Entergy

Entergy Nuclear Northeast
Entergy Nuclear Operations, Inc.
Indian Point 3 NPP
P.O. Box 308
Buchanan, NY 10511
Tel 914 736 8001 Fax 736 8012

Robert J. Barrett
Vice President, Operations-IP3

January 18, 2001
IPN-01-007

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

Subject: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
License No. DPR-64
Supplemental Information Regarding Proposed Change to Section 6.14 of the Administrative Section of the Technical Specifications

Reference: NYPA letter to NRC titled, "Proposed Change to Section 6.14 of the Administrative Section of the Technical Specifications," dated September 6, 2000.

Dear Sir:

The purpose of this letter is to provide supplemental information to support the proposed Technical Specification change request made in the referenced letter. The information provided involves plant specific risk based analysis information to justify extending the Type A integrated leak rate test (ILRT) from once every ten years to once every fifteen years on a one-time basis. This is in response to several telephone conversations held by staff members of the NRC and Entergy - Indian Point 3 (IP3).

An evaluation was performed to assess the risk impact of extending the current containment Type A ILRT. In performing the risk assessment we followed the guidelines of NEI 94-01, the methodology used in EPRI TR-104285 and NRC Regulatory (Reg.) Guide 1.174, on the use of Probabilistic Risk Assessment (PRA) findings and risk insights in support of a license change to a plant's licensing basis.

Attachment I contains a summary of the information used in the approach for the risk assessment and a summary of results. Attachment II contains a copy of the calculation used for the evaluation. This calculation was previously sent to NRC staff members via electronic mail on January 9, 2001. This information is supplemental to that contained in the referenced letter. It does not change the conclusions of the no significant hazards evaluation contained in the reference, but provides additional plant specific risk information.

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There are no new commitments made by this letter. Please note that our original submittal stated that we expected a rule change to be sought related to the ILRT frequency. At this point, we are not aware of any organization pursuing a potential rule change.

Our previous letter requested review and approval of this amendment by February 1, 2001. We request review and approval of this amendment as soon as possible in order to allow for the planning of the schedule for the upcoming refueling outage currently scheduled for April, 2001. If you have any questions, please contact Mr. Ken Peters.

Very truly yours,

Joe Russell for
Robert J. Barrett
Vice President - Operations
Indian Point 3 Nuclear Power Plant

STATE OF NEW YORK
COUNTY OF WESTCHESTER
Subscribed and sworn to before me
this 18th day of January, 2001

Victoria J. Williams
Notary Public

VICTORIA J. WILLIAMS
NOTARY PUBLIC - STATE OF NEW YORK
NO 01WI6046851
QUALIFIED IN PUTNAM COUNTY
MY COMMISSION EXPIRES 08-21-2002

Attachments

cc: U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Resident Inspector's Office
Indian Point Unit 3
U.S. Nuclear Regulatory Commission
P.O. Box 337
Buchanan, NY 10511

Mr. George F. Wunder, Project Manager
Project Directorate I-1
Division of Reactor Projects I/II
U.S. Nuclear Regulatory Commission
Mail Stop 14 B2
Washington, DC 20555

SUMMARY

Entergy Nuclear Northeast - IP3 has completed a risk assessment of the proposed one time TS change of extending the containment Type A test interval from once-per-ten-years to once-per-fifteen-years. In performing the risk assessment we followed the guidelines of NEI 94-01, the methodology used in EPRI TR-104285 and the NRC Reg. Guide 1.174, 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. 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 contained in Attachment II.

Revisions to 10 CFR 50, Appendix J allow individual plants to extend Type A surveillance testing requirements from three-in-ten years to at least once per ten years. The revised Type A test frequency is based on an acceptable performance history defined as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than normal containment leakage or 1.0La. IP3 selected the revised requirements as its testing program. IP3's current ten-year Type A test is due to be performed during the upcoming refueling outage (RO11) currently scheduled for April 2001.

The change in plant risk was evaluated based on the change in the predicted person-rem/year frequency and Large Early Release Frequency (LERF).

The analysis examined IP3's IPE 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 (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 plant post-maintenance test. (For example, valve failing to close following a valve stroke test) (Class 6 sequences).

- Accident sequences involving containment failure induced by severe accident phenomena (Class 7 sequences), containment bypassed (Class 8 sequences), large containment isolation failures (EPRI TR-104285 Class 2 sequences) and small containment isolation 'failure-to-seal' events (Class 4 and 5 sequences) were not accounted for in this evaluation. These sequences are impacted by changes in Type B

and C test intervals, not changes in the Type A test interval.

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

- Quantify the base-lined risk in terms of frequency per reactor year for each of the eight accident classes presented. See Table 1 below.
- Developed 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 on the next page.
- Evaluate the risk impact of extending Type A test interval from 10 to 15 years.
- Determine the change in risk in terms of LERF in accordance with Reg. Guide 1.174.

Table 1
Mean Containment Frequency Measures - Given Accident Class

Class	Description	Frequency (per RX-year)
1	No Containment Failure	2.79×10^{-5}
2	Large containment isolation failures (failure-to-close)	5.15×10^{-9}
3a	Small isolation failures (liner breach)	2.79×10^{-6}
3b	Large isolation failures (liner breach)	9.24×10^{-7}
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed
6	Containment isolation failures (dependent failures, personnel errors)	8.93×10^{-9}
7	Severe accident phenomena induced failure (early and late failures)	9.89×10^{-6}
8	Containment Bypassed (SGTR)	2.43×10^{-6}
Core Damage	All Containment Event Tree Endstates	4.4×10^{-5}

Table 2
Person-Rem Measures - Given Accident Class

Class	Description	Person-Rem (50-miles)
1	No Containment Failure	1.41×10^{6}
2	Large containment isolation failures (failure-to-close)	4.94×10^{7}
3a	Small isolation failures (liner breach)	1.41×10^{7}
3b	Large isolation failures (liner breach)	4.94×10^{7}
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)	4.94×10^{7}
7	Severe accident Phenomena Induced Failure (Early and Late Failures)	1.41×10^{8}
8	Containment Bypassed (SGTR)	5.33×10^{9}

The impact associated with extending the Type A ILRT test frequency interval, measured as percent change with respect to the total integrated risk is presented in Table 3 below.

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

Class[1]	Risk Impact (Base)[2]	Risk Impact (10-years)[3]	Risk Impact (15-years)[4]
1, 3a and 3b	0.86% of integrated value based on 1xLa normal containment leakage for Class 1, 10La for Class 3a and 35La for class 3b 124.2 person-rem/yr	1.23% of integrated value based on 1xLa normal containment leakage for Class 1, 10La for Class 3a and 35La for Class 3b 178.9 person-rem/yr	1.28% of integrated value based on 1xLa normal containment leakage for Class 1, 10La for Class 3a and 35La for Class 3b 186.3 person-rem/yr
Total Integrated Risk	14,515 person-rem/yr	14,570 person-rem/yr	14,577 person-rem/yr

[1] Only accident sequences impacted by a change in Type A test frequency are evaluated. These are sequences 1, 3a and 3b
[2] IP3 IPE baseline values
[3] Type A ILRT test interval of 1-in-10 years
[4] Type A ILRT test interval of 1-in-15 years

The conclusions of the plant risk associated with extending the Type A ILRT test frequency from ten years to fifteen years are as follows:

1. 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 4.1%. However, the increase in risk on the total integrated plant risk for those accident sequences influenced by Type A testing is found to be 0.048%. This value can be considered to be a negligible increase in risk.

2. Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test interval is 5.1 x 10^{-8}/yr. Since guidance in the Reg. Guide defines very small changes in LERF as below 10^{-7}/yr, increasing the ILRT interval to 15 years is therefore considered non-risk significant.

3. For the current ten-year ILRT interval, sequences involving no containment failure (or small releases) contribute 69.6% to the overall CDF. Alternatively stated, the contribution of sequences involving containment failure for the ten-year interval is 30.4%. These numbers are consistent with those documented in our Individual Plant Examination (IPE). For the proposed fifteen-year interval, the contribution of sequences involving containment failure increased to 30.5%. Thus, increasing the ILRT interval from ten years to fifteen years increases the frequency of sequences resulting in a containment failure by 0.1%.

4. Although the attached analysis evaluates the risk to perform the Type A ILRTs at IP3 once every 15 years, this request only seeks this change on a one-time only basis.

ATTACHMENT II TO IPN-01-007

REQUEST FOR SUPPLEMENTAL INFORMATION REGARDING PROPOSED CHANGE TO SECTION 6.14 OF THE ADMINISTRATIVE SECTION OF TECHNICAL SPECIFICATIONS

ENTERGY NUCLEAR NORTHEAST
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
DPR-64

Nuclear Engineering
CALCULATION CONTROL SHEET

Nuclear Plant: IP3 ☒ JAF ☐

CALC. NO. IP3-CALC-VC-03357 REVISION 0

CALCULATION IS: PRELIMINARY ___ FINAL X

	NAME	SIGNATURE	DATE
PREPARER:	J. Favara	[signature]	1/3/01
PREPARER:	J. Bretti	[signature]	1/3/01
CHECKER:	J. Circle	[signature]	1/4/01
(DESIGN) VERIFIED/NA			
APPROVED:	C.Yeh	[signature]	1/4/01

ORIGINATOR: ENTERGY ☒ OR OTHER ☐

SYSTEM NO. /NAME Containment Building Structure

TITLE: Risk Impact Assessment of Extending Containment Type A Test Interval

QA CATEGORY: Non-Cat I DISCIPLINE: ______ STRUCTURE: NA

MODIFICATION NO./TASK NO. NA DBD REF. NO. NA

PROBLEM / OBJECTIVE / METHOD Submit an one-time exemption to the ten year frequency of the performance-based Type A Containment leakage testing program for IP3. In order to support this exemption, a risk assessment of the potential change in the predicted person-rem/year frequency and the plant's Large Early Release Frequency (LERF) in accordance with RG-1.174 is requested by the NRC. The results of the Indian Point Unit Three (IP3) Individual Plant Examination (IPE) Revision 0 are to be used to for this calculation.

DESIGN BASIS / ASSUMPTION

Not Applicable.

INFORMATION ONLY

SUMMARY / CONCLUSIONS

See page 1.

THIS CALC SUPERSEDES OR VOIDS CALC. NO. ______

DISTRIBUTION: C= CONTROLLED I= INFO

NAME	DEPT	LOC	C	I
John Favara	Rx Eng.	11	X	
John Bretti	Rx Eng.	11	X	
Jeff Circle	Rx Eng.	11	X	

Nuclear Engineering
CALCULATION CONTROL SHEET

COMPONENTS

MAJOR EQUIPMENT	PIPE NO.	VALVE NO.	SUPT. NO.	INST. NO.	PENE. NO.

RELATED DOCUMENTS

IP3-RPT-MULT-01539, Indian Point 3 Nuclear Power Plant Individual Plant Examination Volumes 1 and 2, Revision 0, June, 1994

RELATED DRAWINGS

SECURITY: (Y/N) N COMPUTER PRINTOUT: (Y/N) N

CALCULATION

Entergy Nuclear Operations, Inc.

INFORMATION ONLY

Calculation No. IP3-CALC-VC-03357 Revision 0

Project: IP3 Individual Plant Examination Page 1 of 26

Subject: Risk Impact Assessment of Extending Containment Type A Test Interval

Computed by: John Favara Date: 1/3/01
Computed by: John Bretti Date: 1/3/01
Checked by: Jeff Circle Date: 1/4/01

SUMMARY

Revisions to 10 CFR 50, Appendix J allow individual plants to extend Type A surveillance testing requirements from three-in-ten years to at least once per 10 years. The revised Type A test frequency is based on an acceptable performance history defined as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than normal containment leakage or $1.0L_a$.

The Indian Point Unit Three Nuclear Power Plant (IP3) selected the revised requirements as its testing program. IP3 current ten-year Type A test is due to be performed during refueling outage eleven (RO11). However, IP3 seeks a one-time exemption based on (1) the substantial cost savings of $325,000.00 from eliminating the test from the RO11 schedule, and (2) the belief that a rule change will be sought by the industry to eliminate the need for Type A testing.

To support the plant's submittal to the NRC for this change, a risk assessment evaluation was performed to assess the risk impact of extending the current containment Type A integrated leak-rate test (ILRT) from a ten-year to fifteen-year interval. The risk assessment followed the guidelines set forth in NEI 94-01, the methodology used in EPRI TR-104285 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, RG 1.174.

Specifically the approach combined the use of the plant's Individual Plant Examination (IPE) results and findings to the methodology described in ERPR TR-104285 to estimate plant risk on specific accident sequences impacted by Type A testing.

The change in plant risk was evaluated based on the change in the predicted person-rem/year frequency and Large Early Release Frequency (LERF).

The analysis examined IP3's IPE 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 (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 plant post-maintenance test. (For example, valve failing to close following a valve stroke test. (Class 6 sequences).
- Accident sequences involving containment failure induced by severe accident phenomena (Class 7 sequences), containment bypassed (Class 8 sequences), large containment isolation failures (EPRI TR-104285 Class 2 sequences) and small containment isolation 'failure-to-seal' events (Class 4 and 5 sequences) were not accounted for in this evaluation. These sequences are impacted by changes in Type B and C test intervals, not changes in the Type A test interval.

SUMMARY (continued)

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

Step 1 - Quantify the base-lined risk in terms of frequency per reactor year for each of the eight accident classes presented. (Table S-1)

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

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

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

Table S-1
Mean Containment Frequencies Measures - Given Accident Class

Class	Description	Frequency (per Rx-year)
1	No Containment Failure	2.79×10^{-5}
2	Large Containment Isolation Failures (Failure-to-close)	5.15×10^{-9}
3a	Small Isolation Failures (Liner breach)	2.79×10^{-6}
3b	Large Isolation Failures (Liner Breach)	9.24×10^{-7}
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed
6	Containment Isolation Failures (dependent failures, personnel errors)	8.93×10^{-9}
7	Severe Accident Phenomena Induced Failure (Early and late Failures)	9.89×10^{-6}
8	Containment Bypassed (SGTR)	2.43×10^{-6}
Core Damage	All Containment Event Tree Endstates	4.4×10^{-5}

Table S-2
Person-Rem Measures - Given Accident Class

Class	Description	Person-Rem (50-Miles)
1	No Containment Failure	1.41×10^{6}
2	Large Isolation Failures (Failure to Close)	4.94×10^{7}
3a	Small Pre-existing Liner Breach Failure	1.41×10^{7}
3b	Large Pre-existing Liner Breach Failure	4.94×10^{7}
4	Small Isolation Failure to Seal (Type B Test)	N/A
5	Small Isolation Failure to Seal (Type C Test)	N/A
6	Other Isolation Failures (e.g., Dependent Failures)	4.94×10^{7}
7	Failure Induced by Phenomena (Early and Late Failures)	1.41×10^{8}
8	Bypass (SGTR)	5.33×10^{9}

SUMMARY (continued)

The impact associated with extending the Type A ILRT test frequency interval, measured as percent change with respect to the total integrated risk is presented in Table S-3 below.

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

Class[1]	Risk Impact (Base)[2]	Risk Impact (10-years)[3]	Risk Impact (15-years)[4]
1, 3a and 3b	0.86% of integrated value based on $1xL_a$ normal containment leakage for Class 1, $10L_a$ for Class 3a and $35L_a$ for Class 3b 124.2 person-rem/yr	1.23% of integrated value based on $1xL_a$ normal containment leakage for Class 1, $10L_a$ for Class 3a and $35L_a$ for Class 3b 178.9 person-rem/yr	1.28% of integrated value based on $1xL_a$ normal containment leakage for Class 1, $10L_a$ for Class 3a and $35L_a$ for Class 3b 186.3 person-rem/yr
Total Integrated Risk	14,515 person-rem/year	14,570 person-rem/year	14,577 person-rem/year

The conclusions regarding the assessment of the plant risk associated with extending the Type A ILRT test frequency from ten-years to fifteen years are as follows:

1. The risk assessment associated with the risk from implementation of a one-time exemption in extending the containment Type A ILRT from ten years to fifteen years 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 4.1%, given the change from a once-per-ten-years test frequency to a once-per-fifteen-years test frequency. However, the increase in risk on the total integrated plant risk for those accident sequences influenced by Type A testing, given the change from a once-per-ten-years test frequency to a once-per-fifteen-years test frequency, is found to be 0.048%. This value can be considered to be a negligible increase in risk.

2. Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test interval from an once-per-ten year test frequency to an once-per-fifteen test frequency is 5.1×10^{-8}/yr. Since guidance in Reg. Guide 1.174 defines very small changes in LERF as below 10^{-7}/yr, increasing the ILRT interval to 15 years is therefore considered non-risk significant.

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1 Only accident sequences impacted by a change in Type A test frequency are evaluated. Theses are sequences 1, 3a and 3b
2 IP3 IPE baseline values
3 Type A ILRT test interval of 1-in-10-years
4 Type A ILRT test interval of 1-in-15-years

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Calculation Use Limitations

This calculation was developed to address the specific issue(s) described in the above Statement of Problem. Information provided in this calculation should not be used to support conclusions, recommendations, decisions or procedure development/revision unrelated to the above issue(s).

For related issues, information provided in this calculation should be used only by qualified staff and only in conjunction with relevant references (eg, related calculations, FSAR, Technical Specifications, Design Basis Documents, Licensing commitments, design drawings, etc.), as appropriate.

If this calculation is used to change the plant's Design Basis the responsible engineer should notify the Corporate Engineering Group (WPO Nuclear Generation Department) to ensure these changes accurately reflect the information provided in the calculation.

PROBLEM

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 Three Nuclear Power Plant (IP3) 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 (define as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than $1.0L_a$).

IP3 current ten-year Type A test is due to be performed during refueling outage eleven (RO11), scheduled for May 13, 2001. However, IP3 seeks a one-time exemption based on (1) the substantial cost savings of $325,000.00 from eliminating the test from the RO11 schedule, and (2) the belief that a rule change will be sought by the industry to eliminate the need for Type A testing.

OBJECTIVE

Provide a risk impact assessment on extending the plant's integrated leak rate test (ILRT) interval from ten to fifteen years. The risk assessment should be performed in accordance with the guidelines set forth in NEI 94-01 [1], the methodology used in EPRI TR-104285 [2] 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, RG 1.174 [3]

In addition, the results and findings from the IP3 Individual Plant Examination (IPE) [4] are used for this risk assessment calculation.

METHOD

A simplified bounding analysis approach for evaluating the change in risk associated with increasing the interval from 10-years-to15-years for Type A test was used. This approach is similar to that presented in EPRI TR-104285 [2] and NUREG-1493 [5]. Namely, the analysis performed examined IP3's 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 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 containment integrity is impaired due to containment isolation failures of pathways left 'opened' following a plant post-maintenance test. (For example, a valve failing to close following a valve stroke test. (EPRI TR-104285 Class 6 sequences).

METHOD (continued)

- Accident sequences involving containment failure induced by severe accident phenomena (EPRI TR-104285 Class 7 sequences), containment bypassed (EPRI TR-104285 Class 8 sequences), large containment isolation failures (EPRI TR-104285 Class 2 sequences) and small containment isolation 'failure-to-seal' events (EPRI TR-104285 Class 4 and 5 sequences) were not accounted for in this evaluation. These sequences are impacted by changes in Type B and C test intervals, not changes in the Type A test interval impact these sequences. Table 1 presents the IP3 IPE frequencies for these eight accident classes.

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

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.

Step 2 - Developed plant specific person-rem dose (population dose) per reactor year for each of the eight accident classes evaluated in EPRI TR-104285 [2] and presented in 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 in terms of Large Early Release Frequency (LERF) in accordance with RG 1.174 [3]

Step 1- Quantify the base-lined risk in terms of frequency per reactor year.

This step involves the review of the IP3 IPE [4] containment event tree (CET). The CET characterizes the response of the containment to important severe accident sequences. The CET used in this evaluation is based on important phenomena and systems-related events identified in NUREG-1335 [9] and NSAC-159, Volume 2 [10] and on plant features that influence the phenomena.

As previously described, 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 failure induced by severe accident phenomena. As a result, the CET containment isolation model was reviewed for applicable isolation failures and their impact on the overall plant risk. Specifically, a simplified model to predict the likelihood of having a small/large breach in the containment liner that is undetected by the Type A ILRT test was developed.

The containment isolation model found in the IP3 IPE examined the five issues associated with containment isolation in NUREG-1335 [9]: (1) the identity of pathways that could significantly contribute to containment isolation failure, (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

METHOD (continued)

containment that are ultimately routed into the primary auxiliary building and piping that communicates directly with the containment atmosphere and exceeds 2 inches in diameter. It will be noted that this latter piping diameter criterion excludes from further consideration valves in piping that interacts directly with the containment atmosphere and has a diameter of less than 2 inches. The rationale for this exclusion is that containment leakage through smaller diameter piping will not preclude further containment pressurization, and, in any case, any release of fission products from a pipe smaller that 2 inches. will be small and therefore pose a minimal public risk (see write-up in Step 4).

Piping that communicates directly with the Reactor Coolant System (RCS) was also not considered in the containment isolation failure analysis—such failures are considered to be failures of the pressure boundary between the RCS and low pressure systems (i.e., an interfacing system LOCA). In addition, manual valves were not examined in this review of containment isolation valve failures as their failures are considered passive and therefore most unlikely.

Based on the above, eight lines were selected for examination as potential fission product release paths [Attachment A].

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 a containment isolation failure event. The 10^{-3}/demand-failure probability selected for this event is conservative (a similar event modeled in the safeguard actuation system fault tree [IP3 IPE Report] has a predicted value of 3.36×10^{-4} /demand).

4) The examination of testing and maintenance procedures. Failures 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 10^{-3}. Given control room indication of valve positions, this value is conservative.

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 in closing normally open valves.

For this analysis, the question on containment isolation 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 liner breach). (This event models the 'Class 3' sequence depicted in EPRI TR-104285 [2]).

To calculate the probability that a liner leak will be large (Event CLASS-3B), use was made of the data presented in NUREG-1493 [5]. The data found in NUREG-1493 states that 144 ILRTs were conducted. The largest reported leak rate from those 144 tests was 21 times the allowable leakage rate (L_a). Since 21L_a does not constitute a large release (refer to the write-up in Step 4), no large releases have occurred based on the 144 ILRTs reported in NUREG-1493 [5].

METHOD (continued)

To estimate the failure probability given that no failures have occurred, a conservative estimate is obtained from the 95th percentile of the χ^2 distribution. In statistical theory, the χ^2 distribution can be used for statistical testing, goodness-of-fit tests, and evaluating *s*-confidence [11]. The χ^2 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 degrees of freedom, ν. For time-truncated tests (versus failure-truncated tests), an estimate of the probability of a large leak using the χ^2 distribution can be calculated as χ^2_{95} (ν = 2n+2)/2N, where n represents the number of large leaks and N represents the number of ILRTs performed to date. With no large leaks (n = 0) in 144 events (N = 144) and χ^2_{95} (2) = 5.99, the 95th percentile estimate of the probability of a large leak is calculated as 5.99/(2*144) = 0.021.

To calculate the probability that a liner leak will be small (Event CLASS-3A), use was made of the data presented in NUREG-1493 [5]. The data found in NUREG-1493 states that 144 ILRTs were conducted. The data reported that 23 of 144 tests had allowable leak rates in excess of 1.0L_a. However, of these 23 'failures' only 4 were found by an ILRT, the others were found by Type B and C testing or errors in test alignments. Therefore, the number of failures considered for 'small releases' are 4-of-144. Similar to the event CLASS-3B probability, the estimated failure probability for small release is found by using the χ^2 distribution. The χ^2 distribution is calculated by n=4 (number of small leaks) and N=144 (number of events) which yields a χ^2 (10) =18.3070). Therefore, the 95th percentile estimate of the probability of a small leak is calculated as 18.3070/(2*144) = 0.064.

After modifying the containment isolation fault tree model (Attachment A) and including the respective 'large' and 'small' liner breach leak rate probabilities, the IP3 CET was quantified to predict the eight severe accidents class frequencies presented in Table 1 and describe below. The containment event tree quantification was performed with the Event Tree Progress Analysis Code (EVNTRE) [12]. The results of this quantification are presented in Attachment B ('event tree' format).

Class 1 Sequences. This group consists of all core damage accident progression bins for which the containment remains intact. The frequency per year for these sequences is 2.79 x 10^{-5} /year (Attachment B, Figure B-1). For this analysis the associated maximum containment leakage for this group is 2L_a.

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 (>2-inch diameter) containment isolation valves (Attachment C). The frequency per year for these sequences is determined as follows:

$$CLASS\_2\_FREQUENCY = PROB_{large\ CI} * CDF$$

Where:

$PROB_{large\ CI}$ = random large containment isolation failure probability (i.e. large valves) = 1.171 x 10^{-4} [Attachment C]

CDF = IP3 IPE core damage frequency = 4.4 x 10^{-5} /year [4]

$$CLASS\_2\_FREQUENCY = 1.171 \times 10^{-4} * 4.4 \times 10^{-5} /year$$

CLASS_2_FREQUENCY = 5.15 x 10^{-9} /year

METHOD (continued)

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

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 ($2L_a$ to $35L_a$) or large ($>35L_a$).

The respective frequencies per year are determined as follows:

$$CLASS\_3A\_FREQUENCY = PROB_{class\_3a} * CDF$$

$$CLASS\_3B\_FREQUENCY = PROB_{class\_3b} * CDF$$

Where:

$PROB_{class\_3a}$ = probability of small pre-existing containment liner leakage = 0.064 [see above write-up]

$PROB_{class\_3b}$ = probability of large pre-existing containment liner leakage = 0.021 [see above write-up]

$$\mathbf{CLASS\_3A\_FREQUENCY = 0.064 * 4.4 \times 10^{-5} /year = 2.80 \times 10^{-6} /year}$$

$$\mathbf{CLASS\_3B\_FREQUENCY = 0.021 * 4.4 \times 10^{-5} /year = 9.24 \times 10^{-7} /year}$$

For this analysis the associated maximum containment leakage for class 3A is $10L_a$ and for class 3B is $35L_a$.

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

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

Class 6 Sequences. This group is similar to Class 2. These are sequences that 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 vales following a test/maintenance evolution.

The frequency per year for these sequences is determined as follows:

$$CLASS\_6\_FREQUENCY = PROB_{largeT\&M} * CDF$$

METHOD (continued)

Where:
$PROB_{largeT\&M}$ = random large containment isolation failure probability due to valve misalignment
= 2.031×10^{-4} [Attachment C]

CLASS_6_FREQUENCY = $2.031 \times 10^{-4} * 4.4 \times 10^{-5}$ /year = 8.93×10^{-9} /year

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

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. H_2 combustion). For this analysis the associated maximum containment leakage for this group is $35L_a$.

CLASS_7_FREQUENCY = TOT_CFL + CFE

Where:
TOT_CFL = total late containment failure frequency = 9.85×10^{-6} / year [Figure B-1]

CFE = early containment failure frequency (excluding bypass failures)
= TOT_CFE - CI - CONT_BYPASS

Where:
TOT_CFE = total early containment failure frequency = 6.21×10^{-6} / year [Figure B-1]

CI = containment isolation failure
= NCI_LK_CLASS_3A + NCI_RP_CLASS_2 + NCI_RP_CLASS_3B + NCI_RP_CLASS_6

Where:
NCI_LK_CLASS_3A = pre-existing small liner breach failure
= 2.80×10^{-6} /year [Figure B-3]

NCI_RP_CLASS_2 = large containment isolation valve failure
= 5.15×10^{-9} /year [Figure B-3]

NCI_RP_CLASS_3B = pre-existing large liner breach failure
= 9.24×10^{-7} /year [Figure B-3]

NCI_RP_CLASS_6 = large containment isolation valve misalignment failure
= 8.93×10^{-9} /year [Figure B-3]

Therefore, $CI = 2.80 \times 10^{-6} + 5.15 \times 10^{-9} + 9.24 \times 10^{-7} + 8.93 \times 10^{-9}$
$CI = 3.74 \times 10^{-6}$ / year

METHOD (continued)

CONT_BYPASS = containment bypass failure frequency = V_SEQU + SGTR_SO + SGTR_nSO + E_SGTR

Where:
V_SEQU = interface system LOCA frequency = 2.77×10^{-7} / year [Figure B-2]

SGTR_SO = steam generator tube rupture with stuck-open safety relief valve = 6.89×10^{-7} /year [Figure B-2]

SGTR_nSO = SGTR with no stuck-open safety relief valve = 1.36×10^{-6} / year [Figure B-2]

E_SGTR = severe accident phenomena induced SGTR = 1.07×10^{-7} / year [Figure B-2]

Therefore, CONT_BYPASS = $2.77 \times 10^{-7} + 6.89 \times 10^{-7} + 1.36 \times 10^{-6} + 1.07 \times 10^{-7}$

CONT_BYPASS = 2.43×10^{-6} / year

Therefore, CFE = $6.21 \times 10^{-6} - 3.74 \times 10^{-6} - 2.43 \times 10^{-6}$
CFE = 4.19×10^{-8} / year

CLASS_7_FREQUENCY = 9.85×10^{-6} / year + $4.19\ 10^{-8}$ / year
CLASS_7_FREQUENCY = 9.89×10^{-6} / year

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 2.43×10^{-6} / year.

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.

Table 1
Mean Containment Frequencies Measures - Given Accident Class

Class	Description	Frequency (per Rx-year)
1	No Containment Failure	2.79×10^{-5}
2	Large Containment Isolation Failures (Failure-to-close)	5.15×10^{-9}
3a	Small Isolation Failures (Liner breach)	2.79×10^{-6}
3b	Large Isolation Failures (Liner Breach)	9.24×10^{-7}
4	Small isolation failure - failure-to-seal (Type B test)	Not Analyzed
5	Small isolation failure - failure-to-seal (Type C test)	Not Analyzed
6	Containment Isolation Failures (dependent failures, personnel errors)	8.93×10^{-9}
7	Severe Accident Phenomena Induced Failure (Early and late Failures)	9.89×10^{-6}
8	Containment Bypassed (SGTR)	2.43×10^{-6}
Core Damage	All CET Endstates	4.4×10^{-5}

METHOD (continued)

Step 2 - Developed plant specific person-rem dose (population dose) per reactor year.

Plant-specific release analysis was performed to evaluate the 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]

From the Data section of this calculation, 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 $1L_a$) and is 1.41×10^6. This value is used to predict the person-rem dose for accident classes 1 to 7 as follows.

Class 1 = $1.41 \times 10^6 \times 1.0L_a = 1.41 \times 10^6$ person-rem
Class 2 = $1.4\ 1 \times 10^6 \times 35L_a = 4.94 \times 10^7$ person-rem
Class 3a = $1.41 \times 10^6 \times 10L_a = 1.41 \times 10^7$ person-rem
Class 3b = $1.4\ 1 \times 10^6 \times 35L_a = 4.94 \times 10^7$ person-rem
Class 4 = Not analyzed
Class 5 = Not analyzed
Class 6 = $1.41 \times 10^6 \times 35L_a = 4.94 \times 10^7$ person-rem
Class 7 = $1.41 \times 10^6 \times 100L_a = 1.41 \times 10^8$ 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 5.33×10^9 person-rem.

The above values are summarized in Table 2 below.

Table 2
Person-Rem Measures - Given Accident Class

Class	Description	Person-Rem (50-Miles)
1	No Containment Failure	1.41×10^6
2	Large Isolation Failures (Failure to Close)	4.94×10^7
3a	Small Pre-existing Liner Breach Failure	1.41×10^7
3b	Large Pre-existing Liner Breach Failure	4.94×10^7
4	Small Isolation Failure to Seal (Type B Test)	N/A
5	Small Isolation Failure to Seal (Type C Test)	N/A
6	Other Isolation Failures (e.g., Dependent Failures)	4.94×10^7
7	Failure Induced by Phenomena (Early and Late Failures)	1.41×10^8
8	Bypass (SGTR)	5.33×10^9

METHOD (continued)

The above results when combined with the results presented in Table 1 yields the IP3 baseline mean consequence measures for each accident class. These results are presented in Table 3 below.

Table 3
Baseline Mean Consequence Measures - Given Accident Class

Class	Description	Frequency (per Rx-yr)	Person-Rem (50-Miles)	Person-Rem/yr (50-Miles)
1	No Containment Failure	2.79×10^{-5}	1.41×10^{6}	3.93×10^{1}
2	Large Isolation Failures (Failure to Close)	5.15×10^{-9}	4.94×10^{7}	2.54×10^{-1}
3a	Small Pre-existing Liner Breach Failure	2.79×10^{-6}	1.41×10^{7}	3.93×10^{1}
3b	Large Pre-existing Liner Breach Failure	9.24×10^{-7}	4.94×10^{7}	4.56×10^{1}
4	Small Isolation Failure to Seal (Type B Test)	Not Analyzed	N/A	0.0
5	Small Isolation Failure to Seal (Type c Test)	Not Analyzed	N/A	0.0
6	Other Isolation Failures (e.g., Dependent Failures)	8.93×10^{-9}	4.94×10^{7}	4.41×10^{-1}
7	Failure Induced by Phenomena (Early & Late Failures)	9.89×10^{-6}	$1.4 1 \times 10^{8}$	1.39×10^{3}
8	Bypass (SGTR)	2.43×10^{-6}	5.33×10^{9}	1.30×10^{4}
CDF	All CET End States	4.39×10^{-5}	N/A	14,515

Based on the above values, the percent risk contribution ($\%Risk_{BASE}$) for Class 1 and Class 3 is as follows:

$$\%Risk_{BASE} = [(CLASS1_{BASE} + CLASS3a_{BASE} + CLASS3b_{BASE}) / Total_{BASE}] \times 100$$

Where:

$CLASS1_{BASE}$ = class 1 person-rem/year = 3.93×10^{1} person-rem/year [Table 3]

$CLASS3a_{BASE}$ = class 3a person-rem/year = 3.93×10^{1} person-rem/year [Table 3]

$CLASS3b_{BASE}$ = class 3b person-rem/year = 4.56×10^{1} person-rem/year [Table 3]

$Total_{BASE}$ = total person-rem year for baseline interval = 14,515 person-rem/year [Table 3]

$$\%Risk_{BASE} = [(3.93 \times 10^{1} + 3.93 \times 10^{1} + 4.56 \times 10^{1}) / 14{,}515] \times 100$$
$$\%Risk_{BASE} = 0.86\%$$

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

METHOD (continued)

Step 3 - Evaluate risk impact of extending Type A test interval 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 detectable only by an ILRT goes undetected from 18 to 60 months. (The average time for undetection is calculated by multiplying the test interval by 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 (½ * 15 * 12). Since ILRTs only detect about 3% of leaks (the rest are identified during LLRTs), 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 undetection for the increased ILRT test interval (60 months) to the baseline average time for undetection of 18 months. For a 15-yr-test interval, the result is a 15% increase in the overall probability of leakage (i.e., 3 * 90/18). Thus, increasing the ILRT test interval from 10 years 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 Class 1 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 $2L_a$. 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 thought 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 below.

Table 4
Mean Consequence Measures for 10-Year Test Interval - Given Accident Class

Class	Description	Frequency (per Rx-yr)	Person-Rem (50-miles)	Person-Rem/yr (50-Miles)
1	No Containment Failure	2.75E-05	3.10×10^6	8.54×10^1
2	Large Isolation Failures (Failure to Close)	5.15E-09	4.94×10^7	2.54×10^{-1}
3a	Small Pre-existing Liner Breach Failure	3.07E-06	1.41×10^7	4.33×10^1
3b	Large Pre-existing Liner Breach Failure	1.02E-06	4.94×10^7	5.02×10^1
4	Small Isolation Failure to Seal (Type B Test)	0.00E+00	N/A	0.0
5	Small Isolation Failure to Seal (Type C Test)	0.00E+00	N/A	0.0
6	Other Isolation Failures (e.g., Dependent Failures)	8.93E-09	4.9×10^7	4.41×10^{-1}
7	Failure Induced by Phenomena (Early & Late Failures)	9.89E-06	1.41×10^8	1.39×10^3
8	Bypass (SGTR)	2.43E-06	5.33×10^9	1.30×10^4
CD	All CET End States	4.39E-05	N/A	14,570

METHOD (continued)

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:

$$\%Risk_{10} = [(CLASS1_{10} + CLASS3a_{10} + CLASS3b_{10}) / Total_{10}] \times 100$$

Where:

$CLASS1_{10}$ = class 1 person-rem/year = 8.54×10^1 person-rem/year [Table 4]

$CLASS3a_{10}$ = class 3a person-rem/year = 4.33×10^1 person-rem/year [Table 4]

$CLASS3b_{10}$ = class 3b person-rem/year = 5.02×10^1 person-rem/year [Table 4]

$Total_{10}$ = total person-rem year for 10-year interval = 14,570 person-rem/year [Table 4]

$$\%Risk_{10} = [(8.54 \times 10^1 + 4.33 \times 10^1 + 5.02 \times 10^1) / 14{,}570] \times 100$$
$$\%Risk_{10} = 1.23\%$$

Therefore, the total Type A 10-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 1.23%.

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

$$\Delta\%Risk_{10} = [(Total_{10} - Total_{BASE}) / Total_{BASE}] \times 100.0$$

Where:

$Total_{BASE}$ = total person-rem/year for baseline interval = 14,515 person-rem/year [Table 4]

$Total_{10}$ = total person-rem/year for 10-year interval = 14,570 person-rem/year [Table 4]

$$\Delta\%Risk_{10} = [(14{,}570 - 14{,}515) / 14{,}515] \times 100.0$$
$$\Delta\%Risk_{10} = 0.39\%$$

Therefore, the increase in risk contribution because of relaxed ten-year ILRT test frequency from three-in-ten-years to 1-in-ten-years is 0.39%.

METHOD (continued)

Risk Impact 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 percent or 1.15. (Recall that for a 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.

Table 5
Mean Consequence Measures for 15-Year Test Interval - Given Accident Class

Class	Description	Frequency (per Rx-yr)	Person-Rem (50-Miles)	Person-Rem/yr (50-Miles)
1	No Containment Failure	2.73E-05	3.24×10^6	8.87×10^1
2	Large Isolation Failures (Failure to Close)	5.15E-09	4.94×10^7	2.54×10^{-1}
3a	Small Pre-existing Liner Breach Failure	3.21E-06	1.41×10^7	4.52×10^1
3b	Large Pre-existing Liner Breach Failure	1.06E-06	4.94×10^7	5.24×10^1
4	Small Isolation Failure to Seal (Type B Test)	0.00E+00	N/A	0.0
5	Small Isolation Failure to Seal (Type B Test)	0.00E+00	N/A	0.0
6	Other Isolation Failures (e.g., Dependent Failures)	8.93E-09	4.94×10^7	4.41×10^{-1}
7	Failure Induced by Phenomena (Early & Late Failures)	9.89E-06	1.41×10^8	1.39×10^3
8	Bypass (SGTR)	2.43E-06	5.33×10^9	1.30×10^4
CD	All CET End States	4.39E-05	N/A	14,577

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:

$$\%Risk_{15} = [(CLASS1_{15} + CLASS3a_{15} + CLASS3b_{15}) / Total_{15}] \times 100$$

Where:

$CLASS1_{15}$ = class 1 person-rem/year = 8.87×10^1 person-rem/year [Table 5]

$CLASS3a_{15}$ = class 3a person-rem/year = 4.52×10^1 person-rem/year [Table 5]

$CLASS3b_{15}$ = class 3b person-rem/year = 5.24×10^1 person-rem/year [Table 5]

$Total_{15}$ = total person-rem year for 10-year interval = 14,577 person-rem/year [Table 5]

$$\%Risk_{15} = [(8.87 \times 10^1 + 4.52 \times 10^1 + 5.24 \times 10^1) / 14,577] \times 100$$
$$\%Risk_{15} = 1.28\%$$

Therefore, the total Type A 15-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 1.28%.

METHOD (continued)

The percent increase in risk (in terms of person-rem/yr) of these associated specific sequences is computed as follows.

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

Where:

$PER\text{-}REM_{10}$ = person-rem/year of fifteen years interval (for classes 1, 3a and 3b) = 178.93 person-rem/yr [Table 5]

$PER\text{-}REM_{15}$ = person-rem/year of fifteen years interval (for classes 1, 3a and 3b) = 186.3 person-rem/yr [Table 5]

$$\%Risk_{10\text{-}15} = [(186.3 - 178.9) / 178.9] \times 100$$
$$\%Risk_{10\text{-}15} = 4.1\%$$

Therefore, 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 4.1%.

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

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

Where:

$Total_{10}$ = total person-rem/year for 10-year interval = 14,570 person-rem/year [Table 4]
$Total_{15}$ = total person-rem/year for 15-year interval = 14,577 person-rem/year [Table 4]

$$\%TOTAL_{10\text{-}15} = [(14{,}577 - 14{,}570) / 14{,}570] \times 100$$
$$\%TOTAL_{10\text{-}15} = 0.048\%$$

Therefore, the risk impact on the total integrated plant risk for these accident sequences influenced by Type A testing is only 0.048%.

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

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

Where:

$Total_{BASE}$ = total person-rem/year for baseline interval = 14,515 person-rem/year [Table 4]
$Total_{15}$ = total person-rem/year for 15-year interval = 14,577 person-rem/year [Table 4]

$$\Delta\%Risk_{15} = [(14{,}577 - 14{,}515) / 14{,}515] \times 100.0$$
$$\Delta\%Risk_{15} = 0.43\%$$

Therefore, the total increase in risk contribution associated with relaxing the ILRT test frequency from three in ten years to once-per-fifteen years is 0.43%.

METHOD (continued)

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

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 its risk sensitivity calculations (see Figure 1).

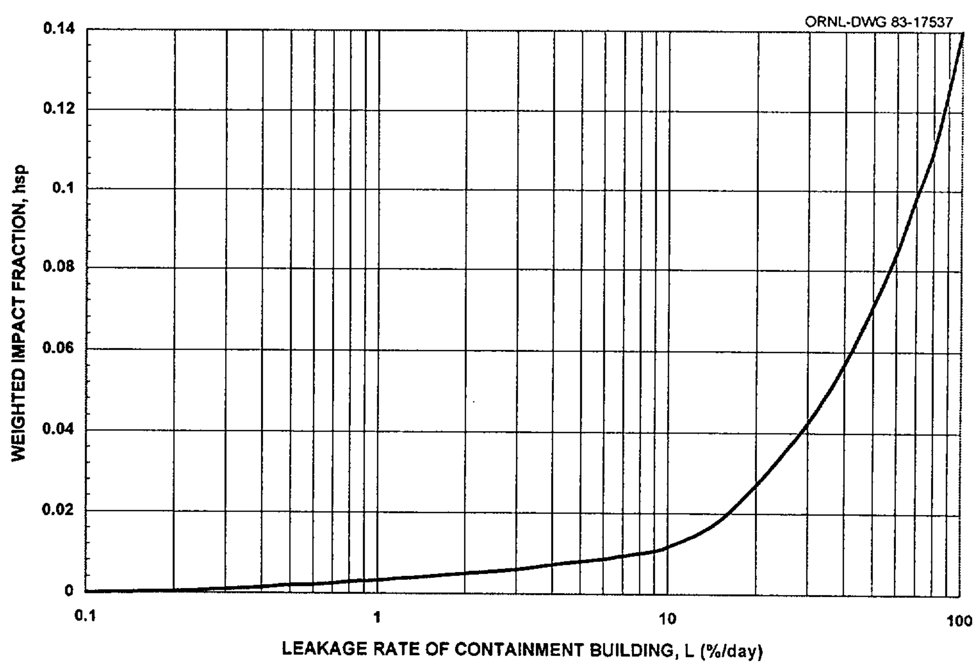
Based upon the information provided by Stone & Webster and ORNL, it is judged that small leaks resulting from a severe accident (that are deemed not to dominate public risk) can be defined as those that change risk by less than 5%. This definition would include leaks of less than 35%/day. Based on the Stone & Webster 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.

METHOD (continued)

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)

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



METHOD (continued)

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 a 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 a pre-existing leak were present. Class 1 sequences are not considered as potential large release pathways because for these sequences the containment remains intact. Therefore, the containment leak rate is expected to be small (less than $2L_a$). 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 IP3 IPE [4], which result in large releases (e.g., large isolation valve failures), 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 IP3. This frequency, based on a ten-year test interval, is 1.02×10^{-6}/yr.

Reg. Guide 1.174 [3] provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 [3] defines very small changes in risk as resulting in increases of core damage frequency (CDF) below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF, the relevant 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 an ILRT goes undetected from 60 to 90 months. Since ILRTs only detect about 3% of leaks (the rest are identified 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 a 10-yr ILRT interval. Thus, increasing the ILRT test interval from 10 years to 15 years results in a 5% increase in the overall probability of leakage. Multiplying the above LERF frequency (1.02×10^{-6}/yr) by the increase in overall probability of leakage (0.05) gives an increase in LERF of 5.1×10^{-8}/yr. Since guidance in Reg. Guide 1.174 defines very small changes in LERF as below 1E-7/yr, increasing the ILRT interval to 15 years is non-risk significant.

It should be noted that if the risk increase is measured from the original 3-in-10-year interval, the increase in LERF is 9.24×10^{-7}/yr multiplied by the 12% incremental increase in overall probability for a fifteen-year test interval (i.e., 15% - 3%) is 1.1×10^{-7}/yr, which is only slighlty above the 1.0E-7/yr screening criterion in Reg. Guide 1.174).

ASSUMPTIONS

1. Containment leak rates greater than $2L_a$ but less than $35L_a$ indicate an impaired containment. The leak rate is considered 'small'. Furthermore, these releases have a break opening of greater than 0.5-inch but less than 2-inch diameter.

2. Containment leak rates greater than $35L_a$ indicate a containment breach. This leak rate is considered 'large'.

3. Containment leak rates less than $2L_a$ indicate an intact containment. This leak rate is considered as 'negligible'.

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

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

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

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

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

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

10. Because Class 9 sequences are containment bypass sequences, potential releases are directly to the environment. Therefore, the containment structure will not impact the release magnitude.

DATA

From reference [13] a summary of the radiological releases used in this evaluation is presented in Table 7 below. This table depicts the whole body individuals and population doses as rem and person-rem within 50 miles. The releases are based on large loss-of-coolant accident (LBLOCA) and reactor coolant system (RCS) releases.

Table 7

IP3 Population Dose

Large Break Loss-of-Coolant Accident and Reactor Coolant System Population Dose

		Doses (rem)		Doses (person-rem)	
Mile	**Population**	**LBLOCA**	**RCS**	**LBLOCA**	**RCS**
1	0	0	0	0	0
2	15130	1.836	6.953E+03	2.78E+04	1.050E+08
3	18428	1.103	4.183E+03	2.03E+04	7.703E+07
4	14225	7.883E-01	2.983E+03	1.120E+04	4.243E+07
5	24508	6.120E-01	2.323E+03	1.500E+04	5.683E+07
6	25922	5.010E-01	1.900E+O3	1.300E+04	4.923E+07
7	28096	4.243E-01	1.610E+03	1.190E+04	4.523E+07
8	25967	3.673E-01	1.393E+03	9.543E+03	3.613E+07
9	36930	3.253E-01	1.233E+03	1.200E+04	4.543E+07
10	46488	2.900E-01	1.1000E+03	1.353E+04	5.110E+07
15	342852	2.210E-01	8.363E+02	7.563E+04	2.873E+08
20	448654	1.570E-01	5.953E+02	7.063E+04	2.670E+O8
25	920850	1.220E-01	4.633E+02	1.1300E+05	4.263E+08
30	2171939	1.000E-01	3.803E+02	2.183E+05	8.243E+08
35	2276172	8.483E-02	3.213E+02	1.933E+05	7.310E+08
40	3451123	7.353E-02	2.783E+02	2.543E+05	9.610E+08
45	3416140	6.483E-02	2.463E+02	2.213E+05	8.393E+08
50	2199601	5.803E-02	2.203E+02	1.283E+05	4.833E+08
Total	**15463025**			**1.41E+06**	**5.333E+09**

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 1.23%.
3. Type A 15-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 1.28%.
4. The person-rem/year increase in risk contribution from extending the ILRT test frequency from the current once-per-ten-year interval to once-per-fifteen years is 4.1%
5. The total integrated increase in risk contribution from extending the ILRT test frequency from the current once-per-10-year interval to once-per-15 years is 0.48%.
6. The risk increase in LERF from extending the ILRT test frequency from the current once-per-10-year interval to once-per-15 years is 5.1 x 10^{-8}/yr.
7. The risk increase in LEFR from the original 3-in-10-year interval, to once-per-15 years is x 1.1 x 10^{-7}/yr
8. Other salient results are summarized in Table 8.

Table 8
Summary of Risk Impact on Extending Type A ILRT Test Frequency

Class[5]	Risk Impact (Base)[6]	Risk Impact (10-years)[7]	Risk Impact (15-years)[8]
1, 3a and 3b	0.86% of integrated value based on $1xL_a$ normal containment leakage for Class 1, $10L_a$ for Class 3a and $35L_a$ for Class 3b 124.2 person-rem/yr	1.23% of integrated value based on $1xL_a$ normal containment leakage for Class 1, $10L_a$ for Class 3a and $35L_a$ for Class 3b 178.9 person-rem/yr	1.28% of integrated value based on $1xL_a$ normal containment leakage for Class 1, $10L_a$ for Class 3a and $35L_a$ for Class 3b 186.3 person-rem/yr
Total Integrated Risk	14,515 person-rem/year	14,570 person-rem/year	14,577 person-rem/year

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5 Only accident sequences impacted by a change in Type A test frequency are evaluated. Theses are sequences 1, 3A and 3B
6 IP3 IPE baseline values
7 Type A ILRT test interval of 1-in-10-years
8 Type A ILRT test interval of 1-in-15-years

CONCLUSIONS

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

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 4.1%. However, the risk impact on the total integrated plant risk for those accident sequences influenced by Type A testing is only 0.048%. Therefore, the risk impact when compared to other severe accident risks is negligible.

Reg. Guide 1.174 provides guidance for determining the risk impact of plant-specific changes to the licensing basis. Reg. Guide 1.174 defines very small changes in risk as resulting in increases of CDF below 10^{-6}/yr and increases in LERF below 10^{-7}/yr. Since the ILRT does not impact CDF, the relevant criterion is LERF. The increase in LERF resulting from a change in the Type A ILRT test interval from an once-per-ten-years to an once-per-fifteen-years is 5.1×10^{-8}/yr. Since guidance in Reg. Guide 1.174 defines very small changes in LERF as below 10^{-7}/yr, increasing the ILRT interval from 10 to 15 years is therefore considered non-risk significant.

REFERENCES

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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.

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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.

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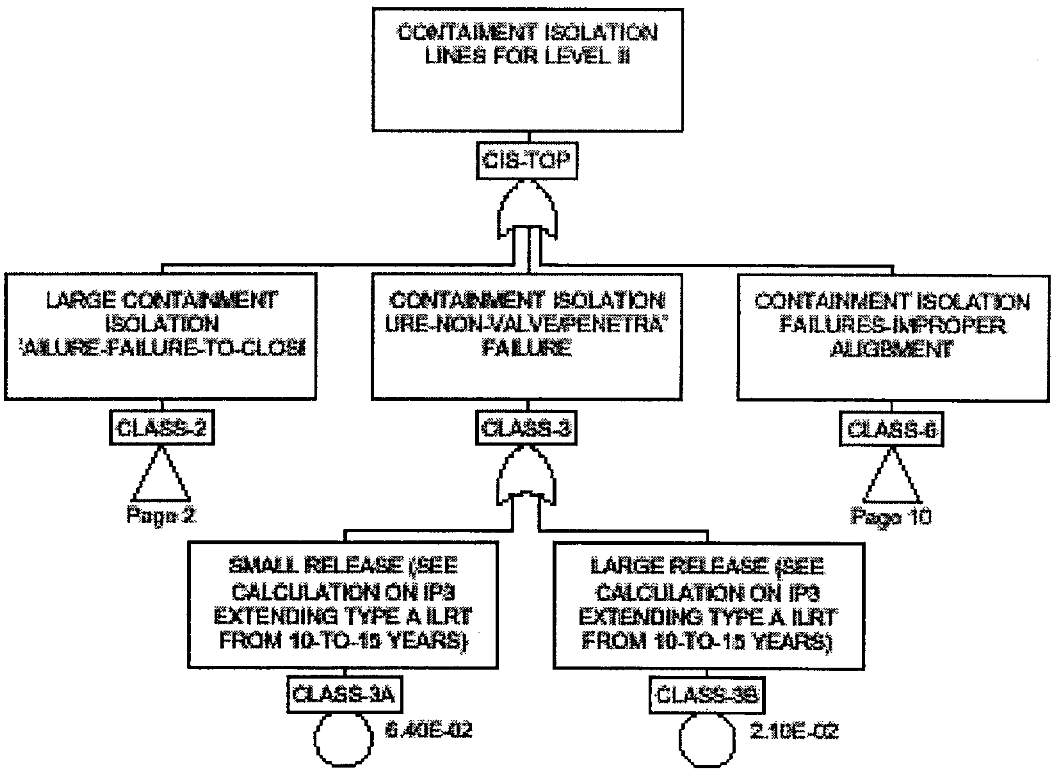
11. Patrick D. T. O'Connnor, "Practical Reliability Engineering," John Wiley & Sons, 2nd Edition, 1985.

12. "A Reference Manual for the Event Progression Analysis Code (EVNTRE), Final Report," prepared by Sandia National Laboratories for U.S. Nuclear Regulatory Commission, NUREG/CR-5174, September 1989.

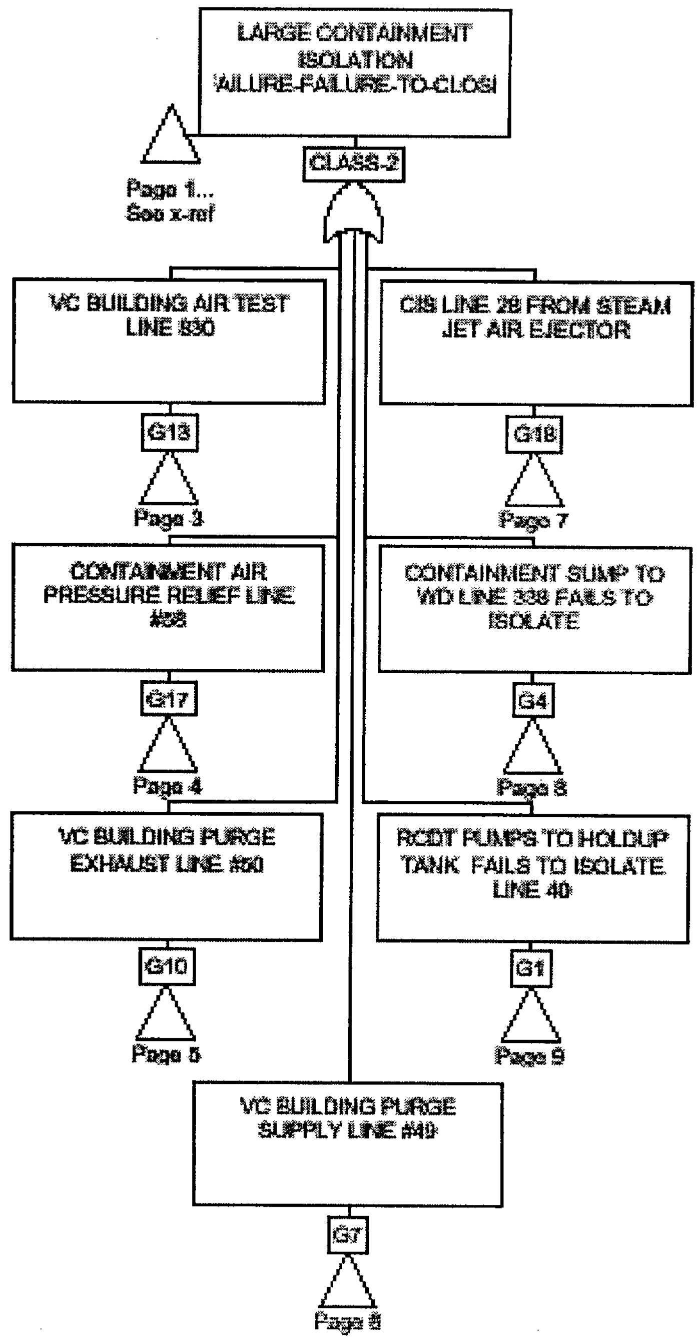
13. Memo, RE-01-001, M. Golshani to K. Peters, "Radiation Doses to the Population within a 50-mileRadius of the Plant", January 2, 2001.

LIST OF FIGURES

IP3 CONTAINMENT ISOLATION FAULT TREE FOR TYPE 'A" ILRT EVALUATION



IP3 CONTAINMENT ISOLATION FAULT TREE FOR TYPE 'A" ILRT EVALUATION



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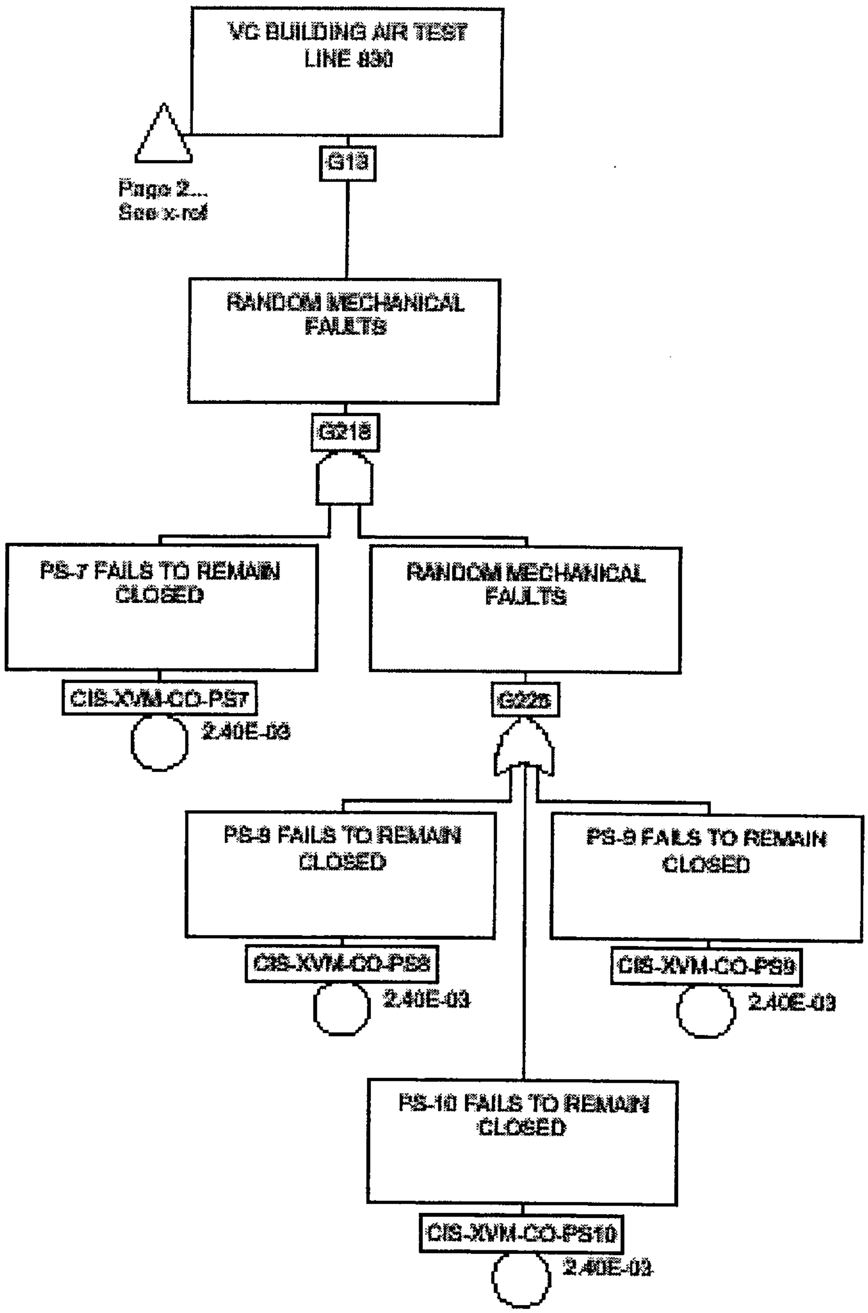

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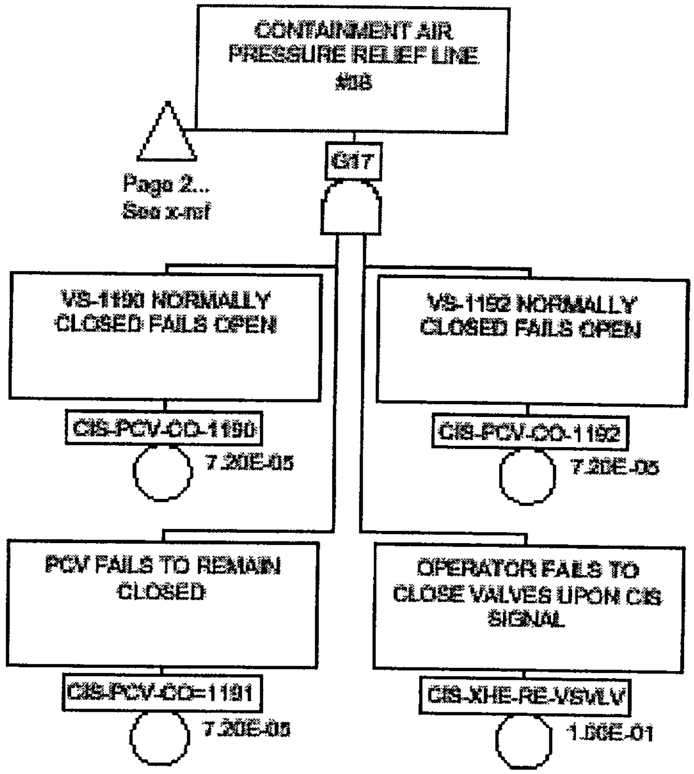

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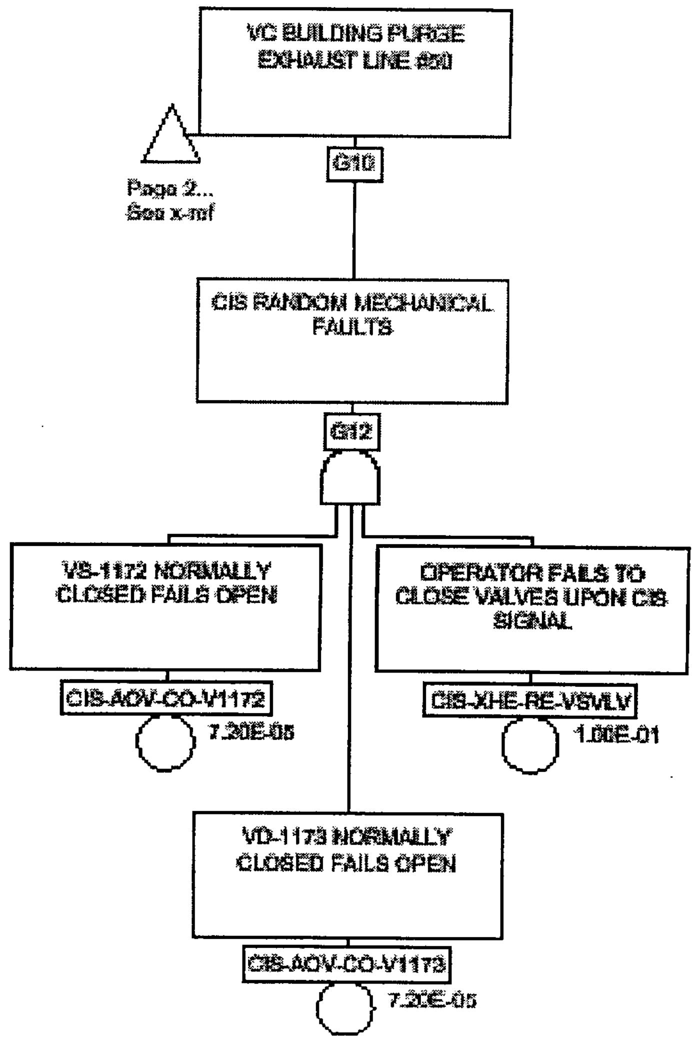

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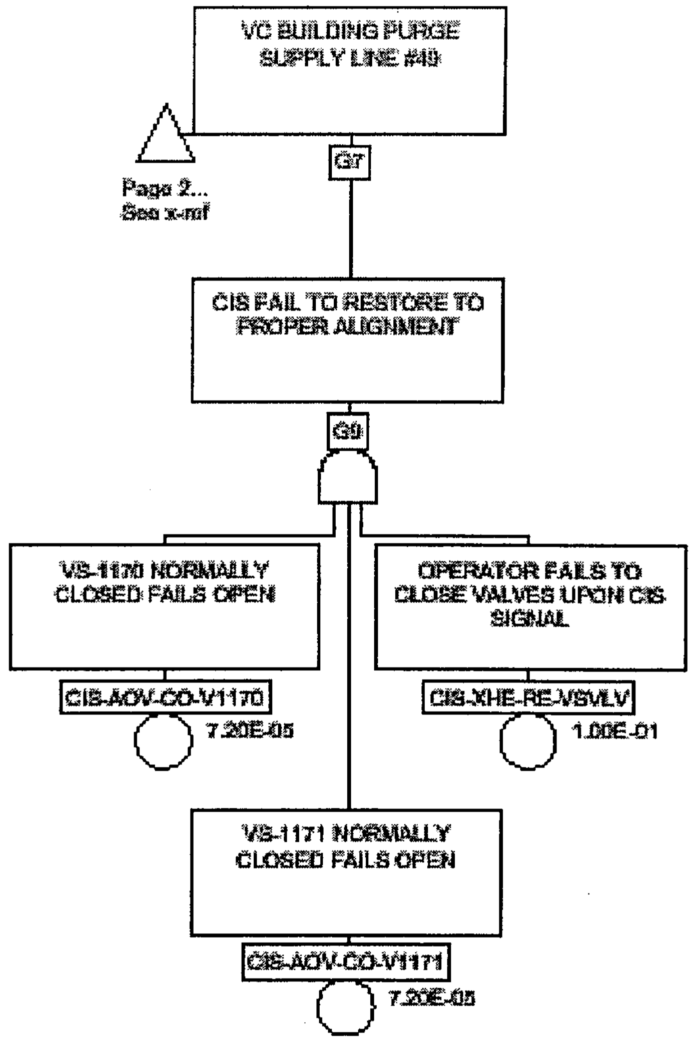

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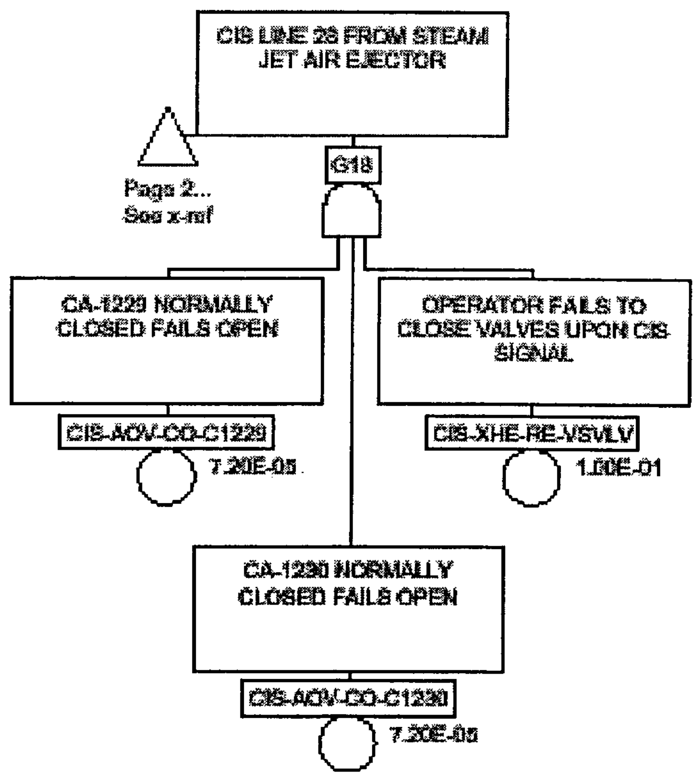

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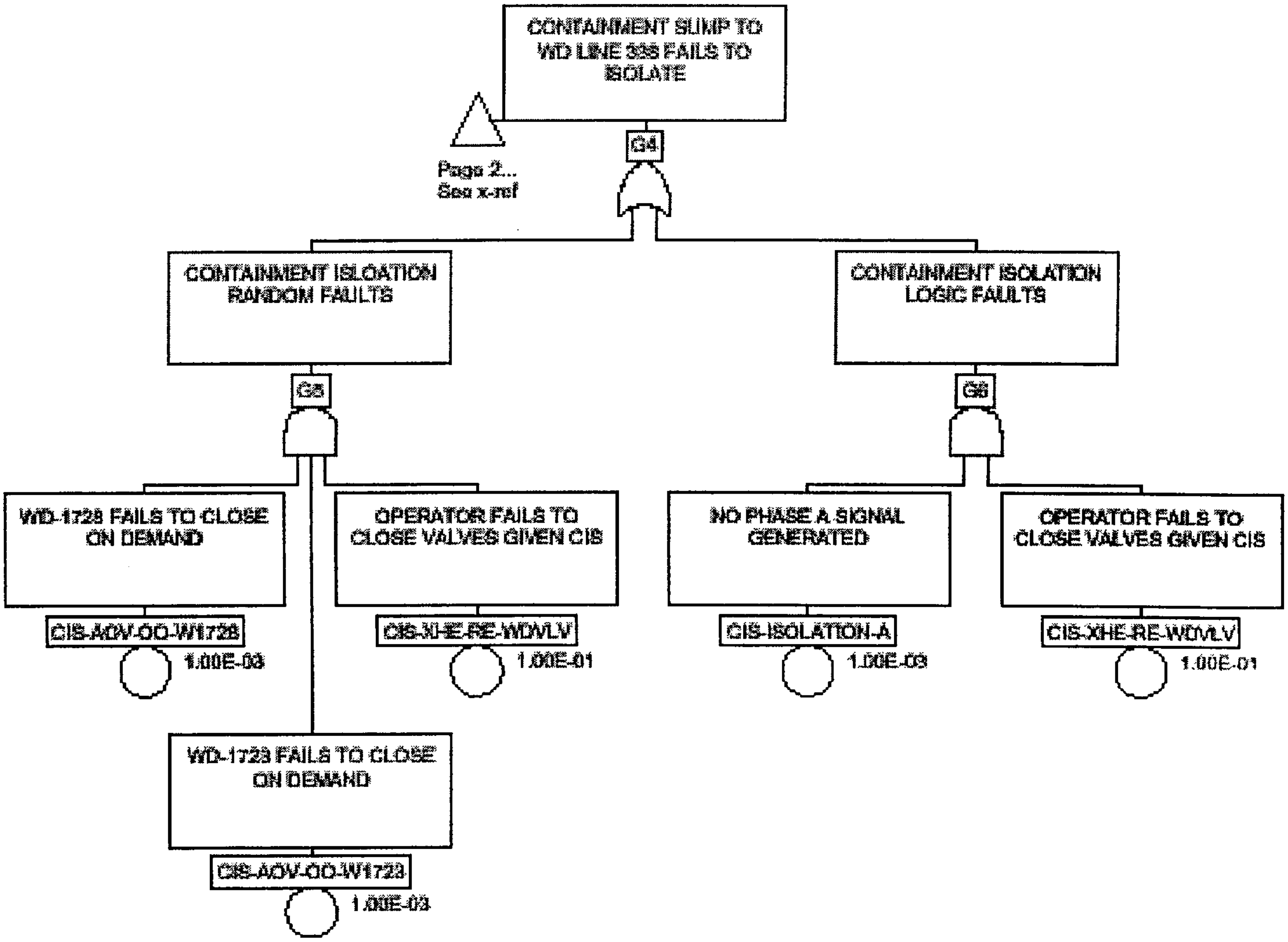

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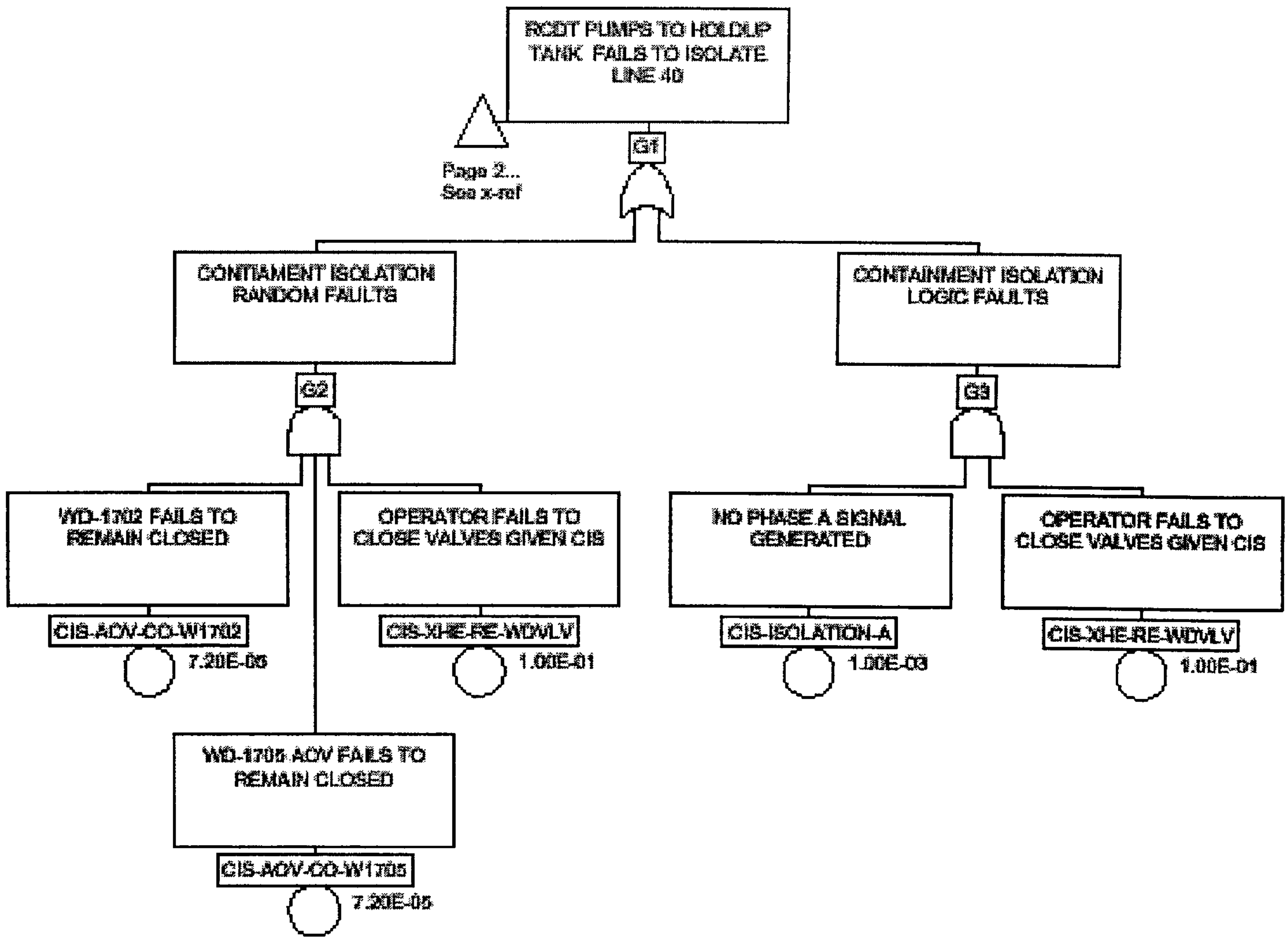

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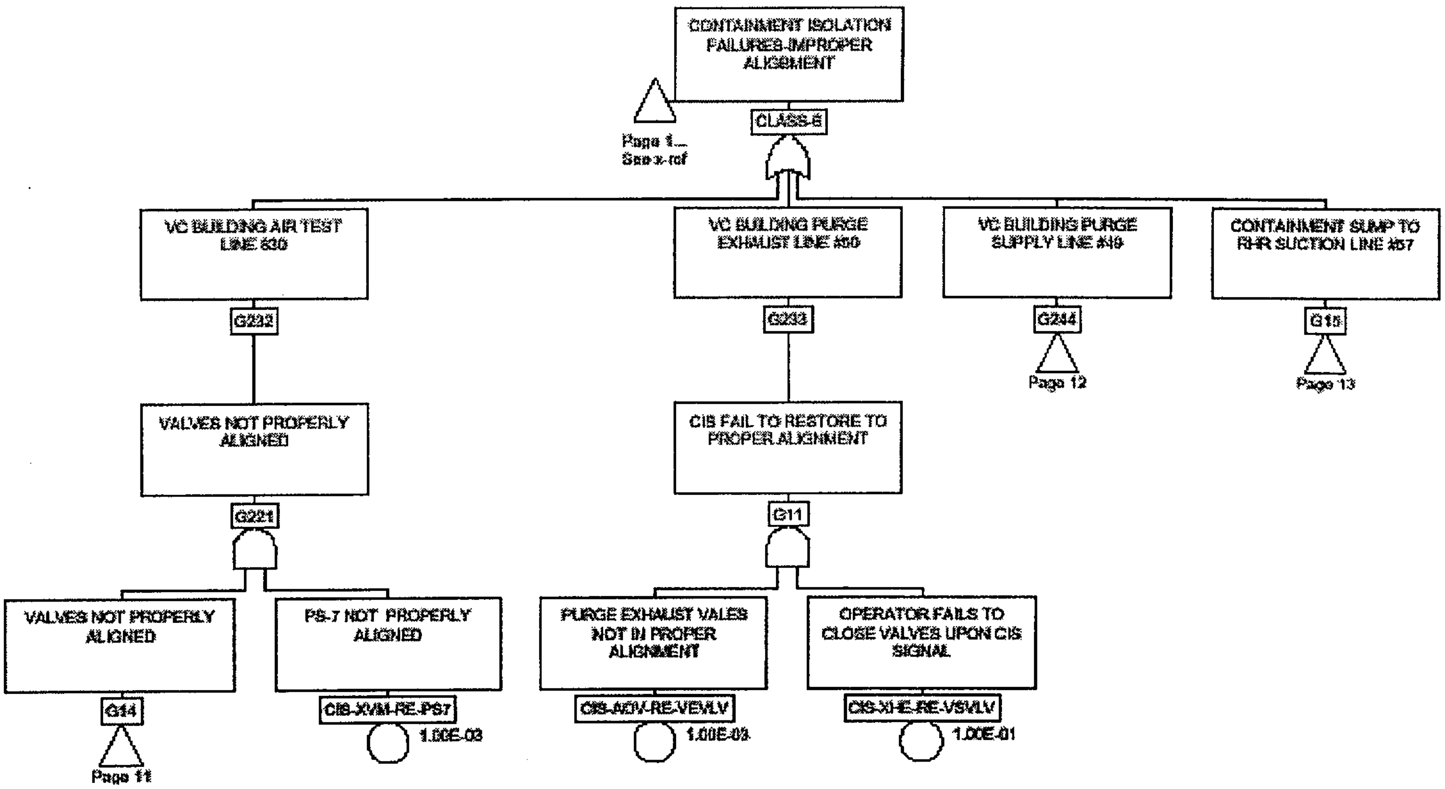

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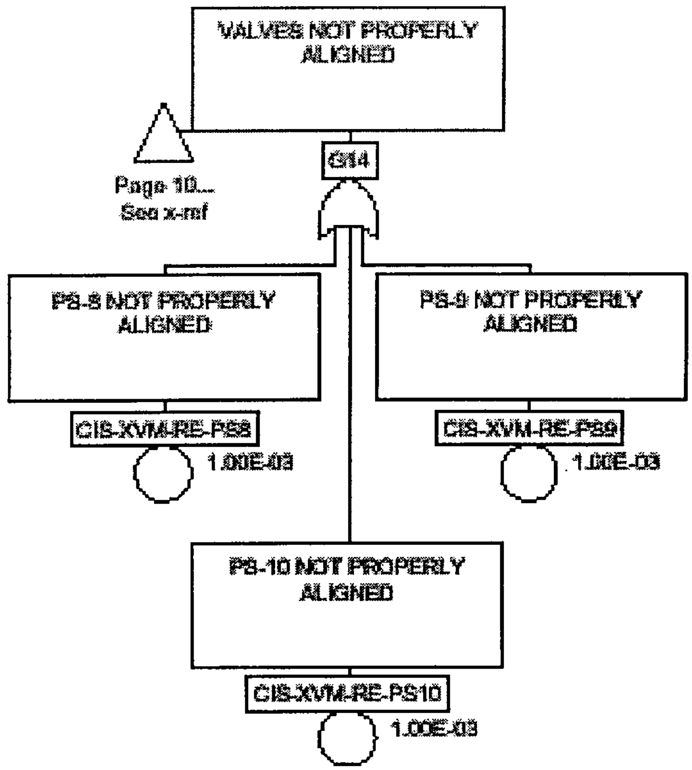
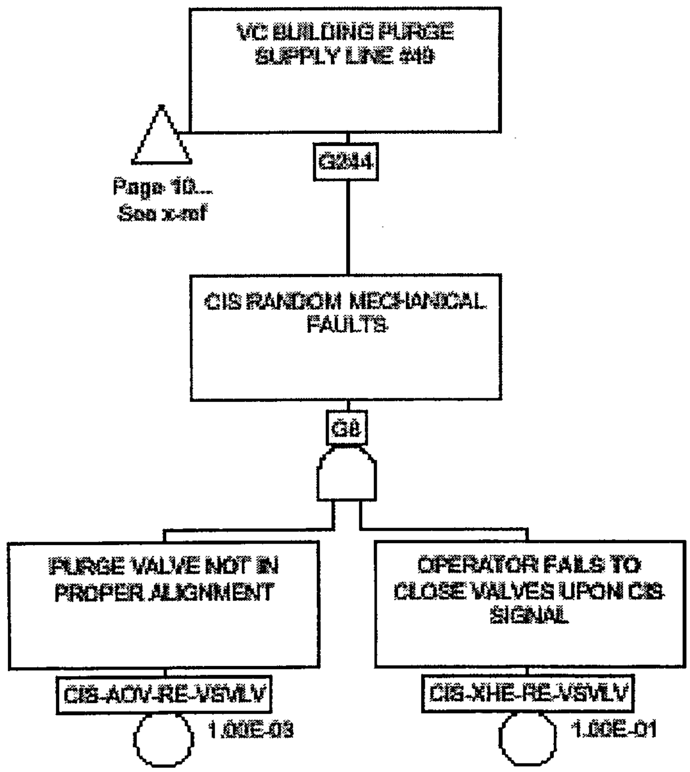
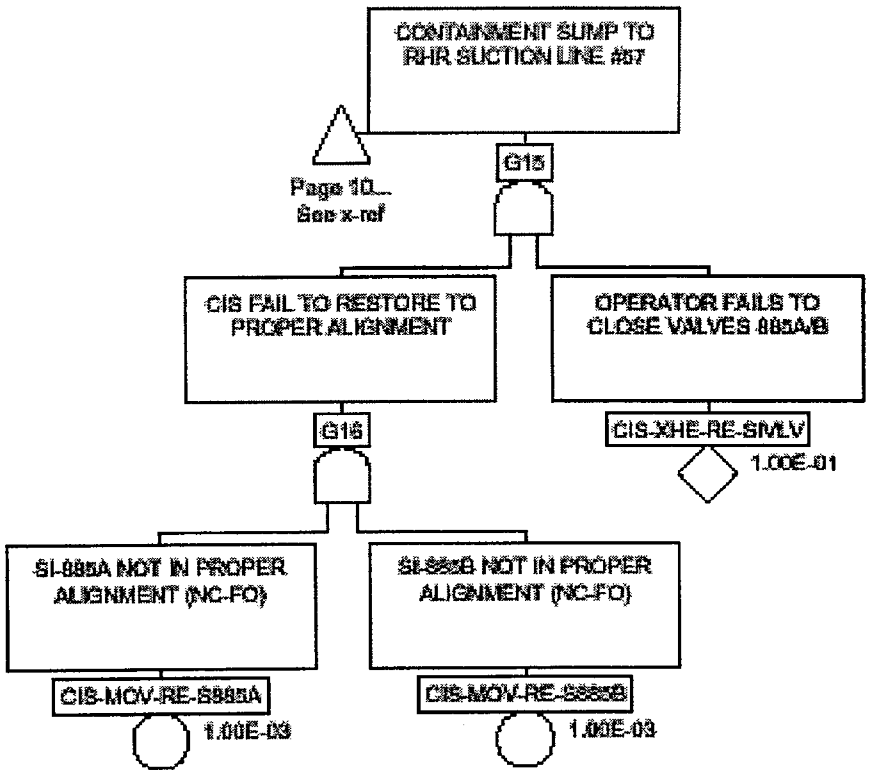


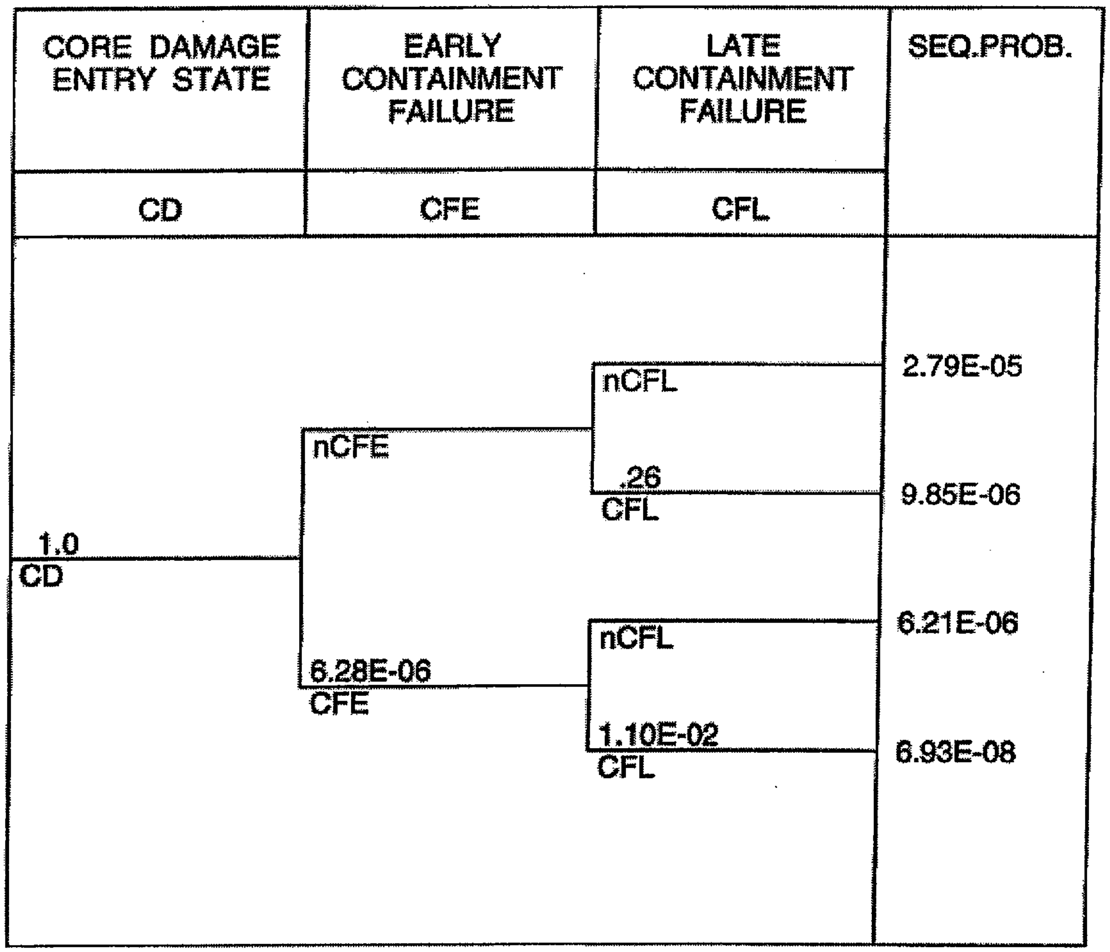

VC BUILDING PURGE SUPPLY LINE #49
G244
Page 10...
See x-ref
CIS RANDOM MECHANICAL FAULTS
G8
PURGE VALVE NOT IN PROPER ALIGNMENT
CIS-AOV-RE-VSVLV
1.00E-03
OPERATOR FAILS TO CLOSE VALVES UPON CIS SIGNAL
CIS-XHE-RE-VSVLV
1.00E-01

IP3 CONTAINMENT ISOLATION FAULT TREE FOR TYPE 'A" ILRT EVALUATION



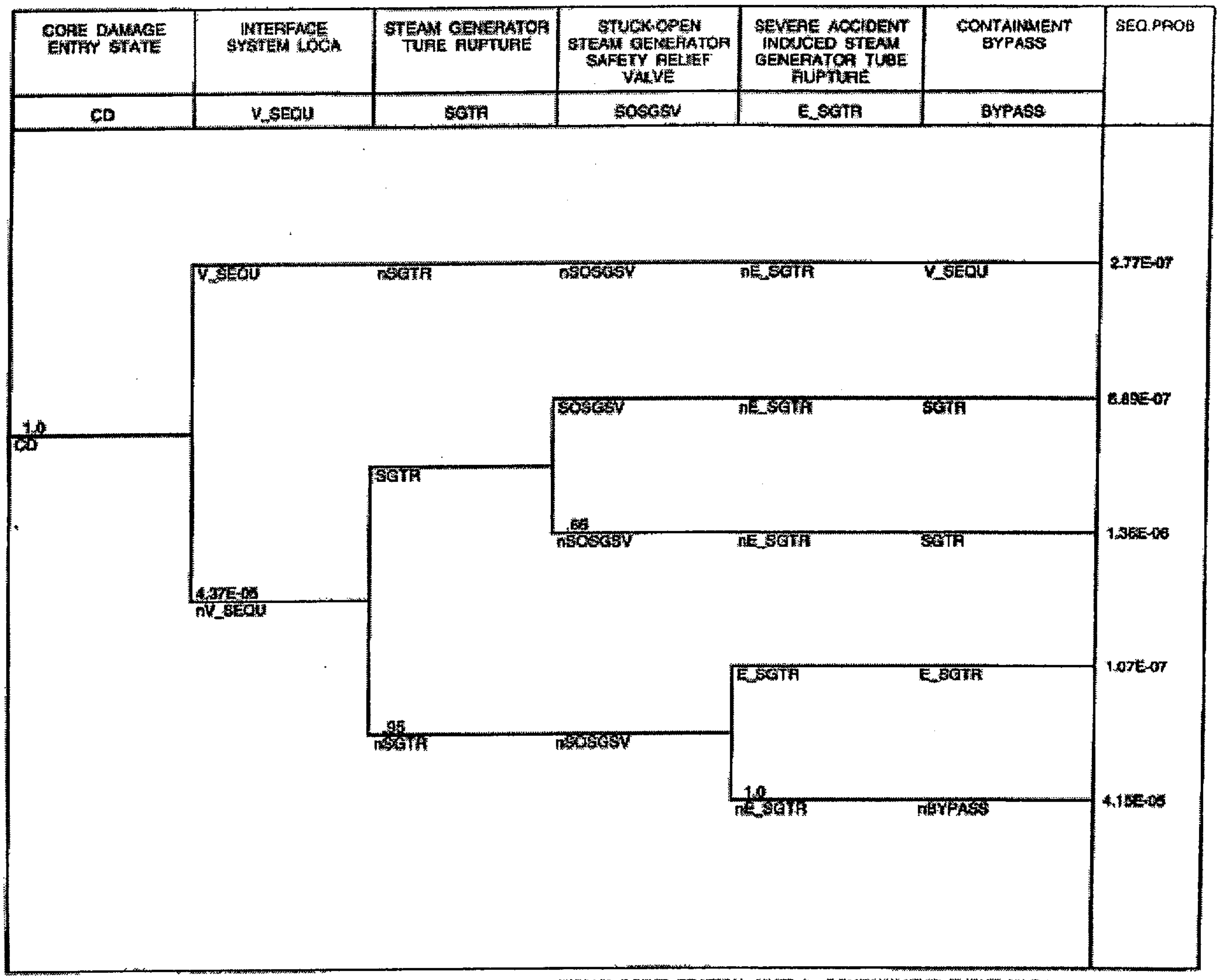
Attachment B

Figure B-1



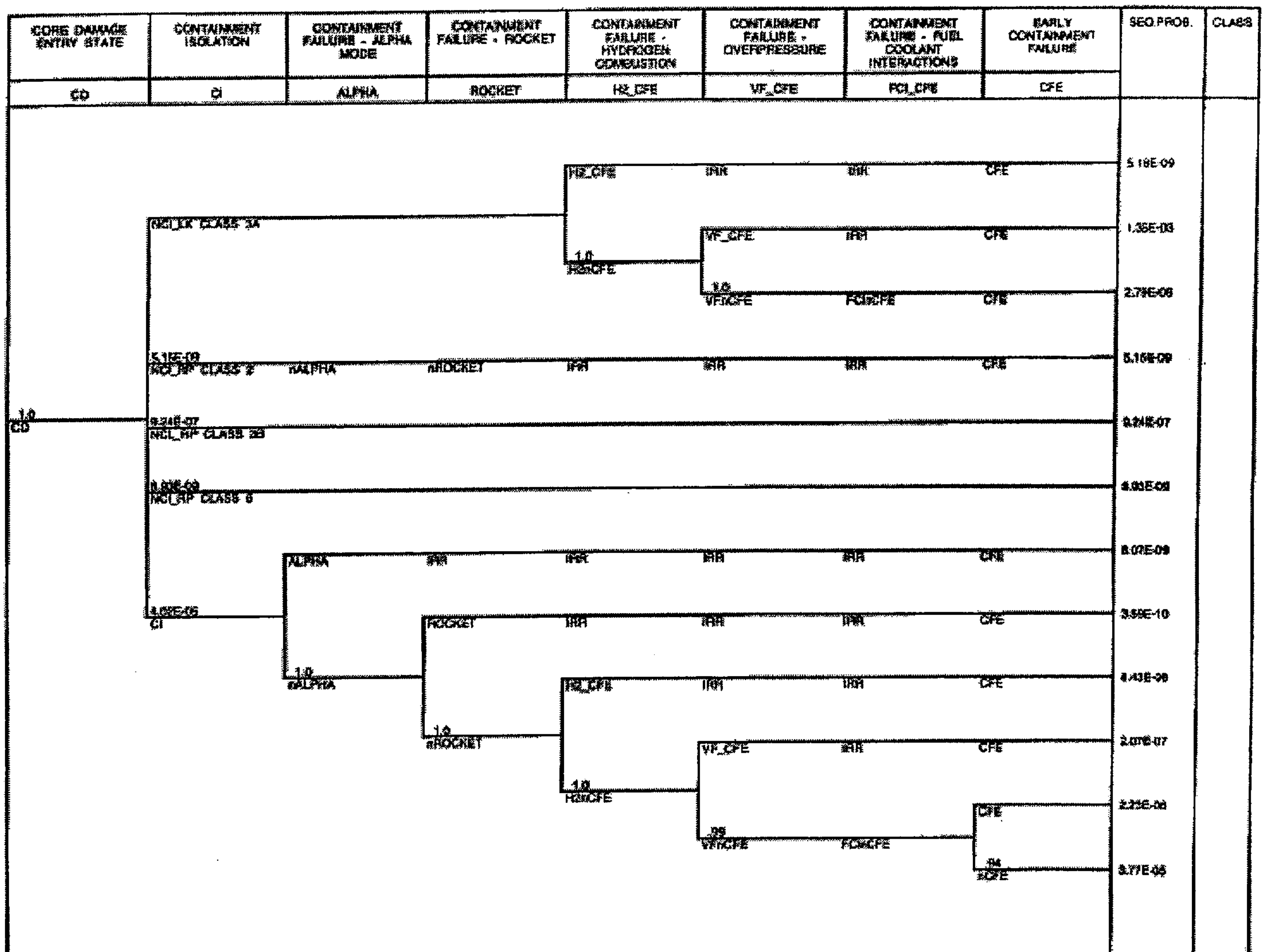
INDIAN POINT STATION, UNIT 3: CONTAINMENT EVENT TREE

Figure B-2



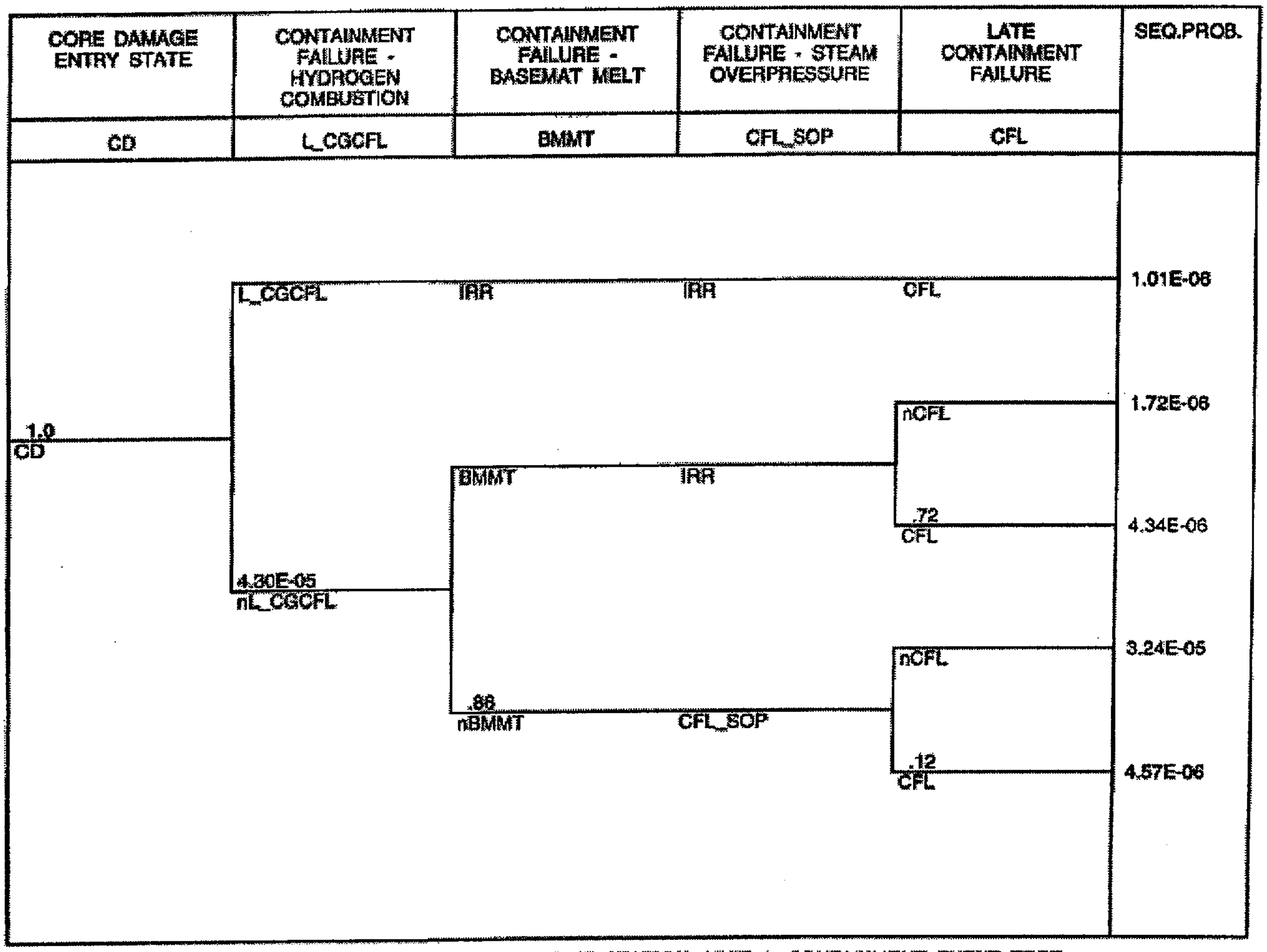
INDIAN POINT STATION, UNIT 3: CONTAINMENT EVENT TREE

Figure B-3



INDIAN POINT STATION, UNIT 3: CONTAINMENT EVENT TREE

Figure B-4



INDIAN POINT STATION, UNIT 3: CONTAINMENT EVENT TREE

Attachment C

Type 'A' Integrated Leak Rate Testing

Cutset Report

Probability	%	Class	Inputs
CLASS-2	1.17E-04		
1.00E-04	85.2%		CIS-ISOLATION-A CIS-XHE-RE-WDVLV
5.76E-06	90.1%		CIS-XVM-CO-PS7 CIS-XVM-CO-PS8
5.76E-06	95.0%		CIS-XVM-CO-PS10 CIS-XVM-CO-PS7
5.76E-06	99.9%		CIS-XVM-CO-PS7 CIS-XVM-CO-PS9
1.00E-07	100.0%		CIS-AOV-CO-W1723 CIS-AOV-CO-W1728 CIS-XHE-RE-WDVLV
5.18E-10	100.0%		CIS-AOV-CO-V1170 CIS-AOV-CO-V1171 CIS-XHE-RE-VSVLV
5.18E-10	100.0%		CIS-AOV-CO-V1172 CIS-AOV-CO-V1173 CIS-XHE-RE-VSVLV
5.18E-10	100.0%		CIS-AOV-CO-C1229 CIS-AOV-CO-C1230 CIS-XHE-RE-VSVLV
5.18E-10	100.0%		CIS-AOV-CO-W1702 CIS-AOV-CO-W1705 CIS-XHE-RE-WDVLV
CLASS-6	2.03E-04		
1.00E-04	49.2%		CIS-AOV-RE-VSVLV CIS-XHE-RE-VSVLV
1.00E-04	98.5%		CIS-AOV-RE-VEVLV CIS-XHE-RE-VSVLV
1.00E-06	99.0%		CIS-XVM-RE-PS7 CIS-XVM-RE-PS9
1.00E-06	99.5%		CIS-XVM-RE-PS10 CIS-XVM-RE-PS7
1.00E-06	100.0%		CIS-XVM-RE-PS7 CIS-XVM-RE-PS8
1.00E-07	100.0%		CIS-MOV-RE-S885A CIS-MOV-RE-S885B CIS-XHE-RE-SIVLV
CLASS-3	8.37E-02		
6.40E-02	76.5%		CLASS-3A
2.10E-02	100.0%		CLASS-3B