: • Calculation • Design Change Package or OWD change • Procedure for a Test or Experiment • DR/Nonconformance • Incorporation of previously approved UFSAR change	☒	☐	Take credit for **10CFR50.59 Screen or Evaluation** already performed. ID: ______

If any other program or regulation *may be* affected by the proposed activity, contact the department indicated for further review in accordance with the governing procedure. If responsible department determines program is not affected, attach written explanation.

If ALL of the answers on the previous pages are "No," then check A below:

A. [ ] None of the activity is controlled by any of the processes above, therefore a 10CFR50.59 review **IS** required. Complete a 10CFR50.59 screen.

If one or more of the answers on the previous pages are "Yes," then check either B or C below as appropriate and explain the regulatory processes which govern the change:

B. [X] All aspects of the activity are controlled by one or more of the processes above, therefore a 10CFR50.59 review **IS NOT** required.

C. [ ] Only part of the activity is controlled by the processes above, therefore a 10CFR50.59 review **IS** required. Complete a 50.59 screen.

Explanation: This calculation supports LCR H02-013 and the LCR approval is covered under 10 CFR 50.90 entirely.

Preparer: Carl Berger (Printed Name) — Carl Berger (Signature) — 9/25/02 (Date)

Reviewer: Courtney Smyth (Printed Name) — C W Smyth (Signature) — 9/25/02 (Date)