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July 13, 2001

Re: Indian Point Unit No. 2
Docket No. 50-247
NL 01-093

US Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station 0-P1-17
Washington, DC 20555-0001

SUBJECT: Indian Point 2 License Amendment Request: Containment Integrated Leakage Rate Testing Frequency

Transmitted herewith is an "Application for Amendment to the Operating License." This application requests an amendment to the Consolidated Edison Company of New York, Inc. (Con Edison) Indian Point Unit No. 2 (IP2) Technical Specifications (TS).

The purpose of this License Amendment Request is to request that the IP2 TS Section 4.4.A.3 be revised. The revision would change the current frequency for integrated leak rate test (ILRT) to allow a one-time exemption to the once-per-ten-year frequency for the performance-based leakage rate testing program for Type A tests. The exemption is to allow ILRT testing on a once-per-fifteen year frequency following the successful Type A test performed in June 1991. This next ILRT was to be performed during the refuel outage (RFO) that was previously scheduled for Spring 2002. This would have been within the allowed 15-month extension for performing the ILRT. During the unscheduled steam generator replacement outage in the year 2000, the ILRT schedule was reviewed since the 2002 RFO schedule was changed to September 2002. This revised schedule would still have permitted the ILRT to be performed without the need for an exemption. However due to delays in startup from the steam generator replacement outage, the next RFO is now scheduled for later in the Fall. Since this would require the ILRT to be performed before the scheduled RFO shutdown, IP2 is requesting a one-time exemption to allow ILRT testing on a 15 year frequency. This exemption, if approved, would result in a substantial economic, ALARA, and operational benefit to IP2 without involving a significant hazards consideration.

Attachment 1 to this letter provides the description and evaluation of the proposed changes. The revised TS pages are provided in Attachment 2 (strikeout/shadow format).

A001

This proposed license amendment is based on and has been evaluated using the "risk informed" guidance in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and Regulatory Guide 1.177, "An Approach for Plant Specific, Risk Informed Decisionmaking: Technical Specifications." Attachment 3 provides the IP2 Risk Impact Assessment.

The Station Nuclear Safety Committee (SNSC) and the Nuclear Facilities Safety Committee (NFSC) have reviewed the proposed changes. Both committees concur that the proposed changes do not involve a significant hazards consideration as defined by 10 CFR 50.92(c).

In order to effectively plan for the next RFO, Con Edison requests NRC approval of the proposed changes by January 31, 2002 with an effective date within 60 days of approval.

In accordance with 10CFR50.91, a copy of this submittal and the associated attachments are being submitted to the designated New York State official.

There are no commitments contained in this submittal. Should you or your staff have any questions regarding this submittal, please contact Mr. John F. McCann, Manager, Nuclear Safety and Licensing at (914) 734-5074.

Very truly yours,

James S. Baumstark
Vice President – Nuclear Engineering

Attachments

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
CONSOLIDATED EDISON COMPANY	)	Docket No. 50-247
OF NEW YORK, INC.	)	
(Indian Point Station, Unit No. 2)	)	

APPLICATION FOR AMENDMENT
TO OPERATING LICENSE

Pursuant to Section 50.90 of the Regulations of the Nuclear Regulatory Commission (NRC), Consolidated Edison Company of New York, Inc. (Con Edison), as holder of Facility Operating License No. DPR-26, hereby applies for amendment of the Technical Specifications contained in Appendix A of this license.

The specific proposed Technical Specification revisions are set forth in Attachment 2. The associated assessments demonstrate that the proposed changes do not involve a significant hazards consideration as defined in 10CFR50.92(c).

As required by 10CFR50.91(b)(1), a copy of this Application and our evaluation concluding that the proposed changes do not involve a significant hazards consideration have been provided to the appropriate New York State official designated to receive such amendments.

By: [signature]
James S. Baumstark
Vice President - Nuclear Engineering

Subscribed and sworn to
before me this 13 day
July, 2001.

[signature] Ersilia A. Amanna (Bovino)
Notary Public

ERSILIA A. AMANNA
Notary Public, State of New York
No. 01AM6038689
Qualified in Westchester County
Commission Expires March 20, 2002

ATTACHMENT 1 TO NL 01-093

LICENSE AMENDMENT REQUEST

ONE TIME CHANGE TO THE CONTAINMENT INTEGRATED LEAKAGE RATE TESTING FREQUENCY

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
INDIAN POINT UNIT NO. 2
DOCKET NO. 50-247

LICENSE AMENDMENT REQUEST

DESCRIPTION OF THE PROPOSED CHANGE

The requested Technical Specification (TS) change involves item 4.4.A.3 of Section 4.4, "Containment Tests," which states: "The integrated leakage rate test frequency shall be performed in accordance with 10CFR50 Appendix J, Option B as modified by approved exemptions and in accordance with guidelines contained in Regulatory Guide 1.163 (Ref. 1), dated September 1995." The performance-based leakage rate testing allows a once-per-10-year frequency for Type A tests.

The requested change proposes a one-time exemption to the requirements of TS 4.4.A.3 to allow an integrated leakage rate test (ILRT) frequency of once-per-15 years. This frequency would only be effective until the performance of the next ILRT.

This License Amendment Request satisfies the requirements of 10CFR50 Appendix J Option B paragraph V.B.3 to submit TS revisions containing justification, including supporting analyses, if the licensee chooses to deviate from methods approved by the Commission and endorsed in a regulatory guide.

REASONS FOR THE CHANGE

Indian Point 2 last performed a Type A containment test (ILRT) on June 20, 1991. IP2's current 10 year ILRT was due on June 20, 2001. This ILRT was to be performed during the next refuel outage (RFO) that had been previously scheduled for Spring 2002. This would have been within the allowable 15-month extension for performing the test so that an exemption would not have been required. During the unscheduled steam generator replacement outage in the year 2000, the ILRT schedule was reviewed since the 2002 RFO schedule was changed to September 2002. This revised schedule would still have permitted the ILRT to be performed without the need for an exemption. However due to delays in startup from the steam generator replacement outage, the next RFO is now scheduled for later in the Fall. Since this has resulted in a requirement that the ILRT be performed before the scheduled RFO, IP2 is requesting a one-time exemption to allow ILRT testing at a once-per-15-years frequency. IP2 will realize a substantial saving of:

- Cost by not performing the ILRT at the next RFO. Cost savings have been estimated for the next outage at $200,000 for actually performing the ILRT and eliminating from schedule up to 100 hours of critical path outage time at a net savings of approximately $21,000 per hour. The total cost, if the ILRT is performed during a scheduled RFO, is thus estimated to exceed $2,000,000.
- Cost by not having to shut down during the current operating cycle to perform the ILRT. Cost savings have been estimated to be an additional 150 hours of critical path outage time to remove the plant from service prior to the ILRT and then return the plant to service following the ILRT. The total cost, if the ILRT is performed during a scheduled operating cycle outage, is thus estimated to exceed $4,000,000.
- Dose by not performing the ILRT at the next RFO. The dose savings are estimated to be approximately one person-rem and would be substantially greater if the ILRT were performed before the scheduled RFO.

Con Edison has concluded that the above benefits of an ILRT deferral are substantial while the safety benefit of performing the ILRT at a once-per-10 years, vice once-per-15 years, frequency is minimal.

EVALUATION OF THE PROPOSED CHANGE

10CFR50.36.c(3) defines surveillance requirements as requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

TS 4.4 lists the surveillance requirements for containment integrity. TS 4.4.A.3 requires that a containment integrated leakage rate test shall be performed on a frequency in accordance with 10CFR50 Appendix J, Option B as modified by approved exemptions and in accordance with guidelines contained in Regulatory Guide 1.163. Regulatory Guide 1.163 specifies the use of NEI 94-01 (Ref. 2) as a method acceptable to the NRC for determining the Type A performance-based test frequency. A Type A test is an overall (integrated) leakage rate test of the containment structure. NEI 94-01 specifies an initial Type A test frequency of once-per-48-months, but section 9.2.3 allows a frequency of once-per-10-years based on two consecutive successful tests. The two most recent tests at IP2 were successful, so the current frequency requirement is once-per-10-years. Con Edison is requesting a one-time exemption to the requirements of NEI 94-01 section 9.2.3 to allow a frequency of once-per-15-years.

The testing requirements of 10CFR50 Appendix J provide assurance that leakage through the containment, including systems and components that penetrate the containment, does not exceed the allowable leakage values. The limitation on containment leakage provides assurance that the containment would perform its design function following an accident up to and including the plant design basis accident.

Risk -Based Evaluation of the ILRT Frequency Change from 10 to 15 Years

The current frequency for testing was based upon a generic evaluation documented in NUREG-1493 (Reference 3). NUREG-1493 made the following observations with regard to decreasing the test frequency:

- "Reducing the Type A (ILRT) testing frequency to one per twenty years was found to lead to an imperceptible increase in risk. The estimated increase in risk is small because ILRTs identify only a few potential leakage paths that cannot be identified by Type B and C testing, and the leaks that have been found by Type A tests have been only marginally above the existing requirements. Given the insensitivity of risk to containment leakage rate, and the small fraction of leakage detected solely by Type A testing, increasing the interval between ILRT testing had minimal impact on public risk."
- "While Type B and C tests identify the vast majority (greater than 95%) of all potential leakage paths, performance-based alternatives are feasible without significant risk impacts. Since leakage contributes less than 0.1 percent of overall risk under existing requirements, the overall effect is very small."

This request is based on the generic results of NUREG-1493 as supplemented by the results of a risk assessment specific for IP2 of a change of the containment Type A test frequency from once-per-ten-years to once-per fifteen-years. The IP2 specific risk assessment followed the guidelines of NEI- 94-01, the methodology used in EPRI TR-104285 (Ref. 4), and the guidance of NRC RG 1.174, (Ref 5) on the use of Probabilistic Risk Assessment (PRA) findings and risk insights in support of a licensee's request for changes to a plant's licensing basis. Specifically, the approach combined the use of the plant's Individual Plant Examination (IPE) results and findings to the methodology described in EPRI TR-104285 to estimate plant risk on specific accident sequences impacted by Type A testing. The calculation used to obtain these numbers is documented in IP2 Calculation PSA-010615-1 that is included in this submittal as Attachment 3.

The change in plant risk was evaluated based on the change in the predicted person-rem/year frequency and the Large Early Release Frequency (LERF). The analysis examined IP2's IPE plant specific accident sequences in which the containment integrity remains intact or the containment integrity is impaired. Specifically, the following were considered:

- Core damage sequences in which the containment remains intact initially and in the long term (Class 1 sequences)
- Core damage sequences in which containment integrity is impaired due to random isolation failures of plant components other than those associated with Type B or Type C test components, for example, liner breach or steam generator manway leakage (Class 3 sequences)
- Core damage sequences in which containment integrity is impaired due to containment isolation failures of pathways left 'opened' following a post-maintenance test, for example, valve failing to close following a valve stroke test. (Class 6 sequences)
- Accident sequence classes (as defined by EPRI TR-104285) involving: a) Large containment isolation failures (Class 2); b) Small containment isolation and "failure-to-seal' events (Classes 4 and 5); c) Severe accident phenomena and containment bypassed (Classes 7 and 8) were not accounted for in this analysis because they are not impacted by Type A test interval. These sequences are impacted only by changes in Type B or Type C test intervals. Their CDF frequencies are included in the analysis for the purpose of evaluating the overall risk related to containment failures.

This risk assessment used the following steps:

Step 1 Quantify the base-line risk in terms of frequency per reactor-year for each of the eight accident classes assessed. See Table 1 below.

Step 2 Develop plant specific person-rem dose (population dose) per reactor-year for each of the eight accident classes evaluated in EPRI TR-104285. See Table 2 below.

Step 3 Evaluate the risk impact of changing the Type A test frequency from 10 to 15 years.

Step 4 Determine the change in risk in terms of LERF in accordance with RG 1.174.

Table 1
Mean Containment Frequency Measures for a Given Accident Class

Class	Description	Frequency (per reactor-year)
1	No containment failure	2.38E-05
2	Large containment isolation failures (failure to close)	4.01E-09
3a	Small isolation failures (liner breach)	1.99E-06
3b	Large isolation failures (liner breach)	6.51E-07
4	Small isolation failure – failure to seal (Type B test)	N/A
5	Small isolation failure – failure to seal (Type C test)	N/A
6	Containment isolation failures (dependent failures, personnel errors)	6.26E-09
7	Severe accident phenomena induced failures (early and late failures)	2.86E-07
8	Containment bypassed (SGTR)	1.94E-06
Core Damage	All containment event tree endstates	3.13E-05

Table 2
Person-Rem Measure for a Given Accident Class

Class	Description	Person-Rem (50 miles)
1	No containment failure	1.41E+06
2	Large containment isolation failures (failure to close)	4.94E+07
3a	Small isolation failures (liner breach)	1.41E+07
3b	Large isolation failures (liner breach)	4.94E+07
4	Small isolation failure – failure to seal (Type B test)	N/A
5	Small isolation failure – failure to seal (Type C test)	N/A
6	Containment isolation failures (dependent failures, personnel errors)	4.94E+07
7	Severe accident phenomena induced failures (early and late failures)	1.41E+08
8	Containment bypassed (SGTR)	5.33E+09

The impact associated with changing the Type A ILRT test frequency, measured as percent of the total integrated risk, is presented in Table 3 below. Results are only presented for Classes 1, 3a, and 3b since these are the only classes impacted by the Type A test. For Class 1 sequences, the total integrated risk value is based on containment leakage of 1.0 times L_a for the baseline case and 2.0 L_a for the one test in 10 years and 15 years cases. For Class 3a sequences, the total integrated risk value is based on containment leakage of 10.0 times L_a for all cases. For Class 3b sequence, the total integrated risk value is based on containment leakage of 35.0 times L_a for all cases. L_a is the maximum as-found leakage allowed by IP2 TS 4.4.A.2.

Table 3
Summary of Risk Impact of Extending Type A ILRT Test Frequency

	Baseline - Type A test frequency of 3 tests per 10 years	Type A test frequency of one test per 10 years	Type A test frequency of one test per 15 years
Class 1, 3a, 3b Risk Impact	0.86% of the total integrated risk value equals 93.77 person-rem/year	1.28% of the total integrated risk value equals 139.3 person-rem/year	1.33% of the total integrated risk value equals 145.23 person-rem/year
Total Integrated Risk	10,838 person-rem/year	10,883 person-rem/year	10,889 person-rem/year

Risk Based Evaluation Conclusions

The conclusions of the plant risk associated with changing the Type A ILRT test frequency from once per 10 years to once per 15 years are as follows:

- The risk assessment predicted a slight increase in risk when compared to that estimated from current requirements. The change in risk for Classes 1, 3a, and 3b, as measured by person-rem/year, increases by 4.25%. However, the increase in risk on the total integrated plant risk for those accident sequences influenced by Type A testing is found to be 0.055%. This value can be considered to be a negligible increase in risk.
- RG 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. RG 1.174 defines very small changes in risk as resulting in increases in core damage frequency (CDF) below $1x10^{-06}$/year and increases in LERF below $1x10^{-07}$/year. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test interval for IP2 is 3.6×10^{-08}/year. Therefore the increase in the IP2 Type A test interval from 10 to 15 years is not risk significant.

<u>Non-Risk-Based Evaluation of the ILRT Frequency Change from 10 to 15 Years</u>

This request is not solely risk-based. The IP2 containment performance has been satisfactory. Numerous plant processes and features are in place to ensure defense-in-depth for the containment system.

History of Type A Testing

The following Table shows the history of Type A testing at IP2. Past Type A testing shows that the IP2 reactor containment structure has historically exhibited low leakage. The conclusion can therefore be drawn that there is minimal risk for increased future leakage.

Date	As Found Leakage[1]	Acceptance Limit[2]	Test Pressure (psia)[3]
06/20/1991	0.047791	0.075	61.696
12/19/1987	0.047726	0.075	61.696
9/21/1984	0.032	0.075	65.582
8/18/1979	0.026	0.075	64.325

1 The leakage is the percent (%) of containment air by weight per day.
2 The total allowable leakage is expressed in percent (%) of containment air by weight per day and is also 0.75 La (La, 0.1% of primary containment air by weight per day, is the maximum as-found leakage allowed by TS 4.4.A.2) with 0.6 La the maximum leakage from Type B and C components.
3 IP2 TS 4.4.A.1.a requires a minimum test pressure of 47 psig.

Penetration Testing

Industry experience has shown that most containment barrier leaks occur through penetrations. Type B and Type C tests are required by 10CFR50 Appendix J. Type B testing tests penetrations whose design includes seals, gaskets, bellows, or flexible metal seal assemblies. This includes air lock doors. The IP2 Type B test program to verify the leak-tight integrity of containment penetrations is unaffected by the proposed change to the Type A testing interval. The IP2 Type C test program to verify the leak-tight integrity of containment isolation valves is unaffected by the proposed change to the Type A testing frequency. Therefore, the ability of IP2 to find, trend, and repair most containment leaks is unchanged.

Structural Inspections

Since industry experience has shown that most containment barrier leaks occur through penetrations, Type A testing would only be effective at finding leakage through defects in the containment liner, a passive component. The detection of defects in the containment liner is the primary goal of the Containment Inservice Inspection Program required by 10CFR50.55a(b)(2)(ix)(E) and conducted at

IP2 in accordance with the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI. More specifically, Subsection IWE provides the rules and requirements for inservice inspection of Class MC pressure-retaining components and their integral attachments and of metallic shell and penetration liners of Class CC pressure-retaining components and their integral attachments in light-water cooled plants. These requirements will not be changed as a result of the proposed ILRT frequency. Examinations of the containment were conducted during the 2000 outage. Only minor discrepancies not affecting containment integrity were found. A summary of the results of the 2000 outage examinations was transmitted to the NRC in a letter dated April 2, 2001 (Reference 6).

10CFR50 Appendix J Option B III.A requires a general inspection of the accessible interior and exterior surface of the containment to uncover any evidence of structural deterioration which may affect containment structural integrity or leak tightness prior to performing an ILRT and at periodic intervals between tests. IP2 TS 4.4.A.1.d requires the inspection prior to an ILRT using procedure PI-R2. This same inspection using procedure PI-R2 is required at each refueling interval, periodically, by IP2 TS 4.4.G. Therefore, the frequency of the performance of a detailed visual inspection of the accessible interior and exterior surface of the containment is unaffected by the proposed TS change. Procedure PI-R2 was last performed in 2000 with satisfactory results.

Weld Channel and Pressurization System

IP2 has a Weld Channel and Penetration Pressurization system (WC&PPS) that provides a means for continuously pressurizing the positive pressure zones incorporated into the containment penetrations and the channels over the welds in the steel liner and certain containment isolation valves. No credit is taken for the WC&PPS in accident analyses. This assures that in the event of a Loss of Coolant Accident (LOCA), the containment leak rate will be lower than that assumed in the accident analysis. The WC&PPS is designed to provide a means of determining the leak-tightness of the containment during power operation.

The operability requirements for the WC&PPS and the requirement to monitor the air consumption of the system are specified in TS 3.3.D.1. The system and the TS 3.3.D.1 are not changed or affected by the requested change to TS 4.4.A.3.

Similar Requests

This request is similar to the request for change of the IP3 ILRT frequency that was approved by the NRC on April 17, 2001 (Ref. 7). The PRA has been enhanced with the knowledge gained from the NRC's evaluation of the recent Crystal River Unit 3 submittal.

Non-Risk-Based Conclusion

Based on the history of the Type A test results and the existence of effective programs and systems to monitor the condition of the containment boundary, Con Edison has concluded that the change of the containment ILRT frequency from once-per-10-years to once-per-15-years would not have a significant adverse impact on the ability of the containment to perform its design function.

NO SIGNIFICANT HAZARDS EVALUATION

Con Edison has determined that this proposed Technical Specification change does not involve a significant hazards consideration as defined by 10CFR50.92(c).

1. **Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability of occurrence or consequences of an accident previously evaluated.**

   The change does not affect the ability of the containment to mitigate the consequences of an accident. The containment is not an accident initiating system or structure. The proposed one time change to Type A testing frequency has been determined to be adequate as documented in NUREG-1493 which determined generically that very few potential containment leakage paths are not identified by Type B and C tests. The NUREG concluded that reducing the Type A (ILRT) testing frequency to one per twenty years was found to lead to an imperceptible increase in risk. This generic result has been confirmed for IP2 by a plant specific risk impact assessment. Past IP2 Type A tests show leakage to be below acceptance criteria, indicating a very leak-tight containment, without credit for the weld channel and penetration pressurization system (WC&PPS). Inspections required by other TS and by the ASME code are performed in order to identify indications of containment degradation that could affect that leak tightness. The WC&PPS monitors the leak tightness of liner plate welds in the containment during plant operation as required by Technical Specifications. Type B and C testing required by TS will identify any containment opening such as valves that would otherwise be detected by the Type A tests. The frequency of performance of surveillance does not result in any hardware changes or the response of equipment in performing its specified function. Therefore, operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. **Operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated.**

   The proposed change does not introduce nor increase the number of failure mechanisms of a new or different type of accident than those previously evaluated since there are no physical changes being made to the facility. Performance of the testing on the revised schedule will not have an adverse affect on the ability of the containment to perform its intended function. The proposed change does not degrade the reliability of systems, structures, or components or create a new accident initiator or precursor. No new failure modes are created. Therefore, the change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. **Operation of the facility in accordance with the proposed amendment would not involve a significant reduction in the margin of safety.**

   The one time change to the current frequency for Type A testing still provides adequate assurance of containment integrity. The NUREG-1493 generic study of the effects of extending containment leakage testing found that a 20-year extension in Type A leakage testing resulted in an imperceptible increase in risk to the public. NUREG -1493 found that, generically, the design containment leakage rate contributes about 0.1 percent to the individual risk and that the decrease in Type A testing frequency would have a minimal affect on this risk since 95% of the potential leakage paths are detected by Type B & C testing. The risk impact assessment specifically performed for IP2 concluded that the increase in risk from the requested change of the test frequency was small. Online testing of the integrity of liner plate welds using the WC&PPS and regular inspections will further reduce the risk of a containment leakage path going undetected. There are no changes being made to TS safety limits or safety system settings that would adversely affect plant safety. Therefore, operation of the facility in accordance with the proposed amendment would not involve a significant reduction in the margin of safety.

CONCLUSIONS

Based on the above evaluation, Con Edison has concluded that the proposed change will not result in a significant increase in the probability or consequences of any accident previously analyzed; will not result in a new or different kind of accident from any accident previously analyzed; and, does not result in a reduction in any margin of safety. Therefore, operation of IP2 in accordance with the proposed amendment does not involve a significant hazards consideration. The Station Nuclear Safety Committee (SNSC) and the Nuclear Facilities Safety Committee (NFSC) have reviewed the proposed change. Both committees concur that the proposed change does not involve a significant hazards consideration as defined by 10CFR50.92(c).

ENVIRONMENTAL ASSESSMENT

An environmental assessment is not required for the change proposed by this technical specification change request because the requested change to the Indian Point Generating Station Unit 2 conform to the criteria for "actions eligible for categorical exclusion," as specified in 10CFR51.22(c)(9). The requested change will have no impact on the environment. The proposed change does not involve a significant hazards consideration as discussed in the preceding section. The proposed change does not involve a significant change in the types or significant increase in the amounts of any effluents that may be released offsite. In addition, the proposed change does not involve a significant increase in individual or cumulative occupational radiation exposure.

REFERENCES

1. Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," September 1995.
2. NEI 94-01, "Nuclear Energy Institute Industry Guideline For Implementing Performance-Based Option of 10 CFR Part 50, Appendix J," Revision 0, July 26, 1995.
3. NUREG-1493, "Performance-Based Containment Leak-Test Program," Final Report, September 1995.
4. EPRI TR-104285, "Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals," August, 1994

5. USNRC Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decision on Plant-Specific Changes to the Licensing Basis, " July, 1998

6. Con Edison letter to NRC, "2000 Refueling Outage Inservice Inspection (ISI) Program Summary Report – Second Outage, Second Period, Third Interval," dated April 2, 2001

7. NRC letter to Entergy Nuclear Operations, "Indian Point Nuclear Generating Unit No. 3 – Issuance of Amendment re: Frequency of Performance-Based Leakage Rate Testing (TAC No. MB0178)," dated April 17, 2001

ATTACHMENT 2 TO NL 01-093

TECHNICAL SPECIFICATION PAGES IN

STRIKEOUT/SHADOW FORMAT

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CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
INDIAN POINT UNIT NO. 2
DOCKET NO. 50-247

e. Closure of the containment isolation valves for the purpose of the test shall be accomplished by the means provided for normal operation of the valves.

2. Acceptance Criteria

The As Found measured leakage rate shall be less than 1.0 L_a where L_a is equal to 0.1 w/o per day of containment steam air atmosphere at 47 psig and 271°F, which are the peak accident pressure and temperature conditions. Prior to entering a mode where containment integrity is required, the As Left leakage rate shall not exceed 0.75 L_a.

3. Frequency

The integrated leakage rate test frequency shall be performed in accordance with 10 CFR 50 Appendix J, Option B as modified by the following approved exemptions and in accordance with guidelines contained in Regulatory Guide 1.163, dated September 1995.

Exemption 1: The Type A testing frequency specified in NEI 94-01 paragraph 9.2.3 as at-least-once-per-10 years based on acceptable performance history is changed to allow a Type A testing frequency of at-least-once-per-15 years based on acceptable performance history. This is a one-time-only exemption that applies only for the interval following the Type A test performed in June 1991.

B. SENSITIVE LEAKAGE RATE

1. Test

A sensitive leakage rate test shall be conducted with the containment penetrations, weld channels, and certain double-gasketed seals and isolation valve interspaces at a minimum pressure of 52 psig and with the containment building at atmospheric pressure.

2. Acceptance Criteria

The test shall be considered satisfactory if the leak rate for the containment penetrations, weld channel and other pressurized zones is equal to or less than 0.2% of the containment free volume per day.

3. Frequency

A sensitive leakage rate test shall be performed at every Refueling Interval (R##).

ATTACHMENT 3 TO NL 01-093

INDIAN POINT 2 RISK INFORMED / RISK IMPACT ASSESSMENT FOR EXTENDING CONTAINMENT TYPE A TEST INTERVAL

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
INDIAN POINT UNIT NO. 2
DOCKET NO. 50-247

Probabilistic Safety Assessment Calculation / Analysis Summary Sheet		Calculation / Analysis No. PSA-010615-1	Revision No.0
Preparer: Hassan Elrada	Date: 06/15/01	Reviewer: Philip Griffith	Date: 6/28/01
Subject / Title IP2 Risk-Informed / Risk impact Assessment for Extending Containment Type A Test Interval			

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

INDIAN POINT UNIT 2

RISK IMPACT ASSESSMENT FOR EXTENDING CONTAINMENT TYPE A TEST INTERVAL

Author:

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P. Guymer

P. Griffith 6/29/01
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Approved By:

E. Goetchius 7/1/01
E. Goetchius

*** Signed original on file in analysis folder (Fax)**

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List of Figures/Attachments

1.0 Purpose:

The purpose of this calculation is to assess the risk impact for extending the IP2 Integrated Leak Rate Test (ILRT) interval from ten to fifteen years. In October 26, 1995, the NRC revised 10 CFR 50, Appendix J. The revision to Appendix J allowed individual plants to select containment leakage testing under Option A "Prescriptive Requirements" or Option B "Performance-Based Requirements". The Indian Point Unit Two Nuclear Power Plant (IP2) selected the requirements under Option B as its testing program.

The surveillance testing requirements as proposed in NEI 94-01[1] for Type A testing 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 $1.00L_a$, where La is the actual containment leakage rate).

IP2 current ten-year Type A test is due to be performed during refueling outage sixteen (RO16), scheduled for Nov 2002. However, IP2 seeks a one-time exemption based on:
(1) The substantial cost savings from eliminating the test from the RO16 schedule
(2) The belief that a rule change will be sought by the industry to eliminate the need for Type A testing.

2.0 Method

This calculation was performed in accordance with NEI 94-01 [1] guidelines, and the NRC regulatory guidance on the use of Probabilistic Risk Assessment (PRA) findings and risk insights in support of a licensee request for changes to a plant's licensing basis, Regulatory Guide RG 1.174[3]. This methodology is similar to that presented in EPRI TR104285 [2] and NUREG-1493 [5]. It uses a simplified bounding analysis approach to evaluate the risk impact on increasing the ILRT Type-A interval from 10 to 15 years by examining the IP2 (IPE)[4] plant specific accident sequences in which the containment integrity remains intact or the containment is impaired. Specifically, the following were considered:

- Core damage sequences in which the containment remains intact initially and in the long term (EPRI TR-104285 Class 1 sequences).

- Core damage sequences in which the containment integrity is impaired due to random isolation failures of plant components other than those associated with type B or Type C test components. For example, Liner breach, or steam generator manway leakage (EPRI TR –104285 Class 3 sequences).

- Core damage sequences in which the containment integrity is impaired due to containment isolation Failures of the pathways left 'opened ' following a plant post-maintenance test. For example, a valve failing to close following a valve stroke test. (EPRI TR-104285 Class 6 sequences).

This calculation provides the Core Damage Frequency (CDF) contribution for the following accident sequences as defined by EPRI TR-104285 (see Table 1):
a) Large containment isolation failures (Class 2);
b) Small containment isolation and "failure-to-seal' events (Classes 4 and 5);
c) Severe accident phenomena and containment bypassed (Classes 7 and 8).

Type A test, which measures the containment air mass and calculates the leakage from the change in mass over time, does not impact these sequences. These sequences are impacted only by changes in Type-B or Type-C test intervals. Type B test measures component leakage across pressure retaining boundaries (e.g. gaskets, expansion bellows and air-locks. Type C test measures component leakage rates across containment isolation valves. The CDF frequencies for the above classes described in items a, b, and c are included in this analysis for the purpose of evaluating the overall risk related to containment failures.

This calculation uses the following steps:

Step 1 – Quantify the base-line risk in terms of frequency per reactor year for each of the eight accident classes presented in Table 1.

Step 2 – Develop plant specific person-rem dose (population dose) per reactor year for each of the eight Accident classes (See Table 2).

Step 3 – Evaluate risk impact of extending Type A test interval from 10 to 15 years.

Step 4 – Determine the change in risk terms of Large Early Release Frequency (LERF) in accordance with R.G. 1.174 [3].

<u>Step 1 – Quantify the base-lined risk in terms of frequency per reactor year.</u>

This step involves the review of the IP2 IPE[4] results for the containment failure mode frequencies, the IP2 Containment Event Tree [10] and the containment Isolation system analysis [14]. The containment failure modes modeled in the IP2 IPE were based on important phenomena and system related events identified in NUREG 1335[9].

The extension of the Type A interval does not influence those accident progressions that involve large containment isolation failures; Type-B or Type-C testing or containment failures induced by severe accident phenomena. As a result, the IP2 IPE containment isolation model was reviewed for applicable isolation failures and their impact on the overall risk. Specifically, this calculation evaluated the likelihood of having a small/large breach in the containment liner that is undetected by the Type-A ILRT.

In addition, this calculation used Reference 14 and examined IP2 IPE containment isolation model related to the five issues associated with the containment isolation in NUREG-1335 [9]: (1) Identify pathways that could significantly contribute to containment isolation failures; (2) The signals required to automatically isolate the containment penetration; (3) The potential generating signals for all initiating events, (4) The examination of testing and maintenance procedures; and (5) the quantification of each containment isolation mode. These issues were addressed as follows:

1) **Pathways that could significantly contribute to containment isolation failure**. Significant fission product release to the environment may occur through containment penetrations for drain lines from sumps inside containment that are ultimately routed into the primary auxiliary building and piping that communicates directly with containment atmosphere and exceeds 2 inches in diameter. Therefore piping lines that interact with containment atmosphere of less than 2 inches in diameter are excluded from this analysis, and in any case, any release of fission products from a pipe smaller than 2 inches will be small and therefore pose a minimal public risk. Reference 14, section IIIE.2 shows that considering pipe size of 2" or greater is conservative.
The containment isolation failure analysis does not model the failure of piping that communicates directly with the Reactor Coolant System (RCS). These failures are considered to be failures of the pressure boundary between the RCS and low pressure systems (i.e., an interfacing system LOCAs).

   Based on the above, six lines were selected and modeled for examination as potential fission product release paths. Attachment A is the fault tree describing the failure modes for the above lines.

2&3) **The signals required to automatically isolate the containment penetration and potential generating signals for all initiating events.** Containment isolation signals, including those generated by unique plant initiators, required to automatically isolate the containment penetration, were not modeled in detail. They were however, addressed in the containment isolation fault tree model as containment isolation failure event. Based on Reference [15], a conservative value of 1.0E-03/demand failure probability was selected for this event.

4) **The examination of testing and maintenance procedures**. Failure attributed to valve test and maintenance procedures were represented in the fault tree as valve misalignment failure prior to a containment isolation demand event and assigned a probability of 1E-03. This value is conservative, given the control room indication of valve positions.

5) The quantification of each containment isolation mode. The containment isolation fault tree also considered failure modes for normally closed valves that fail to remain closed, normally open valves that fail to close on demand and operator action to close normally open valves.

3.0 Assumptions:

1. Containment leak rates greater than 2 La but less than 35La indicate an impaired containment. Break openings of greater than 0.5 inch but less than 2-inch diameter are considered as small leak rate releases. Break openings of greater than 2-inch are considered as large leak rate releases.

2. Containment leak rates greater than 35 La indicate a containment breach. This leak rate is considered "large".

3. Containment leaks rates less than 2 La indicates an intact containment. This leak rate is considered as "negligible".

4. The maximum containment leakage for Class 1 sequences is 2 La.

5. The maximum containment leakage for Class 2 sequences is 35 La.

6. The maximum containment leakage for Class 3a sequences is 10 La.

7. The maximum containment leakage for Class 3b sequences is 35 La.

8. The maximum containment leakage for Class 6 sequences is 35 La.

9. The maximum containment leakage for Class 7 sequences is 100 La.

10. Because Class 8 sequences are containment bypass sequences (e.g. SGTR, ISLOCA), potential releases are directly to the environment. Therefore, the containment structure will not impact the release magnitude.

11. Manual valve failures are considered as passive failures having insignificant failure rates and therefore are not modeled in this analysis.

12. Common Cause Failure is assumed to exist among redundant isolation valves (e.g. two AOV's in series).

13. In the event the containment isolation system fails to automatically isolate the lines modeled in attachment A, it is assumed that the operator has 90% chance of manually closing these valves (i.e. 0.1 failure probability). This value is conservative, since Emergency Operating Procedure EOP-E0 directs the operator to close these valves either from the control room, the fan room or by isolating the instrument air valves supply. Also, if all attempts fail, these lines may be isolated by dispatching an operator to manually close the outside containment isolation valves locally.

4.0 Results

1. The baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.86%.

2. Type A 10-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 1.28%.

3. Type A 15-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 1.33%.

4. The person-rem/year increase in risk contribution from extending the ILRT test frequency from the current once-per-10-years interval to once-per-15-years is 4.25%.

5. The total integrated increase in risk contribution from extending the ILRT test frequency from the current once-per-10-years interval to once-per-15-years is 0.055%.

6. The risk increase in LERF from extending the ILRT test frequency from the current once-per-10-years interval to once-per-15-years is 3.60E-08/yr.

7. The risk increase in LERF from the original 3-in-10-year interval, to once-per-15-years is 7.8E-08/yr.

8. Other results are summarized in the table below.

Summary of Risk Impact on Extending Type A ILRT Test Frequency

Class	Risk Impact		
	Baseline 3 in 10 years	**1 in 10 years**	**1 in 15 years**
1,3a and 3b. These classes are impacted by Type A test	0.86% of integrated value based on 1La normal containment leakage for Class 1, 10La for Class 3a and 35La for Class 3b, which is equivalent to: 93.77 person-rem/year	1.28% of integrated value based on 2La normal containment leakage for Class 1, 10La for Class 3a and 35La for Class 3b, which is equivalent to: 139.3 person-rem/year	1.33% of integrated value based on 2La normal containment leakage for Class 1, 10La for Class 3a and 35La for Class 3b, which is equivalent to: 145.23 person-rem/year
Total Integrated Risk	10,838 person-rem/year	10,883 person-rem/year	10,889 person-rem/year

5.0 Conclusions:

The conclusions regarding the change in plant risk associated with extension of the Type A ILRT test frequency from ten-years to fifteen-years, based on the results in section 4, are as follows:

The change in Type A test frequency from once-per-ten-years to once-per-fifteen years increases the risk of those associated specific accident sequences by 4.25%. However, the impact on the total integrated plant risk for those accident sequences influenced by Type A testing is only 0.055%. Therefore, the risk impact when compared to other accident risks is negligible.

Reg.Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Very small changes in risk are defined in Reg. Guide 1.174 as increases of CDF below 1.0E-06/yr or increases in LERF of less than 1E-07/yr. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test interval from once-per-10-years to once-per-15-years is 3.6E-08/yr. Since guidance in reg. Guide 1.174 defines very small changes in LERF as below 1.0E-7/yr, increasing the ILRT interval from 10 to 15 years is therefore considered non-risk significant.

6.0 References:

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

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

3. 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.

4. Consolidated Edison Company of New York, Inc., "Indian Point Unit Two Nuclear Generating Station Individual Plant Examination," August 1992.

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

6. "ALWR Severe Accident Dose Analysis."DE-ACOG-87RL11313, March 1989".

7. Burns, T.J. "Impact of Containment Building leakage on LWR Accident Risk", Oak Ridge national laboratory, NUREG/CR—3539, April 1984.

8. United States Nuclear Regulatory Commission. Reactor Safety Study, Wash-1400, October 1975.

9. United States Nuclear Regulatory Commission, "Individual Plant Examination: Submittal Guidance," NUREG-1335, August 1989.

10. Consolidated Edison Company of New York, Inc., "Indian Point Unit Two Nuclear Generating Station. "Containment Event Tree Development and Quantification, 2787.F3/06, Revision 1".

11. Patrick D.T. O'Connor, "Practical Reliability Engineering," John Wiley & Sons, 2nd Edition, 1985.

12. Pickard, Lowe and Garrick (PLG) Riskman Computer Code Dos version 9.2.

13. Memo, Re-01-001, M.Golshani to K.Peters, "Radiation Doses to the Population within a 50- mile radius of the plant", January 2, 2001

14. Consolidated Edison Company of New York, Inc., "Indian Point Unit Two Nuclear Generating Station, Containment Isolation System 17050.002 (Revision 0).

15. Entergy Nuclear Operations, Inc. "Calculation # IP3-CALC-VC-03357, Risk Impact Assessment of Extending Containment Type A Test Internal".

7.0 Calculation/Analysis:

Step 1 – Quantify the base-lined risk in terms of frequency per reactor year for each of the eight accident classes presented in table 1.

As mentioned in the methods section above, step 1 quantifies the annual frequencies for the eight accident classes defined in reference 2. Except for Class 1 and Class 7, the equations used in this quantification are very similar to those used in the IP3 Calculation [15]. Class 1 and Class 7 were evaluated based on the Crystal River Unit 3 (CR3) Calculation where the term CI (CI is the sum of the frequencies for classes 2, 3A, 3B, and 6) is deducted from Class 1 as shown below. In the IP3 Calculation [15], the term CI was deducted from class 7. The annual frequencies for each accident class are assessed as follows:

Class 1 Sequences. This group consists of all core damage accident progression bins for which the containment remains intact. For this analysis the associated maximum containment leakage for this group is 2La. The frequency for these sequences is determined as follows:

Class_1_Frequency = No_Cont_Failure_Freq – CI

Where:

No-Cont_Failure_Freq = 2.65E-05/yr [4]
CI = Class_2_Frequency + Class_3A_Frequnency + Class_3B_Frequency + Class_6_Frequency

= 4.06E-09/yr + 1.99E-06/yr + 6.51E-07/yr + 6.26E-09 /yr = 2.65E-06/yr
or

Class_1_Frequency = 2.65E-05/yr – 2.65E-06/yr = 2.38E-05/yr

Class 2 Sequences. This group consists of all core damage accident progression bins for which a pre-existing leakage due to failure to isolate the containment occurs. These sequences are dominated by failure to close of large, greater than 2 inch diameter, containment isolation valves. The frequency for these sequences is determined as follows:

Class_2_Frequency = PE_MEAN(CIC2)*CDF

Where:

PE_MEAN(CIC2) = random large containment isolation failure probability (e.g. large valves)
= 1.2978E-04 (See Attachment B)

The Riskman computer code [12] was used to evaluate the Fault Tree (attachment A) which describes the containment isolation lines modeled for this class. The fault tree modeled the valve failure to close and accounted for common cause failures among redundant valves (i.e. two valves in series.).
Attachment B is the Riskman code output, which provides Point Estimate Mean (PE Mean), for this class.

Class_2_Frequency = 1.30E-04 * 3.13E-05/yr = 4.06E-09/yr

For this analysis the associated maximum containment leakage for this group is 35 La.

Class 3 Sequences. This group consists of all core damage accident progression bins for which a pre-existing leakage in the containment structure (i.e. containment liner) exists. The containment leakage for these sequences can be either small (2La to 35 La) or large (>35La).

For this analysis, the question on containment analysis was modified to include the probability of a liner breach (due to excessive leakage) at the time of core damage. Two basic events were included in the containment isolation fault tree (attachment A). These are event Class 3A (small liner breach) and event Class 3B (large containment breach). (This event models the Class 3 depicted in EPRI TR 104285 [2].
The frequency for this Class event is determined as follows:

Class_3A_Frequency = Prob(Class-3A)*CDF
Class_3B_Frequency = Prob(Class-3B)*CDF

Probability of Class 3A Event (Small Containment Breach) – Prob_Class_3A

To calculate the probability that a liner leak will be small (Event Class-3A), the data of NUREG-1493 was used [5]. The data from NUREG-1493 indicates that 23 of 144 tests had allowable leak rates in excess of 1.0 La. The 23 failures contained four failures that were detected by ILRT; the other 19 failures were detected by type B and C tests or were errors in test alignments. Therefore, the number of failures considered for small releases are four out of 144.
To estimate the failure probability of Class_3A events, a conservative estimate is obtained from the 95th percentile of the $\chi2$ distribution. In statistical theory, the $\chi2$ distribution can be used to for statistical testing, goodness of fit tests, and evaluating s-confidence. The $\chi2$ distribution is really a family of distributions, which range in shape from that of the exponential to that of the normal distribution. Each distribution is identified by the degree of freedom, ν, for time-truncated tests (versus failure-truncated tests).
An estimate of the probability of a small leak using the $\chi2$ distribution can be calculated as $[\chi2_{95}; (\nu=2n+2)]/2N$, where n represents the number of small leaks and N represents the number of ILRTs performed to date.

For n = 4 and N=144, $[\chi2_{95}; (\nu=2n+2)]/2N = [\chi2_{95}; (\nu=2*4+2)]/2*144 = [\chi2_{95}; (\nu=10)]/2*144$
$[\chi2_{95}; (\nu=10)] = 18.3$ See Appendix 3 of Ref [11]

Therefore, the probability of a small leak Prob(Class_3A) = 18.3/288 = 0.06354

Class_3A_ Frequency = The frequency for this class event is = Prob(Class_3A) * CDF ,

Where: CDF = 3.13E-05/yr

Class_3A_ Frequency = 0.06354 * 3.13E-05/yr = 1.99E-06/yr .

Probability of Class 3B Event (Large Containment Breach)

The data presented in NUREG-1493 [5] is used to calculate the probability of Class-3B event. The NUREG-1493 data states that 144 ILRTs were conducted. The largest reported leak rate from those 144 tests was 21 times the allowable leakage rate (La). 21La does not constitute a large release.

Here again the $\chi2$ distribution is used to estimate the failure probability of a large leak.

The probability of a large leak using the $\chi2$ distribution can be calculated as $[\chi2_{95}; (\nu=2n+2)]/2N$, where n represents the number of Large leaks and N represents the number of ILRTs performed to date.
For n = 0 and N=144, $[\chi2_{95}; (\nu=2n+2)]/2N = [\chi2_{95}; (\nu=2*0+2)]/2*144 = [\chi2_{95}; (\nu=2)]/2*144$

$[\chi2_{95}; (\nu=2)] = 5.99$ See Appendix 3 of Ref [11]

Therefore, the probability of a large leak Prob(Class_3B) = 5.99/288 = 0.0208

Class_3B_ Frequency = The frequency for this Class event is = Prob(Class_3B) * CDF,

Where CDF = 3.13E-05/yr

Class_3B_ Frequency = 0.0208 * 3.13E-05/yr = 6.51E-07/yr

For this analysis the associated maximum containment leakage for class 3a is 10 La and for Class 3b is 35 La.

Class 4 Sequences. This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation due to failure of Type B test components occurs. Because these failures are detected by Type B tests, this group is not evaluated further.

Class 5 Sequences. This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation due to failure of Type C test components occurs. Because these failures are detected by Type C tests, this group is not evaluated further.

Class 6 Sequences. This group is similar to Class 2. These sequences involve core damage accident progression bins for which a failure-to-seal containment leakage due to failure to isolate the containment occurs. These sequences are dominated by misalignment of containment isolation valves following a test/maintenance evolution.

The annual frequency for these sequences is determined as follows:

Class_6_Frequency = PE_MEAN(CIC6)*CDF

Where:

PE_MEAN(CIC6) = 2.01 E-04 (See Attachment B),

The Riskman computer code [12] was used to evaluate the Fault Tree (Attachment A) which describes the containment isolation Lines modeled for this class. The fault tree modeled the isolation valves failure-to-close and accounted for common cause failures among redundant valves (i.e. two valves in series.).
Attachment B is the Riskman code output which provides Point Estimate Mean (PE Mean) for this class.

CDF = 3.13E-05/yr
Class_6_Frequency = 2.01E-04 * 3.13E-05/yr = 6.26E-09 /yr

For this analysis the associated maximum containment leakage for this group is 35La.

Class 7 Sequences. This group consists of all core damage accident progression bins in which containment failure induced by severe accident phenomena occurs (i.e. H2 combustion). For this analysis the associated maximum containment leakage for this group is 35La.
The annual frequency for these sequences is determined as follows:

Class_7_Frequency = Tot_CFL + CFE

Where:

Tot_CFL = Total late containment failure frequency = 2.82E-06/yr [Reference 4]

CFE= Early Containment Failure = 4.12E-08/ yr [Reference 4]

or

Class_7_Frequency = 2.82E-06/yr + 4.12E-08/yr = 2.86 E-06/yr

Class 8 Sequences. This group consists of all core damage accident progression bins in which containment bypass occurs. From above (parameter Cont_Bypass) the failure frequency for this class is: 1.94E-06/year [Reference 4]

Note for this class the maximum release is not based on normal containment leakage, because the releases are released directly to the environment. Therefore, the containment structure will not impact the release magnitude.

The annual frequencies for the eight classes are summarized in Table 1.

Step 2 – Develop plant specific person-rem dose (population dose) per reactor year for each of the eight accident classes and quantify baseline risk

In accordance with guidance given by Reference [2], This step develops IP2 population dose and evaluates the baseline risk impact for the eight accident classes defined in the previous sections of this calculation.

2a) Characterize accident scenarios into major groups (eight classes).

(See class one through eight sequences above)

2b) Develop plant specific person-rem dose (population dose) per reactor year.

The Indian Point Unit –3 Nuclear Generating Station evaluated person-rem doses to the population, within a 50-mile radius from the plant. The releases are based on post large Loss-Of-Coolant Accident (LOCA) and reactor coolant system releases [13]. Based on discussion with IP3 staff, the results of IP3 dose release analysis are applicable to the Indian Point Unit 2 site. Because, the two units are practically located on the same site and the volume of both containments are identical.

From the data section of the IP3 evaluation, the person- rem (population dose) taken out to 50 miles is based on the design basis normal containment leak rate of 0.1%/day (or 1La) and is 1.41E+06. This value is used to predict the Person-Rem dose for accident classes 1 to 7 as follows.

Class 1 = (1.41E+06) * 1.0La = 1.41E+06 person-rem
Class 2 = (1.41E+06) * 35La = 4.94E+07 person-rem
Class 3a = (1.41E+06) * 10La = 1.41E+07 person-rem
Class 3b = (1.41E+06) * 35La = 4.94E+07 person-rem
Class 4 = Not Analyzed
Class 5 = Not Analyzed
Class 6 = (1.41E+06) * 35La = 4.94E+07 person-rem
Class 7 = (1.41E+06) * 100La = 1.41E+08 person- rem

Class 8 sequences involve containment bypass failures; as a result, the person-rem dose is not based on normal containment leakage. The releases for this class are expected to be released directly to the environment. Based on reference [13] the value used is 5.33E+09 person-rem.

The above values are summarized in Table 2.

2c) Calculate and Review baseline Risk for Each Accident Class

The baseline line risk for each accident class is presented in Table 3. The baseline risk is defined as the product of the containment Failure Mode Frequency given a core damage accident and population. Table 3 is product of tables 1 and 2. The ILRT baseline risk is based on the test frequency of 3 in 10 years or about 1 in 3 years.

As mentioned in the method section of this calculation, only classes 1,3A and 3B are impacted by the Type A ILRT test. Therefore, the percent risk contribution (%Base_Risk) for these classes is:

%Base_Risk = [(Class1_Base + Class3A_Base + Class3B_Base) / Total_base)] * 100

Where:

Class1_Base = 3.3558E+01 person-rem/year

Class3A_Base = 2.8059E+01 person-rem/year

Class3B_base = 3.2159E+01 person-rem/year

Total_base = 1.0838E+04 person-rem/year

%Base_Risk = [(3.3558E+01 + 2.8059E+01 + 3.2159E+01) / 1.0838E+04] * 100
%Base_Risk = 0.86%

Therefore, the total baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.86%.

Step 3 – Evaluate risk impact of extending Type A test from 10 to 15 years.

According to NUREG-1493 [5], relaxing the Type A ILRT interval from 3- In-10 years to 1-In-10 years will increase the average time that a leak detected only by ILRT goes undetected from 18 to 60 months. The average time for an undetected leak is calculated by multiplying the test interval by ½ and multiplying by 12 to convert from years to months. If the test interval is extended to 1 in 15 years, the average time that a leak detectable only by an ILRT test goes undetected increases to 90 months (1/2*15*12). Since ILRT only detect about 3% of leaks (the rest are identified during LLRTs, Ref [5]), the result for a 10-yr ILRT interval is a 10% increase in the overall probability of leakage. This value is determined by multiplying 3% and the ratio of the average time for not detecting the leakage during the increased ILRT test interval (60 months) to the baseline average time for detecting the leakage during the 18 months test interval (i.e., 0.03* (60/18) * 100)=10%). For a 15-year test interval, the result is a 15% increase of the overall probability of leakage (i.e., 0.0 3* (90/18) *100 = 15%). Thus increasing the ILRT test interval from 10 to 15 years results in a 5% increase in the overall probability of leakage.

Risk impact due to 10-year test interval

As previously stated, Type A tests impact only Class 1 and Class 3 sequences. In addition, the increased probability of not detecting excessive leakage has no impact on the frequency of occurrence for Class1 sequences. Therefore, for Class 1 sequences, to determine the risk contribution of leakage for a 10 year test interval, the person-rem/year results for Class 1 sequences are multiplied by the increase in overall probability of leakage (10% or 1.1) times 2La . For Class 3 sequences, the release magnitude is not impacted by the change in test interval; (a small or large liner opening remains the same, even though the probability of not detecting the liner opening increases). Thus, only the frequency of Class 3 sequences is impacted. Therefore for Class 3 sequences, the risk contribution is determined by multiplying the Class 3 accident frequency by the increase in probability of leakage of 1.1. (Recall that for a 10-year interval there is a 10% increase on the overall probability of leakage). The results of this calculation are presented in table 4.

Based on the above values, the Type A 10-year test frequency percent risk contribution (%Risk_10) for Class 1 and Class 3 is as follows:

%Risk_10 = [(Class1_10 + Class3A_10 +Class3B_10) / Total_10] * 100

Where:

Class1_10 = 7.311E+01 person-rem/year

Class3A_10 = 3.086E+01 person-rem/year

Class3B_10 = 3.537E+01 person-rem/year

Total_10 = 1.0883E+04 person-rem/year

%Risk_10 = [(7.311E+01 + 3.086E+01 + 3.537E+01) / 1.0883E+04] * 100

%Risk_10 = 1.28%

Therefore, the total risk contribution of leakage for Type A 10-Year ILRT interval represented by class 1 and class 3 accident scenarios is 1.28%.

The percent risk increase due to extending the ILRT interval from 3-in-10 Years (baseline case) to 1-in-10 Years is evaluated as follows:

[(Total_10 – Total_base) / Total_base] * 100

Where;
[(Total_10 = 1.0883E+04 person-rem/year

Total_base = 1.0838E+04 person-rem/year

[(Total_10 – Total_base) / Total_base] * 100 = [(1.0883E+04 - 1.0838E+04) / 1.0838E+04] * 100 = 0.41%

Therefore, The total risk increase due to extending the ILRT interval from 3-in-10Years (baseline case) to 1-in-10Years is 0.41%

Risk Imapct due to 15-year test interval

The risk contribution for a 15-year interval is similar to the 10-year interval. The difference is in the increase in probability of leakage value. For this case the value is 15% or 1.15. (Recall that for 10-year interval there is a 10% increase on the overall probability of Leakage). In addition, the containment leakage used for the 10-year test interval for both Class 1 and Class 3 are used in the 15-year interval evaluation. The results for this calculation are presented in Table 5.

Based on the above values, the Type A 15-year test frequency percent risk contribution (%Risk _15) for Class 1 and Class 3 is as follows:

%Risk_15 = [(Class1_15 + Class3A_15 +Class3B_15) / Total_15] * 100

Where:

Class1_15 = 7.598E+01 person-rem/year

Class3A_15 = 3.227E+01 person-rem/year

Class3B_15 = 3.698E+01 person-rem/year

Total_15 = 1.0889E+04 person-rem/year

%Risk_15 = [(7.598E+01 + 3.227E+01 + 3.698E+01) / 1.0889E+04] * 100

%Risk_15 = 1.33%

Therefore, the total risk contribution of leakage for Type A 15-Year ILRT interval represented by Class 1 and Class 3 accident scenarios is 1.33%.

The percent risk increase due to extending the ILRT interval from 3-in-10Years (baseline case) to 1-in-15Years is evaluated as follows:

[(Total_15 – Total_base) / Total_base] * 100

Where;
Total_15 = 1.0889E+04 person-rem/year

Total_base = 1.0838E+04 person-rem/year

[(Total_15 – Total_base) / Total_base] * 100 = [(1.0889E+04 - 1.0838E+04) / 1.0838E+04] * 100 = 0.47%

Therefore, the total risk increase due to extending the ILRT interval from 3-in-10Years (baseline case) to 1-in-15Years is 0.47%

The percent risk increase in terms of person-rem/year from 1-in-10 years to 1-in-15years test interval for classes 1, 3A and 3B is:

% Risk (10-15PR) =[(person-rem(Class1,3)_15) – (person-rem(Class1,3)_10) / (person-rem(Class1,3)_10)]

person-rem(Class1,3)_10 = 139.3 person-rem/yr [Table 4]

person-rem(Class1,3)_15 = 145.23 person-rem/yr [Table 5]

% Risk (10-15PR) = [(145.23 – 139.30) / 139.30] * 100 = 4.25%

Therefore, the change in Type A test frequency from 1-in-10 Years to 1-in-15 Years increases the risk for Classes 1 and 3 by 4.25%

The percent Increase in Person-Rem/year for all accident classes from 1-in-10 years to 1-in-15 years test interval is:
(Total_15 – Total_10) /Total_10= (1.0889E+04 - 1.0883E+04) / 1.0883E+04 = 0.055%

Therefore, the total risk impact for extending the Type test interval from 10 years to 15 years is 0.055%

Step 4 – Determine the change in risk in terms of Large Early Release Frequency (LERF)

This step is based on Reference 15. The following argument is fully applicable to IP2 because the IP2 and IP3 containments and containment isolation lines are very similar in both design and size.

The one time extension of increasing the Type A test interval involves establishing the success criteria for a large release. This criteria is based on two prime issues:

1) The containment leak rate versus breach size, and

2) The impact on risk versus leak rate.

Stone & Webster evaluated the effect of containment leak size on the containment leak rate [6]. A sampling of some of the results is shown in table 6. In addition, Oak Ridge National Laboratory (ORNL) [7] completed a study evaluating the impact of leak rates on public risk using information from Wash-1400[8] as the basis for the risk sensitivity calculation (See figure 1).

Based upon the information provided by Stone and Webster and ORNL, it is judged that small leaks resulting from a severe accident (that are deemed not to dominate public risk) can be defined as those that change risk by less than 5%. This definition would include leaks of less than 35% per day. Based on the Stone and Webester data, a 35%/day containment leak rate equates to a diameter leak of slightly greater than 2 inches. Therefore, this study defines small leakage as containment leakage resulting from an opening of 3.14 in ^{2} or less, large leakage as greater than 35%/day and negligible leakage as 0.1%/day to 2%/day.

Impact on Large Early Release Frequency (LERF)

The risk impact associated with extending the ILRT interval involves the potential that a core damage event that normally would result in only a small radioactive release from containment could in fact result in large release due to failure to detect a pre-existing leak during the relaxation period. For this evaluation only Class 3 sequences have the potential to result in large releases if pre-existing leak were present. Class 1 sequences are not considered as potential large release pathways because for these sequences the containment remains intact. Therefore, the containment leak rate is expected to be small (less than 2La). A larger leak rate would imply an impaired containment, such as Classes 2,3, 6 and 7.

Late releases are excluded regardless of the size of the leak because late releases are by definition, not a LERF event. At the same time, sequences in the IP2 IPE [4], which result in large releases (e.g. large isolation valves failure), are not impacted because a LERF will occur regardless of the presence of a pre-existing leak. Therefore, the frequency of Class 3b sequences (Table 4) is used as the LERF for IP2. This frequency, based on ten-year interval, is 7.16E-07/yr.

Reg. Guide 1.174[3] provides guidance for determining the risk impact of plant specific changes to the licensing basis. It defines very small changes in risk as resulting in increases of core damage frequency CDF below 1.0E-6/yr and increases in LERF 1.0E-7/yr. Since the ILRT does not impact the CDF, the relevant metric is LERF. Calculating the increase in LERF requires determining the impact of the ILRT interval on the leakage probability.

As described in Step 3, extending the ILRT interval from once-per-10 years to once-per-15 years will increase the average time that a leak detectable only by ILRT goes undetected from 60 to 90 months. Since the ILRT only detect about 3% of leaks (the rest are defined during LLRTs), the result for a 15-yr ILRT interval is a 15% increase in the overall probability of leakage (3*90/18) versus 10% for 10-yr ILRT interval. Thus increasing the ILRT test interval from 10 years to 15 years results in 5% increase in the overall probability of leakage. Multiplying the above LERF frequency (7.16E-07/yr) by the increase in overall probability of leakage (0.05) gives an increase in LERF of 3.60E-08/yr. Since guidance in Regulatory Guide 1.174 defines very small changes in LERF as below 1.0E-7/yr, the risk due to increasing the ILRT interval to 15 years is insignificant.

If the risk increase is measured from the original 3-in-10 year interval to the 1-in-15 years test interval, then the increase in LERF is 7.8E-08/yr (i.e. frequency of Class 3b (Table 3) =6.51E-07/yr multiplied by the (15%-3%)=12% incremental increase). This increase of 7.8E-08/yr is below the 1.0E-7/yr screening criterion defined in Reg. Guide 1.174).

Figure 1
Fractional Impact on Risk Associated with Containment Leak Rates [6]

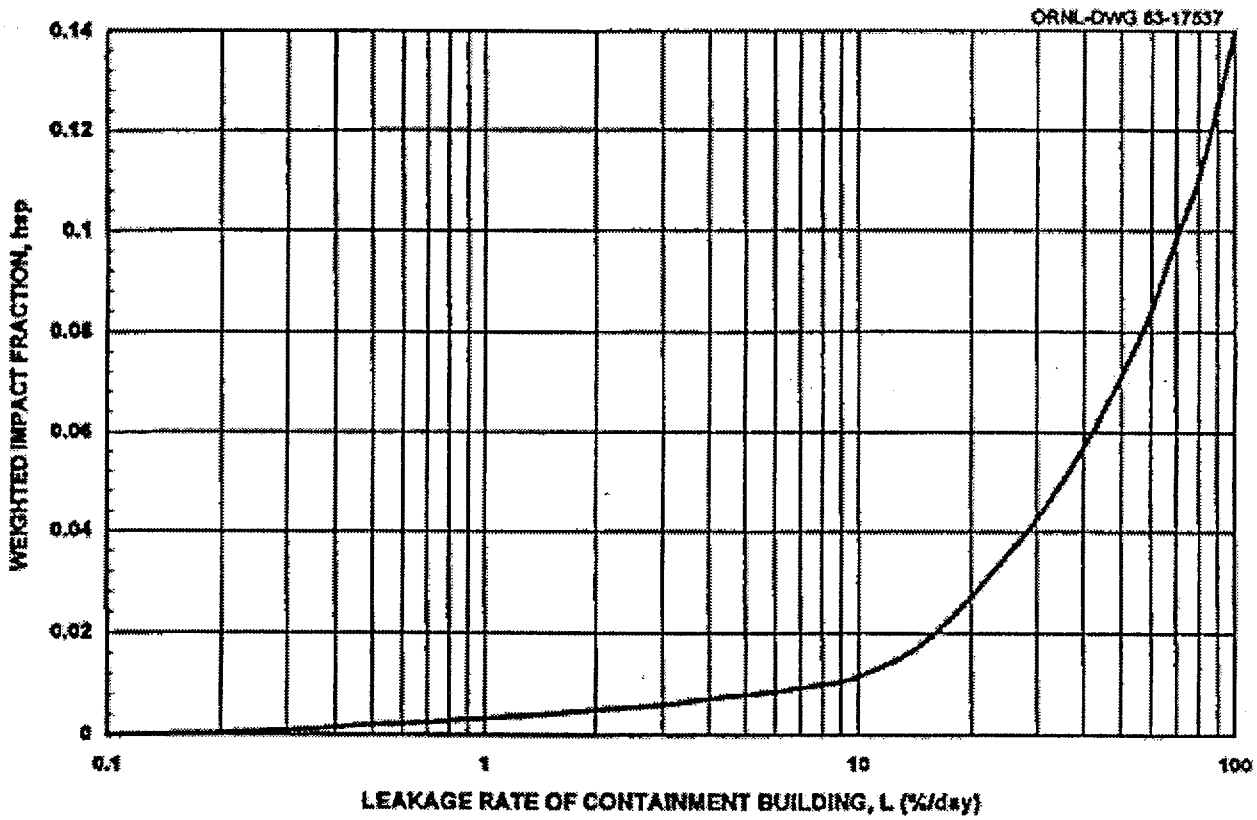


TABLE 1 - Mean Containment Frequency Measures for a Given Accident Class

Class	Description	Frequency/yr.	comments
1	No Containment Failure	2.38E-05	See section 7.0
2	Large Containment Isolation Failure (Failure-To-Close)	4.01E-09	
3a	Small Isolation Failures (Liner Breach)	1.99E-06	
3b	Large Isolation Failures (Liner Breach)	6.51E-07	
4	Small Isolation Failure – Failure-To-Seal (Type B test)	NA	
5	Small Isolation Failure – Failure-To-Seal (Type C Test)	NA	
6	Containment Isolation Failures (Dependent failures, Personnel Errors)	6.26E-09	
7	Severe Accident Phenomena Induced Failure (Early and Late Failures)	2.86E-06	=cfe+cfl+cfll=4.12e-8+2.49e-6+3.25e-7
8	Containment Bypassed (SGTR)	1.94E-06	Table 1.4-2 Bypass Type I +SGTR w/oSOV = 1.54E-6+3.99E-7
Core Damage	All CET Endstates	3.13E-05	Table 1.4-2 Ref. [4]

TABLE 2 - Person-Rem Measures for a Given Accident Class

Class	Description	Person-rem (50-miles)
1	No Containment Failure	1.41E+06
2	Large Containment Isolation Failure (Failure-To-Close)	4.94E+07
3a	Small Isolation Failures (Liner Breach)	1.41E+07
3b	Large Isolation Failures (Liner Breach)	4.94E+07
4	Small Isolation Failure – Failure-To-Seal (Type B test)	N/A
	Small Isolation Failure – Failure-To-Seal (Type C Test)	N/A
6	Containment Isolation Failures (Dependent failures, Personnel Errors)	4.94E+07
7	Severe Accident Phenomena Induced Failure (Early and Late Failures)	1.41E+08
8	Containment Bypassed (SGTR)	5.33E+09

TABLE 3 – Baseline Mean Consequence Measures for a Given Accident Class

Class	Description	Frequency/yr	Person-rem (50-miles)	Person-rem/yr (50-miles)
1	No Containment Failure	2.38E-05	1.41E+06	3.3558E+01
2	Large Containment Isolation Failure (Failure-To-Close)	4.06E-09	4.94E+07	2.0056E-01
3a	Small Isolation Failures (Liner Breach)	1.99E-06	1.41E+07	2.8059E+01
3b	Large Isolation Failures (Liner Breach)	6.51E-07	4.94E+07	3.2159E+01
4	Small Isolation Failure – Failure-To-Seal (Type B test)	NA	N/A	NA
5	Small Isolation Failure – Failure-To-Seal (Type C Test)	NA	N/A	NA
6	Containment Isolation Failures (Dependent failures, Personnel Errors)	6.26E-09	4.94E+07	3.0924E-01
7	Severe Accident Phenomena Induced Failure (Early and Late Failures)	2.86E-06	1.41E+08	4.0326E+02
8	Containment Bypassed (SGTR)	1.94E-06	5.33E+09	1.0340E+04
	All CET End states	3.13E-05		1.0838E+04

TABLE 4 Mean Consequence Measures for 10 – Year Test Interval for a Given Accident Class

Class	Description	Frequency/yr	Person-rem (50-miles)	Person-rem/yr (50-miles)
1	No Containment Failure	2.36E-05	3.10E+06	7.3112E+01
2	Large Containment Isolation Failure (Failure-To-Close)	4.06E-09	4.94E+07	2.0056E-01
3a	Small Isolation Failures (Liner Breach)	2.19E-06	1.41E+07	3.0865E+01
3b	Large Isolation Failures (Liner Breach)	7.16E-07	4.94E+07	3.5375E+01
4	Small Isolation Failure – Failure-To-Seal (Type B test)	NA	N/A	NA
5	Small Isolation Failure – Failure-To-Seal (Type C Test)	NA	N/A	NA
6	Containment Isolation Failures (Dependent failures, Personnel Errors)	6.26E-09	4.94E+07	3.0924E-01
7	Severe Accident Phenomena Induced Failure (Early and Late Failures)	2.86E-06	1.41E+08	4.0326E+02
8	Containment Bypassed (SGTR)	1.94E-06	5.33E+09	1.0340E+04
CDF	All CET Endstates	3.13E-05		1.0883E+04

TABLE 5 - Mean Consequence Measures for 15 – Year Test Interval for a Given Accident Class

Class	Description	Frequency/yr	Person-rem (50-miles)	Person-rem/yr (50-miles)
1	No Containment Failure	2.35E-05	3.24E+06	7.5986E+01
2	Large Containment Isolation Failure (Failure-To-Close)	4.06E-09	4.94E+07	2.0056E-01
3a	Small Isolation Failures (Liner Breach)	2.29E-06	1.41E+07	3.2268E+01
3b	Large Isolation Failures (Liner Breach)	7.49E-07	4.94E+07	3.6983E+01
4	Small Isolation Failure – Failure-To-Seal (Type B test)	NA	N/A	NA
5	Small Isolation Failure – Failure-To-Seal (Type C Test)	NA	N/A	NA
6	Containment Isolation Failures (Dependent failures, Personnel Errors)	6.26E-09	4.94E+07	3.0924E-01
7	Severe Accident Phenomena Induced Failure (Early and Late Failures)	2.86E-06	1.41E+08	4.0326E+02
8	Containment Bypassed (SGTR)	1.94E-06	5.33E+09	1.0340E+04
CDF	All CET End States	3.13E-05		1.0889E+04

Table 6 Evaluated Impact of Containment Leak Size on Containment Leak rate

Containment Leak Size		Approximate Containment Leak Rate at Design Pressure (Wt%/day)
Diameter (in.)	Area (in.^{2})	
0.25	0.05	0.5
0.34	0.09	1.0
0.50	0.2	2.4
1.25	1.2	14.4
2.00	3.1	31.0
3.4 (estimated)	9.1	100(estimated

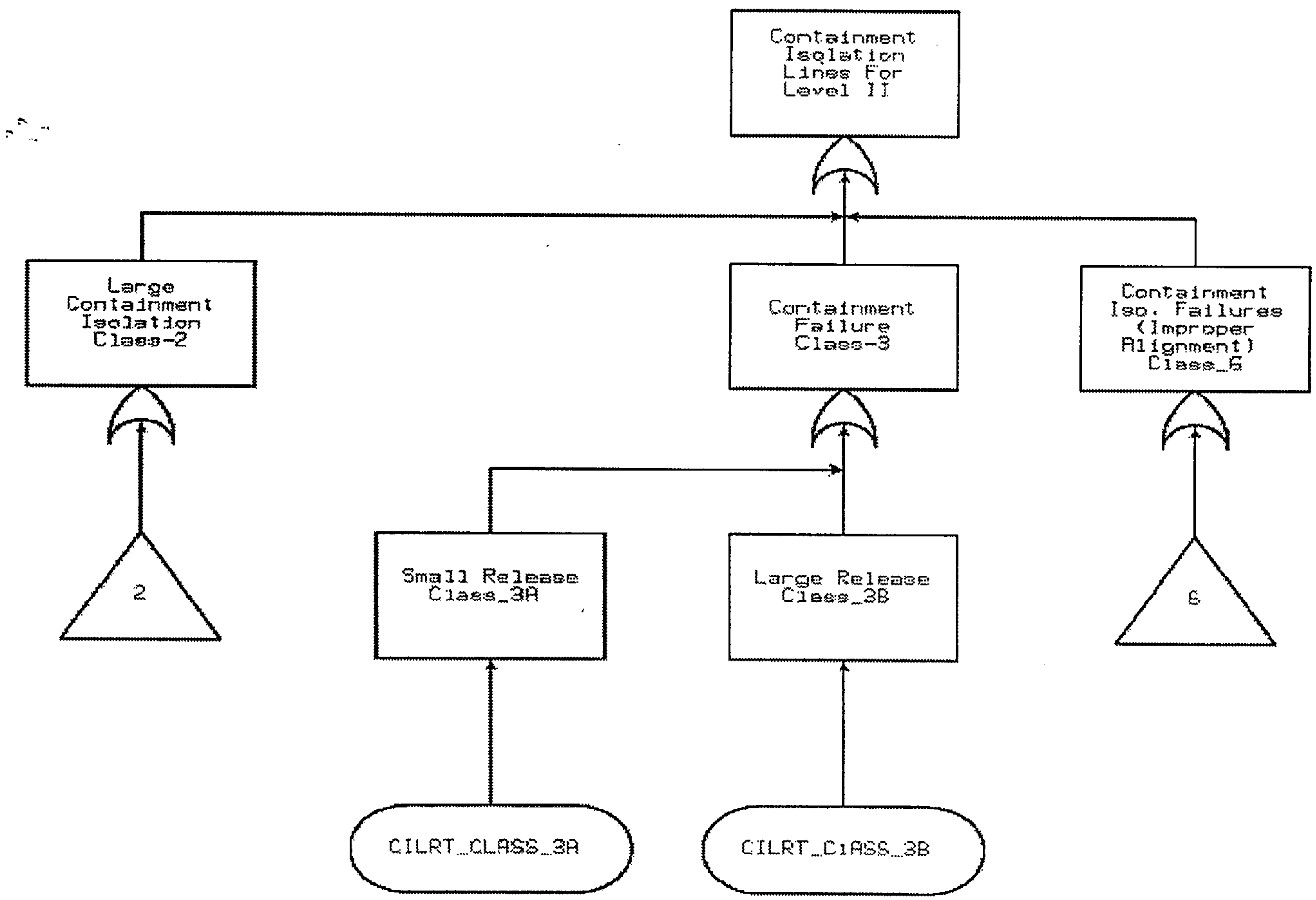
TABLE 7 - IP2 Population Dose
Large Break Loss-Of-Coolant Accident and Reactor Coolant Population Dose

Mile	Population	Doses (rem)		Doses (Person-rem)	
		LBLOCA	RCS	LBLOCA	RCS
1	0	0	0	0	0
2	15130	1.836	6.95E+03	2.778E+04	1.052E+08
3	18428	1.103	4.18E+03	2.033E+04	7.708E+07
4	14225	7.88E-01	2.98E+03	1.121E+04	4.243E+07
5	24508	6.12E-01	2.32E+03	1.500E+04	5.693E+07
6	25922	5.01E-01	1.90E+03	1.299E+04	4.925E+07
7	28096	4.24E-01	1.61E+03	1.192E+04	4.523E+07
8	25967	3.67E-01	1.39E+03	9.538E+03	3.617E+07
9	36930	3.25E-01	1.23E+03	1.201E+04	4.553E+07
10	46488	2.90E-01	1.10E+03	1.348E+04	5.114E+07
15	342852	2.21E-01	8.36E+02	7.577E+04	2.867E+08
20	448654	1.57E-01	5.95E+02	7.044E+04	2.671E+08
25	920850	1.22E-01	4.63E+02	1.123E+05	4.266E+08
30	2171939	1.00E-01	3.80E+02	2.172E+05	8.260E+08
35	2276172	8.48E-02	3.21E+02	1.931E+05	7.313E+08
40	3451123	7.35E-02	2.78E+02	2.538E+05	9.604E+08
45	3416140	6.48E-02	2.46E+02	2.215E+05	8.414E+08
50	2199601	5.80E-02	2.20E+02	1.276E+05	4.846E+08

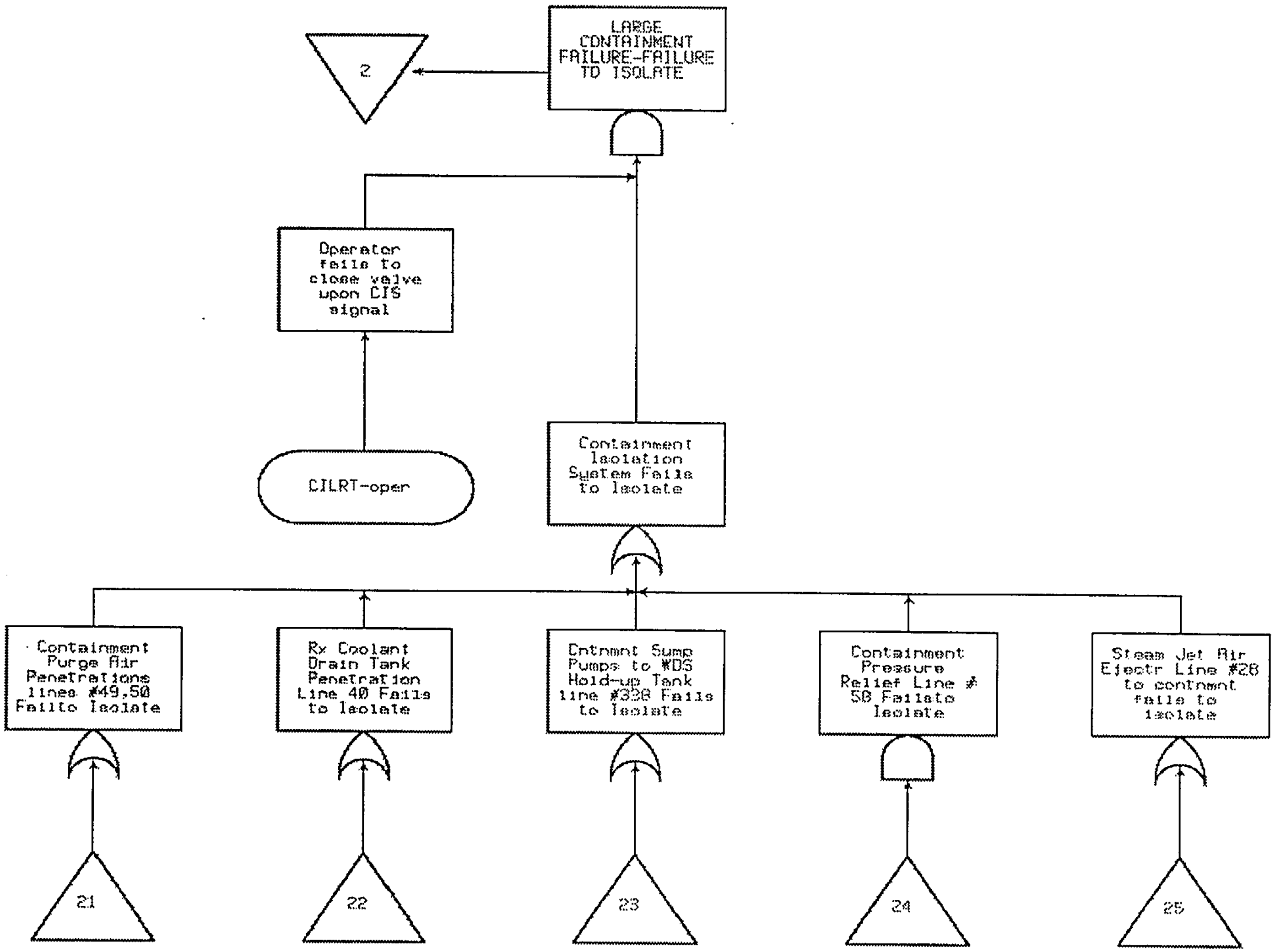
Attachment - A

Containment Isolation Fault Tree for Type A ILRT Evaluation

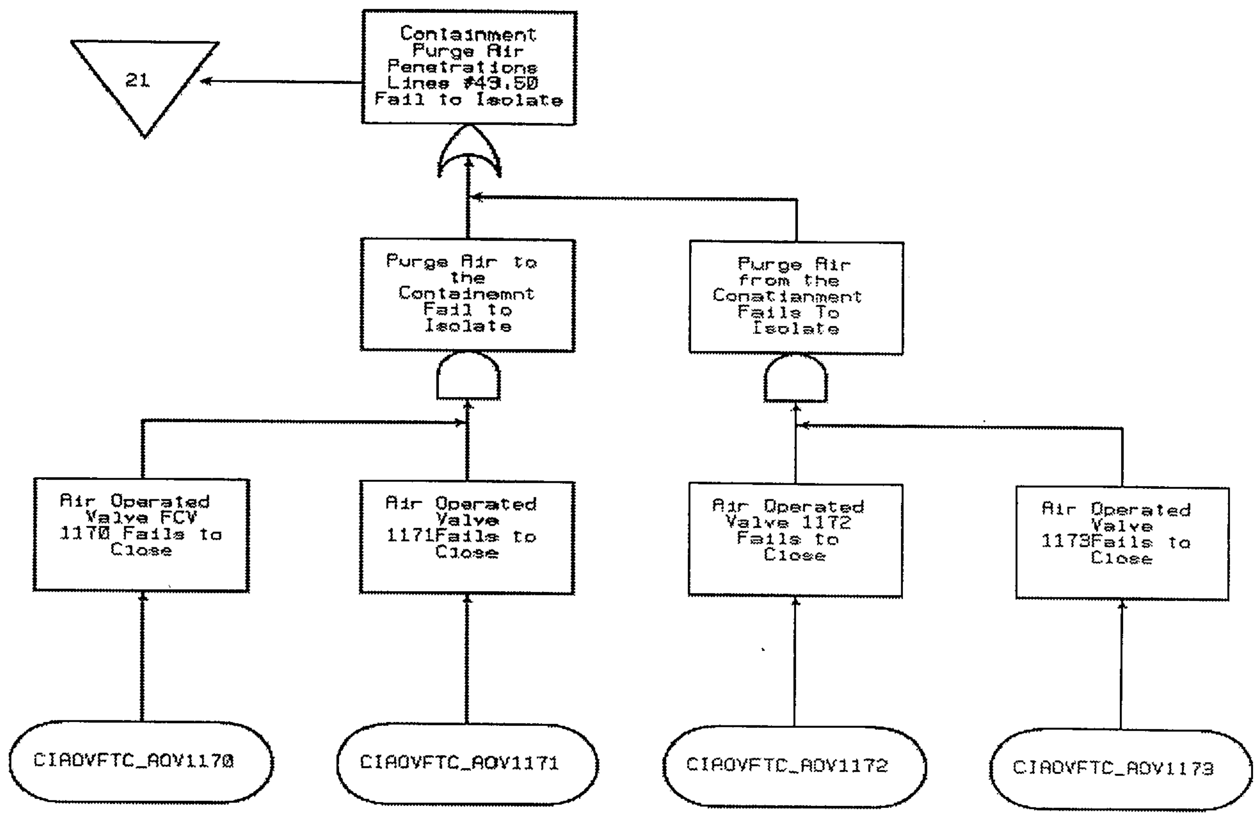
Containment Isolation Fault Tree for Type A ILRT Evaluation (Riskman File # CIS0T.EFS)



Containment Isolation Fault Tree for Type A ILRT Evaluation (Riskman File # CISC2.EFS)



Containment Isolation Fault Tree for Type A ILRT Evaluation (Riskman File # CISC21.EFS)



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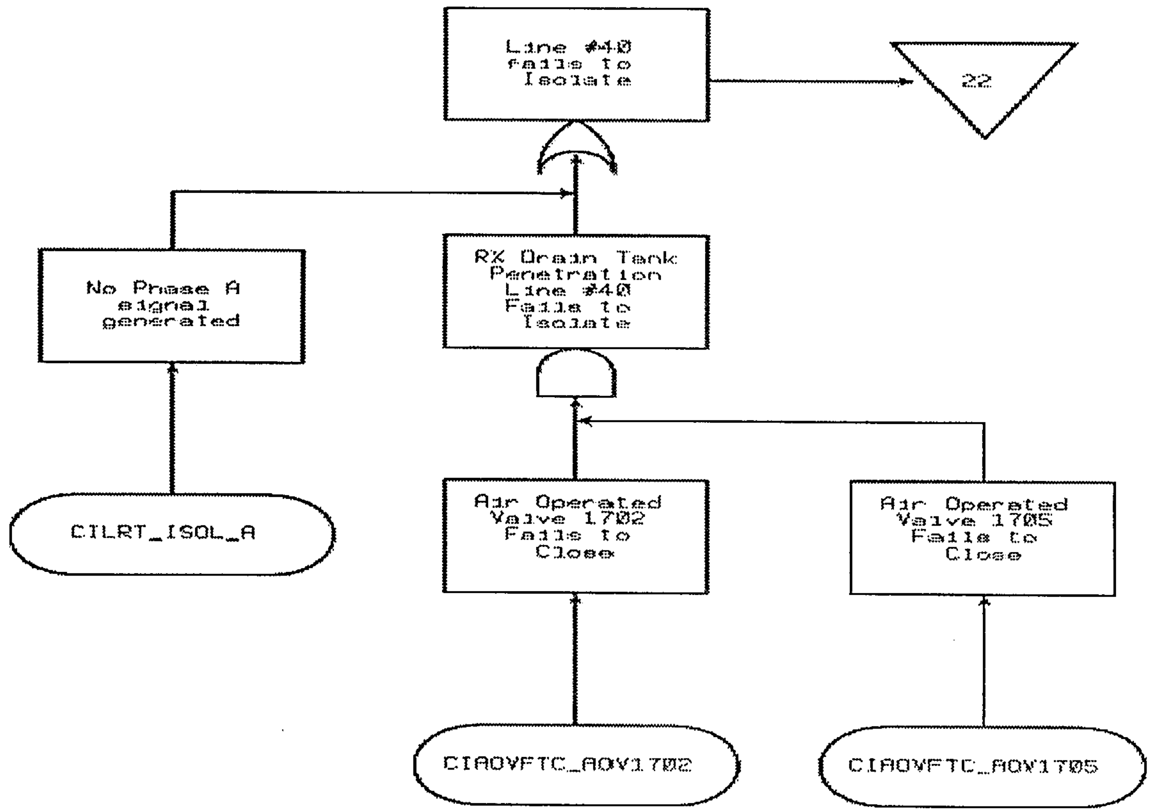

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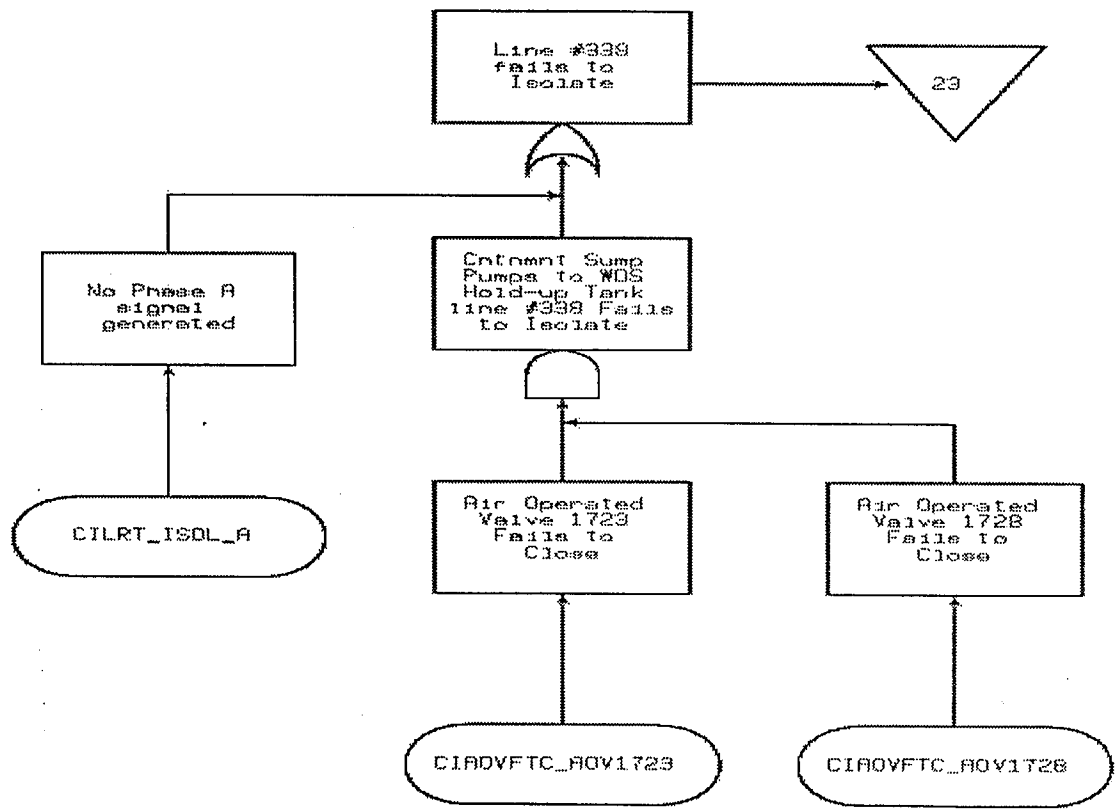
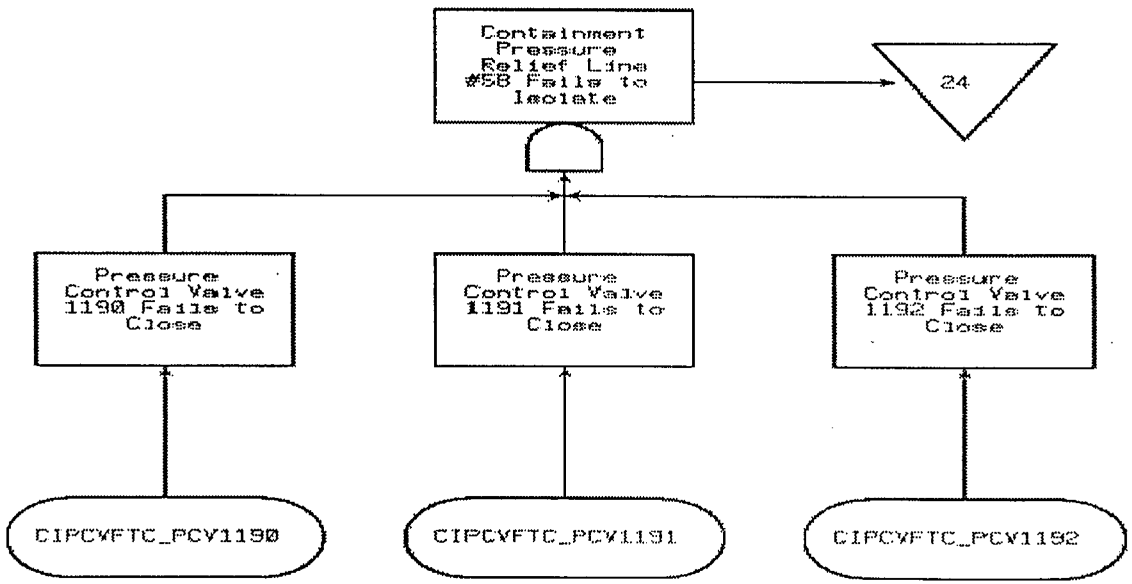
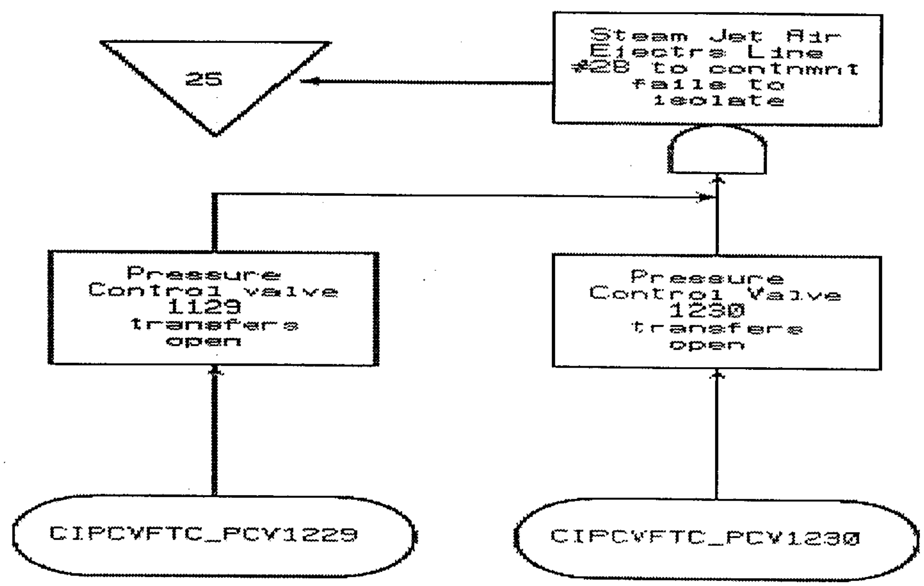


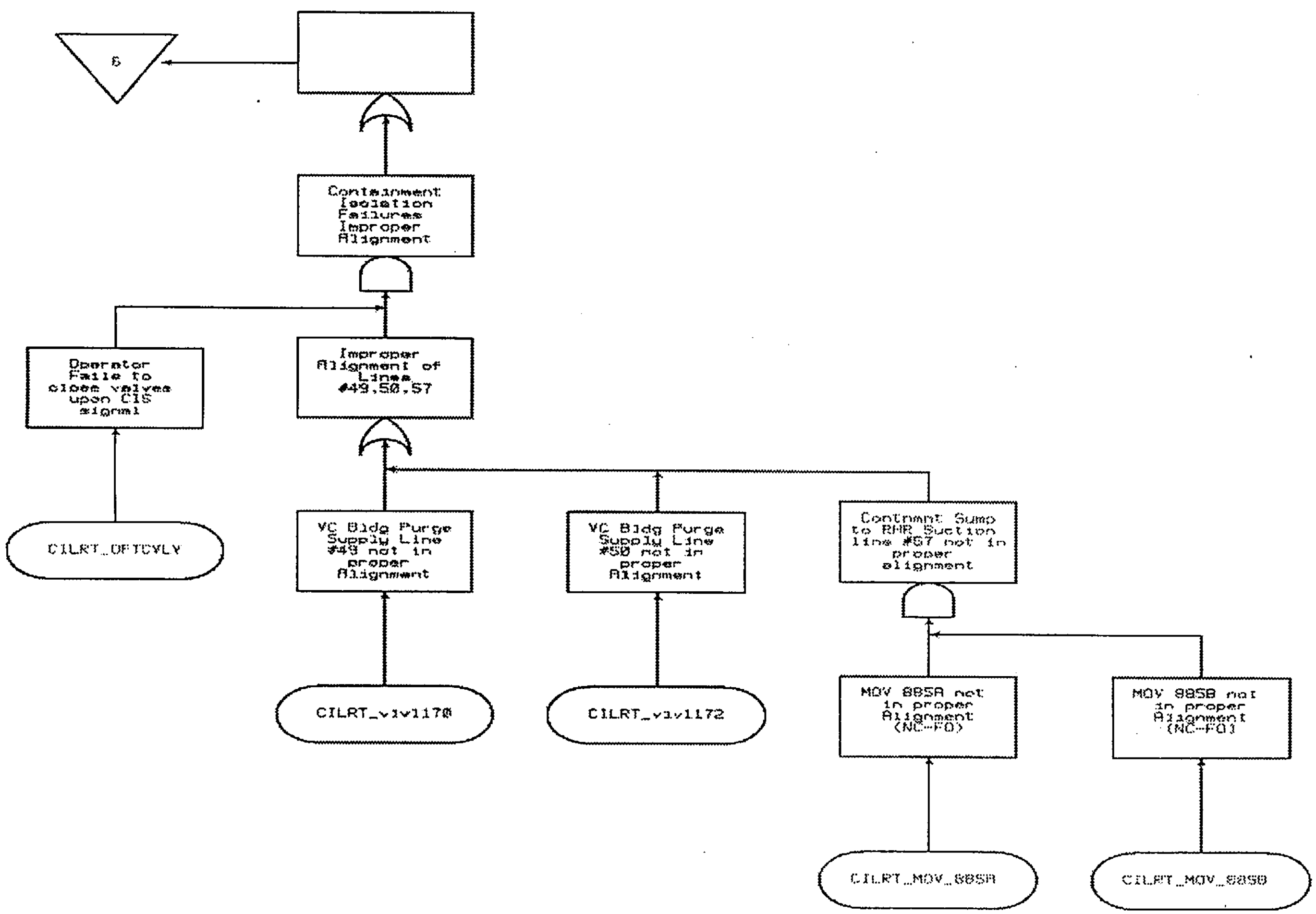
Containment Isolation Fault Tree for Type A ILRT Evaluation (Riskman File # CISC22.EFS)



Containment Isolation Fault Tree for Type A ILRT Evaluation (Riskman File # CIS22.EFS)



Containment Isolation Fault Tree for Type A ILRT Evaluation (Riskman File # CISC6.EFS)



Attachment B

SYSTEM NOTEBOOK
For TOP EVENT: CILRT
CONTAINMENT ISOLATION FOR ILRT
15:26:42 14 MAY 2001
MODEL Name: NOV99

```
SYSTEM NOTEBOOK
For TOP EVENT: CILRT
CONTAINMENT ISOLATION FOR ILRT
15:26:42  14 MAY 2001
SYSTEM NOTEBOOK
Common Cause Report for CILRT
Section I
MODEL Name: NOV99
CCF Model Report for Top Event CILRT

Group ID : AOVGA        Basic Events      Description

CIAOVFTC_AOV1702   Air Operated Valve 1702 Fails to Close
CIAOVFTC_AOV1705   Air Operated Valve 1705 Fails to Close
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Group ID : AOVGB        Basic Events      Description

CIAOVFTC_AOV1723   Air Operated Valve 1723 Fails to Close
CIAOVFTC_AOV1728   Air Operated Valve 1728 Fails to Close
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Group ID : AOVGC        Basic Events      Description
CIPCVFTC_PCV1190   Pressure Control Valve 1190 Fails to Close
CIPCVFTC_PCV1191   Pressure Control Valve 1191 Fails to Close
CIPCVFTC_PCV1192   Pressure Control Valve 1192 Fails to Close
Algebraic Method: MGL
Order = 2 out of 3
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D
```

```
Gamma = IPVG5D
Group ID : AOVGD       Basic Events     Description

CIAOVFTC_AOV1170   Air Operated Valve FCV 1170 Fails to Close
CIAOVFTC_AOV1171   Air Operated Valve 1171Fails to Close
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Group ID : AOVGE       Basic Events     Description
CIAOVFTC_AOV1172   Air Operated Valve 1172 Fails to Close
CIAOVFTC_AOV1173   Air Operated Valve 1173Fails to Close
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Group ID : AOVGS       Basic Events     Description
CIPCVFTC_PCV1229   Pressure Control valve 1129 transfers open
CIPCVFTC_PCV1230   Pressure Control Valve 1230 transfers open
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Group ID : AOVGT       Basic Events     Description
CIPCVFTCPCV1216A
CIPCVFTC_PCV1216
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Group ID : AOVGU       Basic Events     Description
```

```
CIPCVFTCPCV1217A
CIPCVFTC_PCV1217
Algebraic Method: MGL
Order = 1 out of 2
Failure Mode ID : OPEN
Total Failure Rate = IPV05D
Beta = IPVB5D

Basic Event Report for Top Event CILRT

  Basic Events     Description

CIAOVFTC_AOV1170   Air Operated Valve FCV 1170 Fails to Close
CIAOVFTC_AOV1170 is replaced in Common Cause Group AOVGD
[CIAOVFTC_AOV1170] Common Cause: Group AOVGD, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIAOVFTC_AOV1171   Air Operated Valve 1171Fails to Close
Constant Value: 1.0
[CIAOVFTC_AOV1171] Common Cause: Group AOVGD, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIAOVFTC_AOV1172   Air Operated Valve 1172 Fails to Close
CIAOVFTC_AOV1172 is replaced in Common Cause Group AOVGE
[CIAOVFTC_AOV1172] Common Cause: Group AOVGE, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIAOVFTC_AOV1173   Air Operated Valve 1173Fails to Close
CIAOVFTC_AOV1173 is replaced in Common Cause Group AOVGE
[CIAOVFTC_AOV1173] Common Cause: Group AOVGE, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIAOVFTC_AOV1702   Air Operated Valve 1702 Fails to Close
CIAOVFTC_AOV1702 is replaced in Common Cause Group AOVGA
[CIAOVFTC_AOV1702] Common Cause: Group AOVGA, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIAOVFTC_AOV1705   Air Operated Valve 1705 Fails to Close
CIAOVFTC_AOV1705 is replaced in Common Cause Group AOVGA
[CIAOVFTC_AOV1705] Common Cause: Group AOVGA, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIAOVFTC_AOV1723   Air Operated Valve 1723 Fails to Close
CIAOVFTC_AOV1723 is replaced in Common Cause Group AOVGB
[CIAOVFTC_AOV1723] Common Cause: Group AOVGB, 1/2
 (1-(IPVB5D))*(IPV05D) = 7.6219E-04
```

```
CIAOVFTC_AOV1728   Air Operated Valve 1728 Fails to Close
CIAOVFTC_AOV1728 is replaced in Common Cause Group AOVGB
[CIAOVFTC_AOV1728] Common Cause: Group AOVGB, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CILRT-oper         Operator fails to close valve upon CIS signal
Constant Value: 0.1
CILRT_CLASS_3A     Small Release Class_3A
Constant Value: 6.4E-2
CILRT_ClASS_3B     Large Release Class_3B
Constant Value: 2.1E-2
CILRT_ISOL_A       No Phase A signal generated
Constant Value: 1E-3
CILRT_MOV_885A     MOV 885A not in proper Alignment (NC-FO)
Constant Value: 1E-3
CILRT_OFTCVLV      Operator Fails to close valves upon CIS signal
Constant Value: 0.1
CILRT_vlv1170      VC Bldg Purge Supply Line #49 not in proper Alignment
Constant Value: 1E-3
CILRT_vlv1172      VC Bldg Purge Supply Line #50 not in proper Alignment
Constant Value: 1E-3
CIPCVFTCPCV1216A
CIPCVFTCPCV1216A is replaced in Common Cause Group AOVGT
[CIPCVFTCPCV1216A] Common Cause: Group AOVGT, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTCPCV1217A
CIPCVFTCPCV1217A is replaced in Common Cause Group AOVGU
[CIPCVFTCPCV1217A] Common Cause: Group AOVGU, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTC_PCV1190   Pressure Control Valve 1190 Fails to Close
CIPCVFTC_PCV1190 is replaced in Common Cause Group AOVGC
[CIPCVFTC_PCV1190] Common Cause: Group AOVGC, 1/3
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTC_PCV1191   Pressure Control Valve 1191 Fails to Close
CIPCVFTC_PCV1191 is replaced in Common Cause Group AOVGC
[CIPCVFTC_PCV1191] Common Cause: Group AOVGC, 1/3
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTC_PCV1192   Pressure Control Valve 1192 Fails to Close
CIPCVFTC_PCV1192 is replaced in Common Cause Group AOVGC
[CIPCVFTC_PCV1192] Common Cause: Group AOVGC, 1/3
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
```

```
CIPCVFTC_PCV1216
CIPCVFTC_PCV1216 is replaced in Common Cause Group AOVGT
[CIPCVFTC_PCV1216] Common Cause: Group AOVGT, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTC_PCV1217
CIPCVFTC_PCV1217 is replaced in Common Cause Group AOVGU
[CIPCVFTC_PCV1217] Common Cause: Group AOVGU, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTC_PCV1229   Pressure Control valve 1129 transfers open
CIPCVFTC_PCV1229 is replaced in Common Cause Group AOVGS
[CIPCVFTC_PCV1229] Common Cause: Group AOVGS, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
CIPCVFTC_PCV1230   Pressure Control Valve 1230 transfers open
CIPCVFTC_PCV1230 is replaced in Common Cause Group AOVGS
[CIPCVFTC_PCV1230] Common Cause: Group AOVGS, 1/2
(1-(IPVB5D))*(IPV05D) = 7.6219E-04
[CIAOVFTC_AOV1170,CIAOVFTC_AOV1171]Common Cause: Group AOVGD, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIAOVFTC_AOV1172,CIAOVFTC_AOV1173]Common Cause: Group AOVGE, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIAOVFTC_AOV1702,CIAOVFTC_AOV1705]Common Cause: Group AOVGA, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIAOVFTC_AOV1723,CIAOVFTC_AOV1728]Common Cause: Group AOVGB, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIPCVFTCPCV1216A,CIPCVFTC_PCV1216]Common Cause: Group AOVGT, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIPCVFTCPCV1217A,CIPCVFTC_PCV1217]Common Cause: Group AOVGU, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIPCVFTC_PCV1190,CIPCVFTC_PCV1191]Common Cause: Group AOVGC, 2/3
5.0000E-01*(IPVB5D)*(1-(IPVG5D))*(IPV05D) = 2.4669E-05
[CIPCVFTC_PCV1190,CIPCVFTC_PCV1192]Common Cause: Group AOVGC, 2/3
5.0000E-01*(IPVB5D)*(1-(IPVG5D))*(IPV05D) = 2.4669E-05
[CIPCVFTC_PCV1191,CIPCVFTC_PCV1192]Common Cause: Group AOVGC, 2/3
5.0000E-01*(IPVB5D)*(1-(IPVG5D))*(IPV05D) = 2.4669E-05
[CIPCVFTC_PCV1229,CIPCVFTC_PCV1230]Common Cause: Group AOVGS, 2/2
(IPVB5D)*(IPV05D) = 5.7369E-05
[CIPCVFTC_PCV1190,CIPCVFTC_PCV1191,CIPCVFTC_PCV1192]Common Cause: Group AOVGC, 3/3
(IPVB5D)*(IPVG5D)*(IPV05D) = 8.0317E-06

Basic Event Report for Top Event CILRT
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Database Variables

IPV05D
IPVB5D
IPVG5D

SYSTEM NOTEBOOK
Split Fraction Report for CILRT
Section IV
Split Fraction Report for Top Event CILRT
15:26:50  14 MAY 2001

Split Fraction CIC2 - Class_2 Failure
PE Mean     = 1.2978E-04          Date : 14 MAY 2001 14:35
MC/LH Mean = 0.0000E+00          Date :
Basic Event Impacts for Split Fraction : CIC2
Basic Event      State   Description
CILRT_OFTCVLV        S     Operator Fails to close valves upon CIS signal
CILRT_CLASS_3A       S     Small Release Class_3A
CILRT_ClASS_3B       S     Large Release Class_3B
Split Fraction CIC6 - Class_6 Failure
PE Mean     = 2.0100E-04          Date : 14 MAY 2001 14:35
MC/LH Mean = 0.0000E+00          Date :

Basic Event Impacts for Split Fraction : CIC6
Basic Event      State   Description
CILRT-oper           S     Operator fails to close valve upon CIS signal
CILRT_CLASS_3A       S     Small Release Class_3A
CILRT_ClASS_3B       S     Large Release Class_3B

Split Fraction CIC3 - Class_3 Failure
PE Mean     = 8.5000E-02          Date : 14 MAY 2001 14:35
MC/LH Mean = 0.0000E+00          Date :
Basic Event Impacts for Split Fraction : CIC3
Basic Event      State   Description
CILRT-oper           S     Operator fails to close valve upon CIS signal
CILRT_OFTCVLV        S     Operator Fails to close valves upon CIS signal

Split Fraction CIC3A - Class_3a Failure
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PE Mean     = 6.4000E-02          Date : 14 MAY 2001 14:35
MC/LH Mean = 0.0000E+00          Date :
Basic Event Impacts for Split Fraction : CIC3A
Basic Event       State   Description
CILRT-oper            S     Operator fails to close valve upon CIS signal
CILRT_ClASS_3B        S     Large Release Class_3B
CILRT_OFTCVLV         S     Operator Fails to close valves upon CIS signal

Split Fraction CIC3B - Class_3b Failure
PE Mean     = 2.1000E-02          Date : 14 MAY 2001 14:35
MC/LH Mean = 0.0000E+00          Date :
Basic Event Impacts for Split Fraction : CIC3B
Basic Event       State   Description
CILRT-oper            S     Operator fails to close valve upon CIS signal
CILRT_CLASS_3A        S     Small Release Class_3A
CILRT_OFTCVLV         S     Operator Fails to close valves upon CIS signal

SYSTEM NOTEBOOK
Cause Table for CILRT
Section VI
MODEL Name: NOV99
Cause Table for Top Event CILRT and Split Fraction CIC2
PE Value of CIC2 = 1.2978E-04      Date : 14 MAY 2001 14:35
MC/LH Value of CIC2 = 0.0000E+00      Date : 15:26:52  14 MAY 2001
Page 1
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No...	Cutsets...........	Value.....	% Importance	% Cumulative	Alignment...
1	CILRT-oper * CILRT_ISOL_A	1.000E-04	77.0508	77.0508	NORMAL
2	[CIAOVFTC_AOV1172, CIAOVFTC_AOV1173] * CILRT-oper	5.737E-06	4.4204	81.4712	NORMAL
3	[CIAOVFTC_AOV1723, CIAOVFTC_AOV1728] * CILRT-oper	5.737E-06	4.4204	85.8916	NORMAL
4	[CIAOVFTC_AOV1702, CIAOVFTC_AOV1705] * CILRT-oper	5.737E-06	4.4204	90.3120	NORMAL
5	[CIAOVFTC_AOV1170, CIAOVFTC_AOV1171] * CILRT-oper	5.737E-06	4.4204	94.7324	NORMAL
6	[CIPCVFTC_PCV1229, CIPCVFTC_PCV1230] * CILRT-oper	5.737E-06	4.4204	99.1528	NORMAL
7	[CIPCVFTC_PCV1190,	8.032E-07	.6189	99.7717	NORMAL

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        CIPCVFTC_PCV1191,CIPCVFTC_PCV1192] * CILRT-oper
8       [CIAOVFTC_AOV1723] 5.809E-08      .0448        99.8164    NORMAL
        * [CIAOVFTC_AOV1728]
        * CILRT-oper
9       [CIAOVFTC_AOV1172] 5.809E-08      .0448        99.8612    NORMAL
        * [CIAOVFTC_AOV1173]
        * CILRT-oper
10      [CIPCVFTC_PCV1229] 5.809E-08      .0448        99.9060    NORMAL
        * [CIPCVFTC_PCV1230]
* CILRT-oper
11      [CIAOVFTC_AOV1170] 5.809E-08      .0448        99.9507    NORMAL
        * [CIAOVFTC_AOV1171]
* CILRT-oper
12      [CIAOVFTC_AOV1702] 5.809E-08      .0448        99.9955    NORMAL
        * [CIAOVFTC_AOV1705]
* CILRT-oper
13      [CIPCVFTC_PCV1191, 1.880E-09      .0014        99.9969    NORMAL
        CIPCVFTC_PCV1192]
        * [CIPCVFTC_PCV1190]
* CILRT-oper
14      [CIPCVFTC_PCV1190, 1.880E-09      .0014        99.9984    NORMAL
        CIPCVFTC_PCV1192]
        * [CIPCVFTC_PCV1191]
* CILRT-oper
15      [CIPCVFTC_PCV1190, 1.880E-09      .0014        99.9998    NORMAL
        CIPCVFTC_PCV1191] *
        [CIPCVFTC_PCV1192]*CILRT-oper
16      [CIPCVFTC_PCV1190, 6.086E-11      .0000        99.9999    NORMAL
        CIPCVFTC_PCV1192] * [CIPCVFTC_PCV1191,CIPCVFTC_PCV1192]
        * CILRT-oper
17      [CIPCVFTC_PCV1190, 6.086E-11      .0000        99.9999    NORMAL
        CIPCVFTC_PCV1191] * [CIPCVFTC_PCV1191,
        CIPCVFTC_PCV1192]
        * CILRT-oper
18      [CIPCVFTC_PCV1190, 6.086E-11      .0000       100.0000    NORMAL
        CIPCVFTC_PCV1191] *
        [CIPCVFTC_PCV1190,
         CIPCVFTC_PCV1192]
         * CILRT-oper
19      [CIPCVFTC_PCV1190] 4.428E-11      .0000       100.0000    NORMAL
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        * CIPCVFTC_PCV1191]
        * [CIPCVFTC_PCV1192]
        * CILRT-oper
Cause Table for Top Event CILRT and Split Fraction CIC6
PE Value of CIC6 =2.01000E-04       Date : 14 MAY 2001 14:35
MC/LH Value of CIC6 = 0.0000E+00       Date :15:26:53  14 MAY 2001
No... Cutsets........... Value..... % Importance % Cumulative Alignment...
1      CILRT_OFTCVLV *     1.000E-04    49.9999       49.9999    NORMAL
       CILRT_vlv1172
2      CILRT_OFTCVLV *     1.000E-04    49.999       99.9999    NORMAL
       CILRT_vlv1170
3      CILRT_MOV_885A *    1.000E-07    .0001      100.0000    NORMAL
       CILRT_MOV_885B *
       CILRT_OFTCVLV

Cause Table for Top Event CILRT and Split Fraction CIC3
PE Value of CIC3 = 8.5000E-02       Date : 14 MAY 2001 14:35
MC/LH Value of CIC3 = 0.0000E+00       Date : 15:26:54  14 MAY 2001
No... Cutsets........... Value..... % Importance % Cumulative Alignment...
1      CILRT_CLASS_3A      6.400E-02    75.2941       75.2941    NORMAL
2      CILRT_ClASS_3B      2.100E-02    24.7059      100.0000    NORMAL
MODEL Name: NOV99
Cause Table for Top Event CILRT and Split Fraction CIC3A
PE Value of CIC3A = 6.4000E-02       Date : 14 MAY 2001 14:35
MC/LH Value of CIC3A = 0.0000E+00       Date : 15:26:55  14 MAY 2001

No... Cutsets........... Value..... % Importance % Cumulative Alignment...
1      CILRT_CLASS_3A      6.400E-02   100.0000      100.0000    NORMAL
MODEL Name: NOV99
Cause Table for Top Event CILRT and Split Fraction CIC3B
PE Value of CIC3B = 2.1000E-02       Date : 14 MAY 2001 14:35
MC/LH Value of CIC3B = 0.0000E+00       Date : 15:26:55  14 MAY 2001
No... Cutsets........... Value..... % Importance % Cumulative Alignment...
1      CILRT_ClASS_3B      2.100E-02   100.0000      100.0000    NORMAL
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