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Evaluation of Severe Accident Risks: Peach Bottom, Unit 2

Main Report

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ABSTRACT

In support of the Nuclear Regulatory Commission's assessment of the risk from severe accidents at commercial nuclear power plants in the U.S. reported in NUREG-1150, the Severe Accident Risk Reduction Program (SARRP) has completed a revised calculation of the risk to the general public from the operation of the Peach Bottom Atomic Power Station, Unit 2. This power plant, located in southeastern Pennsylvania, is operated by the Philadelphia Electric Company (PECO).

The emphasis in this risk analysis was not on determining a 'so-called' point estimate of risk. Rather, it was to determine the distribution of risk, and to determine the fundamental parameters or phenomena whose uncertainties account for the breadth of this distribution.

The offsite risk from internal initiating events was found to be quite low with respect to the safety goals. For internal initiators, the offsite risk is dominated by long-term station blackout type accidents (loss of all AC power) in which AC power is never recovered and ATWS (failure to scram) accidents in which injection works until it fails from high suppression pool temperatures or harsh environments in the reactor building after containment venting or failure. The low values for risk can be attributed to the low core damage frequency, the good emergency response, and plant features that reduce the potential source term. The offsite risk from fire initiators is also low with respect to the safety goals but higher than internal events. The fire accidents have less recovery potential than the internally initiated accidents and have a higher core damage frequency. The fire accidents are dominated by sequences that are equivalent to short and long term station blackouts. The seismic results are even higher than the fire results because of the higher initiating event frequency and significantly reduced recovery potential. The risk is above or close to the safety goal for early fatalities and within a factor of 100 of the latent cancer goal. Given that core damage occurs, it appears quite likely that the containment will fail during the accident. Considerable uncertainty is associated with the risk estimates produced in this analysis.

	Safety Goal	Internal Analysis	Fire Analysis	Seismic Analysis		
				LLNL	EPRI	
Individual Early Fatality Risk 0-1 Mi.	5.0E-07	4.7E-11	4.8E-10	1.6E-06	5.3E-08	Mean
		2.4E-10	1.7E-09	4.3E-06	1.8E-07	95%
Individual Latent Cancer Fatality Risk 0-10 Mi.	2.0E-06	4.3E-10	2.4E-09	3.4E-07	1.1E-08	Mean
		9.1E-10	8.1E-09	6.4E-07	3.0E-08	95%

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FOREWORD

This is one of numerous documents that support the preparation of the final NUREG-1150 document by the NRC Office of Nuclear Regulatory Research. Figure 1 illustrates the documentation of the accident progression, source term, consequence, and risk analyses. The direct supporting documents for the first draft of NUREG-1150 and for the revised draft of NUREG-1150 are given in Table 1. They were produced by the three interfacing programs that performed the work: the Accident Sequence Evaluation Program (ASEP), the Severe Accident Risk Reduction Program (SARRP), and the PRA Phenomenology and Risk Uncertainty Evaluation Program (PRUEP). The Zion volumes were written by Brookhaven National Laboratory and Idaho National Engineering Laboratory.

The Accident Frequency Analysis, and its constituent analyses, such as the Systems Analysis and the Initiating Event Analysis, are reported in NUREG/CR-4550. Originally, NUREG/CR-4550 was published without the designation "Draft for Comment." Thus, the current revision of NUREG/CR-4550 is designated Revision 1. The label Revision 1 is used consistently on all volumes, including Volume 2 which was not part of the original documentation. NUREG/CR-4551 was originally published as a "Draft for Comment". While the current version could have been issued without a revision indication, all volumes of NUREG/CR-4551 have been designated Revision 1 for consistency with NUREG/CR-4550.

The material contained in NUREG/CR-4700 in the original documentation is now contained in NUREG/CR-4551; NUREG/CR-4700 is not being revised. The contents of the volumes in both NUREG/CR-4550 and NUREG/CR-4551 have been altered. In both documents now, Volume 1 describes the methods utilized in the analyses, Volume 2 presents the elicitation of expert judgment, Volume 4 concerns the analyses for Peach Bottom and so on.

In addition to NUREG/CR-4550 and NUREG/CR-4551, there are several other reports published in association with NUREG-1150 that explain the methods used, document the computer codes that implement these methods, or present the results of calculations performed to obtain information specifically for this project. These reports include:

> NUREG/CR-5032, SAND87-2428, "Modeling Time to Recovery and Initiating Event Frequency for Loss of Off-site Power Incidents at Nuclear Power Plants," R. L. Iman and S. C. Hora, Sandia National Laboratories, Albuquerque, NM, January 1988.
>
> NUREG/CR-4840, SAND88-3102, "Procedures for the External Event Core Damage Frequency Analyses for NUREG-1150," M. P. Bohn and J. A. Lambright, Sandia National Laboratories, Albuquerque, NM, December 1990.

NUREG/CR-5174, SAND88-1607, J. M. Griesmeyer and L. N. Smith, "A Reference Manual for the Event Progression and Analysis Code (EVNTRE)," Sandia National Laboratories, Albuquerque, NM, September 1989.

NUREG/CR-5380, SAND88-2988, S. J. Higgins, "A User's Manual for the Post Processing Program PSTEVNT," Sandia National Laboratories, Albuquerque, NM, November 1989.

NUREG/CR-5360, SAND89-0943, H.-N. Jow, W. B. Murfin, and J. D. Johnson, "XSOR Codes User's Manual," Sandia National Laboratories, Albuquerque, NM, 1991.

NUREG/CR-4624, BMI-2139, R. S. Denning et al., "Radionuclide Release Calculations for Selected Severe Accident Scenarios," Volumes I-V, Battelle's Columbus Division, Columbus, OH, 1986.

NUREG/CR-5062, BMI-2160, M. T. Leonard et al., "Supplemental Radionuclide Release Calculations for Selected Severe Accident Scenarios," Battelle Columbus Division, Columbus, OH, 1988.

NUREG/CR-5331, SAND89-0072, S. E. Dingman et al., "MELCOR Analyses for Accident Progression Issues," Sandia National, Laboratories, Albuquerque, NM, 1990.

NUREG/CR-5253, SAND88-2940, R. L. Iman, J. C. Helton, and J. D. Johnson, "PARTITION: A Program for Defining the Source Term/Consequence Analysis Interfaces in the NUREG-1150 Probabilistic Risk Assessments, User's Guide," Sandia National Laboratories, Albuquerque, NM, May 1990.

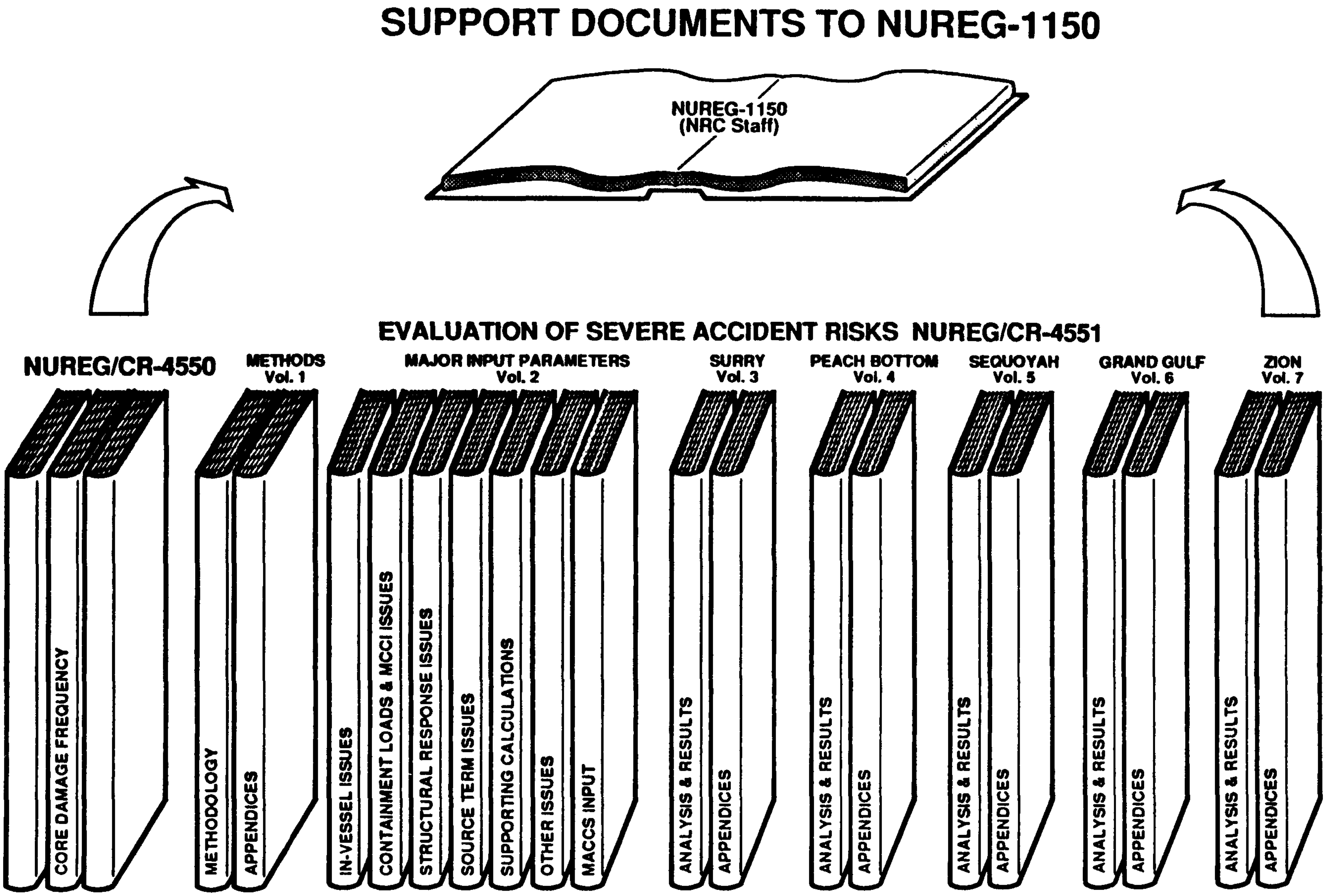

Figure 1. Back-End Documentation for NUREG-1150.

Table 1 NUREG-1150 Analysis Documentation

Original Documentation

NUREG/CR-4550	NUREG/CR-4551	NUREG/CR-4700
Analysis of Core Damage Frequency From Internal Events	Evaluation of Severe Accident Risks and the Potential for Risk Reduction	Containment Event Analysis for Potential Severe Accidents
Vol 1 Methodology	Vol 1 Surry Unit 1	Vol 1 Surry Unit 1
2 Summary (Not Published)	2 Sequoyah Unit 1	2 Sequoyah Unit 1
3 Surry Unit 1	3 Peach Bottom Unit 2	3 Peach Bottom Unit 2
4 Peach Bottom Unit 2	4 Grand Gulf Unit 1	4 Grand Gulf Unit 1
5 Sequoyah Unit 1		
6 Grand Gulf Unit 1		
7 Zion Unit 1		

Revised Documentation

NUREG/CR-4550, Rev 1, Analysis of Core Damage Frequency		NUREG/CR-4551, Rev 1, Eval of Severe Accident Risks	
Vol 1	Methodology	Vol 1	Part 1, Methodology, Part 2, Appendices
2	Part 1 Expert Judgment Elicit Expert Panel	2	Part 1 In-Vessel Issues
	Part 2 Expert Judgment Elicit Project Staff		Part 2 Containment Loads and MCCI Issues
			Part 3 Structural Issues
			Part 4 Source Term Issues
			Part 5 Supporting Calculations
			Part 6 Other Issues
			Part 7 MACCS Input
3	Part 1 Surry Unit 1 Internal Events	3	Part 1 Surry Analysis and Results
	Part 2 Surry Unit 1 Internal Events App		Part 2 Surry Appendices
	Part 3 Surry External Events		
4	Part 1 Peach Bottom Unit 2 Internal Events	4	Part 1 Peach Bottom Analysis and Results
	Part 2 Peach Bottom Unit 2 Int Events App		Part 2 Peach Bottom Appendices
	Part 3 Peach Bottom Unit 2 External Events		
5	Part 1 Sequoyah Unit 1 Internal Events	5	Part 1 Sequoyah Analysis and Results
	Part 2 Sequoyah Unit 1 Internal Events App		Part 2 Sequoyah Appendices
6	Part 1 Grand Gulf Unit 1 Internal Events	6	Part 1 Grand Gulf Analysis and Results
	Part 2 Grand Gulf Unit 1 Internal Events App		Part 2 Grand Gulf Appendices
7	Zion Unit 1 Internal Events	7	Part 1 Zion Analysis and Results
			Part 2 Appendices

ACRONYMS AND INITIALISMS

ADS	automatic depressurization system
APB	accident progression bin
APET	accident progression event tree
ASEP	accident sequence evaluation program
ATWS	anticipated transient without scram
BAF	bottom of active fuel
BNL	Brookhaven National Laboratory
BWR	boiling water reactor
CCF	common cause failure
CCI	core-concrete interaction
CCDF	complementary cumulative distribution function
CDF	cumulative distribution function
CF	containment failure
CFW	chronic fatality weight
CHR	containment heat removal
CRD	control rod drive system
CSS	containment spray system
CST	condensate storage tank
CST	condensate storage tank
DCH	direct containment heating
DG	diesel generator
ECCS	emergency core cooling system
EF	early fatality
EFW	early fatality weight
EOP	emergency operating procedures
EPRI	Electric Power Research Institute
EVSE	ex-vessel steam explosion
FSAR	final safety analysis report
HEP	human error probability
HPCS	high pressure core spray system
HPME	high pressure melt ejection
HRA	human reliability analysis
INEL	Idaho National Engineering Laboratory
IVSE	in-vessel steam explosion
LCF	latent cancer fatalities
LHS	Latin hypercube sampling
LOCA	loss-of-coolant accident

LOSP	loss of offsite power
LPCI	low pressure coolant injection system
LPCS	low pressure core spray system
MCDF	mean core damage frequency
MDP	motor-driven pump
MOV	motor-operated valve
MSIV	main stream isolation valve
NRC	Nuclear Regulatory Commission
PCS	power conversion system
PDS	plant damage state
PRA	probabilistic risk analysis
PWR	pressurized water reactor
RCIC	reactor core isolation cooling system
RCS	reactor coolant system
RHR	residual heat removal
RPS	reactor protection system
RPV	reactor pressure vessel
RSS	Reactor Safety Study
SB	station blackout
SBO	station blackout
SERG	steam explosion review group
SLC	standby liquid control
SNL	Sandia National Laboratories
SORV	stuck open relief valve
SPC	suppression pool cooling system
SRV	safety relief valve
TAF	top of active fuel
TDP	turbine-driven pump
TEMAC	Top Event Matrix Analysis Code
VB	vessel breach

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SUMMARY

S.1 Introduction

The United States Nuclear Regulatory Commission (NRC) has recently completed a major study to provide a current characterization of severe accident risks from light water reactors (LWRs). This characterization is derived from integrated risk analyses of five plants. The summary of this study, NUREG-1150,[1] has been issued as a second draft for comment.

The risk assessments on which NUREG-1150 is based can generally be characterized as consisting of four analysis steps, an integration step, and an uncertainty analysis step:

1. Accident frequency analysis: the determination of the likelihood and nature of accidents that result in the onset of core damage.
2. Accident progression analysis: an investigation of the core damage process, both within the reactor vessel before it fails and in the containment afterwards, and the resultant impact on the containment.
3. Source term analysis: an estimation of the radionuclide transport within the reactor coolant system and the containment, and the magnitude of the subsequent releases to the environment.
4. Consequence analysis: the calculation of the offsite consequences, primarily in terms of health effects in the general population.
5. Risk integration: the assembly of the outputs of the previous tasks into an overall expression of risk.
6. Uncertainty analysis: the propagation of the uncertainties in the initiating events, failure events, accident progression branching ratios and parameters, and source term parameters through the first three analyses above, and the determination of which of these uncertainties contributes the most to the uncertainty in risk.

This volume presents the details of the last five of the six steps listed above for the Peach Bottom Atomic Power Station, Unit 2. The first step is described in NUREG/CR-4550.[2]

S.2 Overview of Peach Bottom Atomic Power Station, Unit 2

The Peach Bottom Atomic Power Station, Unit 2 is operated by Philadelphia Electric Company (PECO) and is located on the west shore of Conowingo Pond in southeastern Pennsylvania, York County. The plant is 38 miles northwest of Baltimore, Maryland, and 63 miles west-southwest of Philadelphia, Pennsylvania.

The nuclear reactor of Peach Bottom Unit 2 is a 3293 MWt BWR-4 boiling water reactor (BWR) designed and supplied by General Electric Company. Unit 2, constructed by Bechtel Corporation, began commercial operation in July 1974.

Peach Bottom has four diesel generators (DGs) shared between the two units that are used to supply emergency AC power in the event that offsite power from the grid is lost. The DGs supply AC power to four trains of emergency systems for each unit simultaneously. In the event of an accident, there are several systems that can supply coolant injection to the core. Two systems are available to provide high pressure coolant injection: the high pressure coolant injection system (HPCI) and the reactor core isolation cooling system (RCIC). Both systems use turbine-driven pumps with steam obtained from the reactor pressure vessel (RPV) and can only be used when the vessel pressure is high enough to run the turbines. Both the low pressure core spray system (LPCS) and the low pressure coolant injection system (LPCI) (which is a mode of the residual heat removal system (RHR)) can provide coolant injection to the reactor vessel during accidents in which the system pressure is low. Both systems use motor driven pumps and have two loops with two pumps in each loop. Additional systems that can be used as primary sources of coolant, in special cases, are the main feedwater system (FW) and the condensate system (CDS). For additional backup sources of coolant injection the high pressure service water system (HPSW), the control rod drive system (CRD), and the firewater system (DFW) can be used in some circumstances. To allow any of the low pressure injection systems to supply coolant to the vessel, either a break in the primary system has had to occur of sufficient size to depressurize the RPV or the automatic depressurization system (ADS) is used depressurize the reactor vessel. This system (ADS) uses five relief valves to direct the vessel steam to the suppression pool (as backup another six relief valves or the ADS valves may be opened manually).

The Peach Bottom containment is a Mark I BWR containment. The containment consists of a light-bulb shaped steel pressure vessel forming the drywell which is connected to a toroidal shaped steel pressure vessel forming the suppression chamber (wetwell). In the Mark I design the reactor pressure vessel is housed in the drywell. The drywell and the wetwell communicate through passive vents (downcomers) in the suppression pool. Figure S-1 shows a section through the Peach Bottom containment. During an accident, steam from the vessel is directed through the safety/relief valves and is discharged through a sparger into the suppression pool. The steam is condensed in the pool and any noncondensible gases pass through the pool

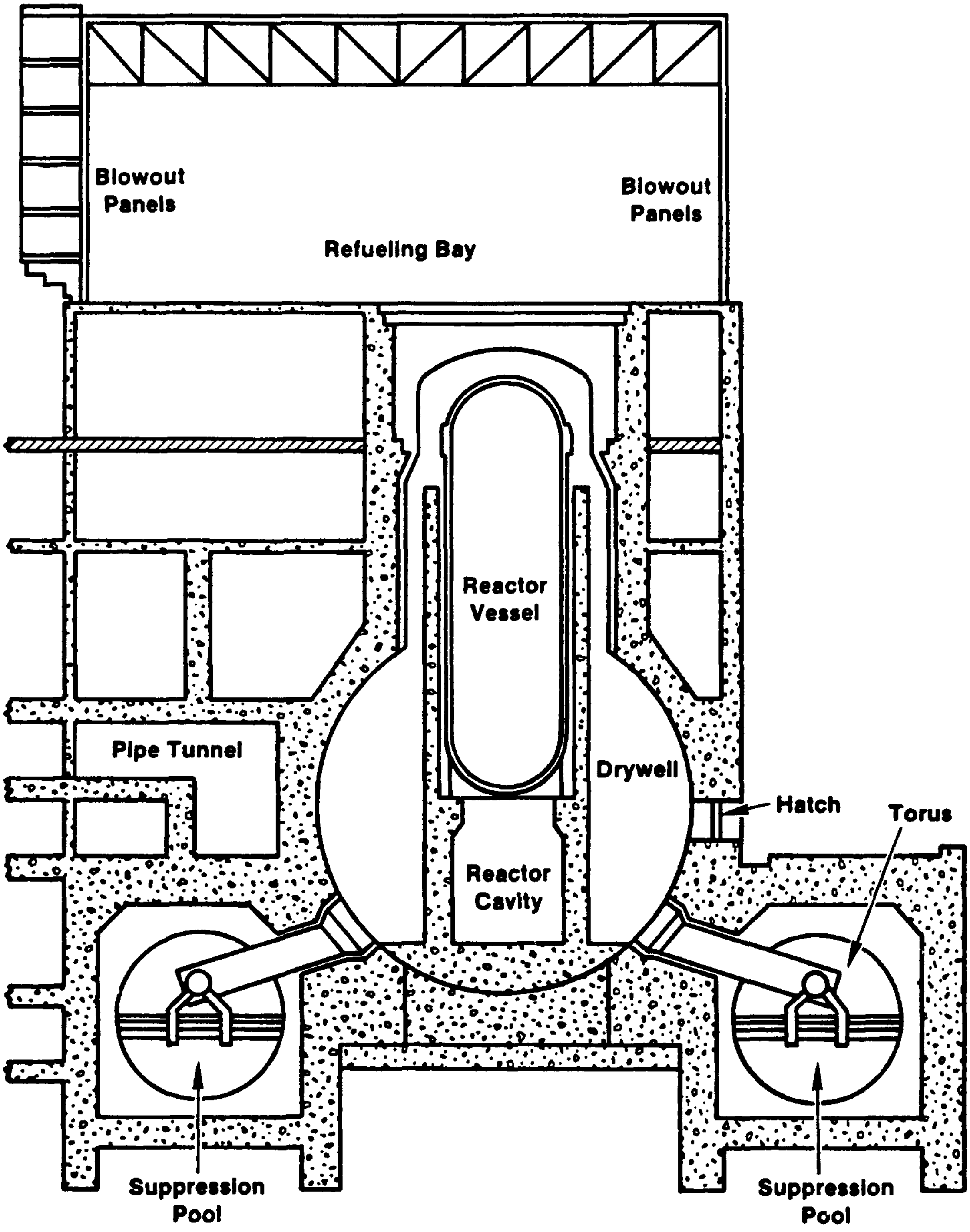

Figure S-1
Cross-Section of the Peach Bottom Containment

into the wetwell atmosphere. Vacuum breakers allow any overpressure in the wetwell to be relieved back into the drywell to keep the pressure difference less than 2 psig. Similarly, any steam and noncondensible gases released into the drywell are vented into the suppression pool through the downcomers. The design pressure of the Peach Bottom containment is 56 psig (487 KPa) and the free volume of the containment is 307,000 cubic feet.

To suppress the pressure in the containment during an accident, two trains of containment sprays are located in the Peach Bottom containment. The containment spray system is one mode of the residual heat removal system (RHR). In the event that the RHR system fails to suppress the pressure in the containment, the containment can be vented.

To reduce the potential of a severe hydrogen combustion event during an accident, the containment is inerted with nitrogen.

S.3 Description of the Integrated Risk Analysis

Risk is determined by combining the results of four constituent analyses: the accident frequency, accident progression, source term, and consequence analyses. Uncertainty in risk is determined by assigning distributions to important variables, generating a sample from these variables, and propagating each observation of the sample through the entire analysis. The sample for Peach Bottom consisted of 200 observations involving variables from the first three constituent analyses. The risk analysis synthesizes the results of the four constituent analyses to produce measures of offsite risk and the uncertainty in that risk. This process is depicted in Figure S-2. This figure shows, in the boxes, the computer codes utilized. The interfaces between constituent analyses are shown between the boxes. A mathematical summary of the process, using a matrix representation, is given in Section 1.4 of this volume.

The accident frequency analysis uses event tree and fault tree techniques to investigate the manner in which various initiating events can lead to core damage and the frequency of various types of accidents. Experimental data, past observational data, and modeling results are combined to produce frequency estimates for the minimal cut sets that lead to core damage. A minimal cut set is a unique combination of initiating event and individual hardware or operator failures. The minimal cut sets are grouped into plant damage states (PDSs), where all minimal cut sets in a PDS provide a similar set of initial conditions for the subsequent accident progression analysis (e.g., similar system successes and failures). Thus, the PDSs form the interface between the accident frequency analysis and the accident progression analysis. The outcome of the accident frequency analysis is a frequency for each PDS for each observation in the sample.

The accident progression analysis uses large, complex event trees to determine the possible ways in which an accident might evolve from each plant damage state. The definition of each plant damage state provides enough information to define the initial conditions for the accident

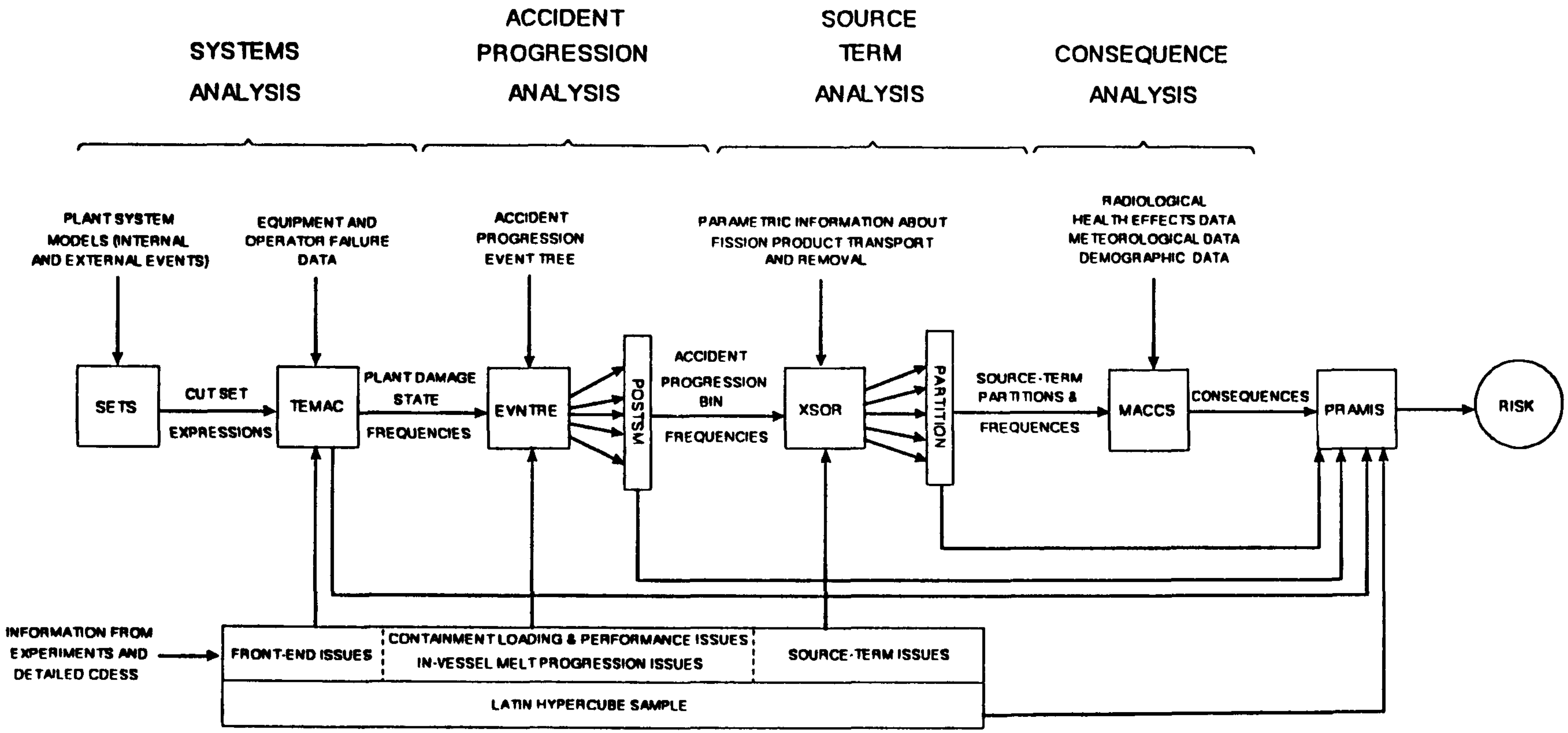

Figure S-2
Overview of the Integrated Plant Analysis Performed in NUREG-1150

progression event tree (APET) analysis. Past observations, experimental data, mechanistic code calculations, and expert judgment were used in the development of the model for accident progression that is embodied in the APET and in the selection of the branch probabilities and parameter values used in the APET. Due to the large number of questions in the Peach Bottom APET and the fact that many of these questions have more than two outcomes, there are far too many paths through the APET to permit their individual consideration in subsequent source term and consequence analysis. Therefore, the paths through the trees are grouped into accident progression bins (APBs), where each bin is a group of paths through the event tree that define a similar set of conditions for source term analysis. The properties of each accident progression bin define the initial conditions for the estimation of a source term. The result of the accident progression analysis is a probability for each APB, conditional on the occurrence of a PDS, for each observation in the sample.

A source term is calculated for each APB with a non-zero conditional probability for each observation in the sample by PBSOR, a fast-running parametric computer code. PBSOR is not a detailed mechanistic model; it is not designed to model the fission product transport, physics, and chemistry from first principles. Instead, PBSOR integrates the results of many detailed codes and the conclusions of many experts. Most of the parameters that calculate fission product release fractions in PBSOR are sampled from distributions provided by an expert panel. Because of the large number of APBs, use of a fast-executing code like PBSOR is necessary.

The number of APBs for which source terms are calculated is so large that it is not computationally practical to perform a consequence calculation for every source term. As a result, the source terms had to be combined into source term groups. Each source term group is a collection of source terms that result in similar consequences. The process of determining which APBs go to which source term group is called partitioning. This process considers the potential of each source term group to cause early fatalities and latent cancer fatalities. The result of the source term calculation and subsequent partitioning is that each APB for each observation is assigned to a source term group.

A consequence analysis is performed for each source term group, generating both mean consequences and distributions of consequences. As each APB is assigned to a source term group, the consequences are known for each APB of each observation in the sample. The frequency of each PDS for each observation is known from the accident frequency analysis, and the conditional probability of each APB is determined for each PDS group for each observation in the accident progression analysis. Thus, for each APB of each observation in the sample, both frequency and consequences are determined. The risk analysis assembles and analyzes all these separate estimates of offsite risk.

S.4 Results of the Accident Frequency Analysis

The accident frequency analysis for Peach Bottom is documented elsewhere.[2] This section only summarizes the results of the accident frequency analyses since they form the starting point for the analyses that are covered in this volume. Table S-1 (a-f) lists four summary measures of the core damage frequency distributions for Peach Bottom for the 9 internal, 4 fire, and 7 seismic PDSs used in the analysis. The four summary measures are the mean, and the 5th, 50th (median) and 95th percentiles and are based on an LHS sample of size 1000 from the Level I analysis.

S.4.1 Internal Initiators

PDS 1 is composed of two accident sequences: the first is a large LOCA followed by immediate failure of all injection; the second is a medium LOCA with initial HPCI success but almost immediate failure as the vessel depressurizes below HPCI working pressure, all other injection has failed. Early core damage results. CRD and containment heat removal are working. Venting is available.

PDSs 2 and 3 are fast transients and are composed of four sequences consisting of a transient initiator followed by two stuck open SRVs (the equivalent of an intermediate LOCA). HPCI works initially but fails when the vessel depressurizes below HPCI working pressure; all other injection has failed and early core damage results. In PDS 2, CRD and containment heat removal are working and steam is directed through the SRVs to the suppression pool. Venting is available. PDS 3 is similar to PDS 2 except that containment heat removal is not working and CRD may not be working for some subgroups (CRD is assumed to be working since the cut sets where it is not are negligible contributors).

PDSs 4 and 5 are station blackouts. PDS 4 is a short-term station blackout with DC power failed. It consists of two sequences: one with a stuck open SRV and one without. Early core damage results from the immediate loss of all injection. Venting is possible if AC power is restored (manual venting is possible if AC is not restored but considered unlikely). PDS 5 is a long-term station blackout. It is composed of three sequences, one of which has a stuck open SRV. High pressure injection is initially working. AC power is not recovered and either: 1) the batteries deplete, resulting in injection failure, reclosure of the ADS valves, and repressurization of the RPV (in those cases where an SRV is not stuck open), followed by boiloff of the primary coolant and core damage or 2) HPCI and RCIC fail on high suppression pool temperature or high containment pressure, respectively, followed by boiloff and core damage at low RPV pressure (since if DC has not failed, ADS would still be possible, or an SRV is stuck open). The containment is at high pressure but less than or equal to the saturation pressure corresponding to the temperature at which HPCI will fail (i.e., about 40 psig at the start of core damage). PDS 5 is one of the two dominant internal initiator PDSs.

Table S-1a
Plant Damage State Frequencies - Internal Events

Plant Damage State	Core Damage Frequency (1/yr) 5%	 Median	 Mean	 95%	% TCD Freq.*
PDS1 LOCA	2.5E-09	4.4E-08	2.6E-07	7.8E-07	5.8
PDS2 Fast Transient	1.1E-09	3.0E-08	2.2E-07	8.1E-07	4.9
PDS3 Fast Transient	5.9E-11	1.2E-09	6.1E-09	2.7E-08	0.1
PDS4 Fast SBO	3.5E-09	5.0E-08	2.1E-07	7.1E-07	4.7
PDS5 Slow SBO	3.5E-08	4.0E-07	1.9E-06	4.8E-06	42.0
PDS6 Fast ATWS	3.2E-09	5.9E-08	3.0E-07	1.1E-06	6.7
PDS7 ATWS CV	1.2E-09	2.3E-08	1.1E-07	3.8E-07	2.4
PDS8 ATWS CV	1.8E-08	2.9E-07	1.5E-06	5.6E-06	33.0
PDS9 ATWS CV	4.3E-10	1.0E-08	4.4E-08	1.6E-07	1.0
Total	3.5E-07	1.9E-06	4.5E-06	1.3E-05	100.0

* FCMCD, fractional contribution to the mean core damage frequency based on an LHS sample of 1000.

Table S-1b
Plant Damage State Frequencies - Fire

Plant Damage State	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.*
PDS1 Fast Transient	8.3E-08	2.0E-06	6.8E-06	2.4E-05	34.0
PDS2 Slow SBO	6.8E-09	3.3E-06	5.9E-06	2.1E-05	30.0
PDS3 Slow SBO	2.1E-09	8.5E-07	5.7E-06	2.3E-05	29.0
PDS4 Transient CV	9.5E-10	3.9E-07	1.1E-06	4.2E-06	5.5
Total	1.1E-06	1.2E-05	2.0E-05	6.4E-05	100.0

* FCMCD, fractional contribution to the mean core damage frequency based on an LHS sample of 1000.

Table S-1c
Plant Damage State Frequencies - Seismic HIG, LLNL

Plant Damage State	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.*
PDS1 FSB RPV	4.7E-10	1.1E-07	7.2E-06	1.4E-05	9.6
PDS2 FSB LLOCA	6.9E-10	4.8E-07	1.4E-05	6.1E-05	18.6
PDS3 FSB LLOCA	1.9E-11	7.7E-08	2.8E-06	2.0E-05	3.7
PDS4 Slow SBO	4.1E-09	6.6E-07	1.7E-05	4.0E-05	22.6
PDS5 Fast SBO	7.7E-11	4.2E-08	1.8E-06	5.3E-06	2.4
PDS6 FSB ILOCA	1.9E-10	1.6E-07	3.9E-06	2.1E-05	5.2
PDS7 FSB I/SLOCA	1.6E-10	5.2E-08	1.4E-06	6.1E-05	1.9
HIG 200	3.3E-08	2.8E-06	4.8E-05	2.8E-04	64.0

* FCMCD, fractional contribution to the mean core damage frequency based on an LHS sample of 1000.

Table S-1d
Plant Damage State Frequencies - Seismic LOWG, LLNL

Plant Damage State	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.*
PDS1 FSB RPV	1.0E-10	2.4E-08	1.6E-06	3.1E-06	2.1
PDS2 FSB LLOCA	1.4E-10	9.8E-08	2.9E-06	1.2E-05	3.9
PDS3 FSB LLOCA	1.7E-12	6.7E-09	2.4E-07	1.7E-06	0.3
PDS4 Slow SBO	5.0E-09	8.0E-07	2.0E-05	4.9E-05	26.6
PDS5 Fast SBO	6.3E-11	3.4E-08	1.4E-06	4.3E-06	1.8
PDS6 FSB ILOCA	3.6E-11	3.1E-08	7.5E-07	4.0E-06	1.0
PDS7 FSB I/SLOCA	2.2E-11	7.1E-09	1.9E-07	8.3E-07	0.3
LOWG 200	1.4E-08	1.5E-06	2.7E-05	1.0E-04	36.0

* FCMCD, fractional contribution to the mean core damage frequency based on an LHS sample of 1000.

Table S-1e
Plant Damage State Frequencies - Seismic HIG EPRI

Plant Damage State	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.*
PDS1 FSB RPV	7.2E-11	1.7E-08	2.5E-07	1.0E-06	7.9
PDS2 FSB LLOCA	1.5E-10	6.2E-08	5.0E-07	2.0E-06	15.9
PDS3 FSB LLOCA	3.0E-12	1.3E-08	1.2E-07	6.2E-07	3.8
PDS4 Slow SBO	2.4E-09	9.6E-08	6.3E-07	1.8E-06	20.0
PDS5 Fast SBO	1.4E-11	4.6E-09	9.1E-08	3.4E-07	2.9
PDS6 FSB ILOCA	6.2E-11	1.7E-08	1.5E-07	6.2E-07	4.8
PDS7 FSB I/SLOCA	2.6E-11	6.7E-09	6.1E-08	2.0E-07	1.9
HIG 200	1.1E-08	3.6E-07	1.8E-06	8.6E-06	57.2

* FCMCD, fractional contribution to the mean core damage frequency based on an LHS sample of 1000.

Table S-1f
Plant Damage State Frequencies - Seismic LOWG, EPRI

Plant Damage State	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.*
PDS1 FSB RPV	2.3E-11	5.3E-09	7.9E-08	3.2E-07	2.5
PDS2 FSB LLOCA	4.1E-11	1.6E-08	1.3E-07	5.3E-07	4.1
PDS3 FSB LLOCA	3.7E-13	1.6E-09	1.5E-08	7.7E-08	0.5
PDS4 Slow SBO	3.8E-09	1.5E-07	9.8E-07	2.8E-06	31.0
PDS5 Fast SBO	1.5E-11	5.1E-09	1.0E-07	3.8E-07	3.2
PDS6 FSB ILOCA	1.5E-11	4.2E-09	3.7E-08	1.6E-07	1.1
PDS7 FSB I/SLOCA	4.5E-12	1.2E-09	1.1E-08	3.6E-08	0.4
LOWG 200	6.9E-09	2.7E-07	1.4E-06	5.0E-06	42.8

* FCMCD, fractional contribution to the mean core damage frequency based on an LHS sample of 1000.

PDSs 6, 7, 8, and 9 are all ATWS sequences. PDS 6 is an ATWS with SLC working. HPCI works and the vessel is not manually depressurized. Injection fails on high suppression pool temperature and early core damage ensues. Venting is available. PDS 7 is an ATWS with failure of SLC, the initiator is a stuck open SRV. High pressure injection fails on high suppression pool temperature and the reactor either is: 1) not manually depressurized or 2) the operator depressurizes and uses low pressure injection systems until either the injection valves fail due to excessive cycling or the containment fails or is vented and the injection systems fail due to harsh environments in the reactor building or loss of NPSH (condensate can not supply enough water since the CST can only supply about 800 gpm to the condenser, condensate can only last a few minutes). Early core damage ensues in case 1 and late core damage in case 2. Venting will not take place before core damage if the operator does not depressurize; but, it may, if he goes to low pressure systems. RHR and CSS are working and the containment pressure will begin to drop in case 1 or will level off at the venting or SRV reclosure pressure in case 2. PDS 8 is an ATWS sequence with loss of an AC bus or PCS followed by failure to scram. Everything else is the same as PDS 7. PDS 8 is the other dominant PDS for internal initiators. PDS 9 is an ATWS with failure of SLC, the initiator is T1 (LOSP); however, other AC is available. Otherwise, this PDS is the same as PDS-8.

PDSs 5 and 8 are the dominant contributors to the core damage frequency.

S.4.2 Fire Initiators

PDS 1 is a fast transient and is composed of three fire scenarios, two in the control room and one in the cable spreading room. Power is available but remote control of the systems has been lost and auto actuation has failed due to the fire. No injection is available and early core damage ensues.

PDSs 2 and 3 are slow station blackouts. PDS 2 is composed of eight fire scenarios in different emergency switchgear rooms (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D). All lead to a fire induced LOSP followed by a random loss of emergency service water due to valve failure resulting in an early loss of all AC power and station blackout. HPCI will work until it fails on battery depletion or high suppression pool temperature and late core damage will ensue. PDS 3 is composed of eight fire scenarios in different switchgear rooms (2A, 2B, 2C, 2D, 3A,3B, 3C, and 3D). All lead to fire induced LOSP followed by a random loss of emergency service water from DG failure to run resulting in a delayed station blackout. HPCI will work until failure on high suppression pool temperature and late core damage will ensue.

PDS 4 is a core vulnerable transient and is composed of two fire scenarios in emergency switchgear room 2C. The fires result in LOSP with failure of PCS, venting, and failure of most RHR trains. Random failures complete the failure of containment heat removal. The HPCI and LPCI systems succeed but core damage results when HPCI fails on high suppression pool temperature and LPCI fails when the SRVs reclose on high containment pressure.

PDSs 1, 2, and 3 all contribute equally to the core damage frequency.

S.4.3 Seismic Initiators

PDS 1 is composed of one sequence with a seismically induced LOSP followed by RPV rupture. All injection is lost as a result of the initiator and early core damage ensues. The core damage estimate does not depend on any other consideration; but, for the Level II/III analysis, the status of the containment systems needs to be determined. Onsite AC could be available but the failure probability of a DG is also high in this scenario, we assessed that enough onsite AC would be available to vent the containment; but, not enough to operate the containment heat removal systems. Early containment failure occurs as a result of the seismic event.

PDSs 2 and 3 are both fast station blackouts with concomitant Large LOCAs. PDS 2 is composed of one sequence with a seismically induced LOSP followed by a loss of all onsite AC leading to a station blackout. A large LOCA is also induced by the seismic event resulting in high pressure injection failure (only steam-driven systems are available and these fail on low pressure in the RPV) and early core damage results. Early containment failure occurs as a result of the seismic event. PDS 3 is the same as PDS 2 except that DC power has also failed. This has no effect on accident progression since all systems have failed anyway.

PDSs 4 and 5 are station blackouts. PDS 4 is a short-term station blackout and is composed of one sequence with a seismically induced LOSP followed by loss of all AC leading to station blackout. HPCI succeeds until battery depletion or high suppression pool temperature results in HPCI failure and late core damage. PDS 5 is a long-term station blackout and is composed of two sequences, one with a stuck open SRV and one without. Both sequences have a seismically induced LOSP followed by a loss of all AC resulting in station blackout. High pressure injection fails initially upon Radwaste/Turbine building failure and early core damage ensues.

PDSs 6 and 7 are both fast station blackouts with concomitant Intermediate or Small LOCA. PDS 6 is composed of one sequence with a seismically induced LOSP, failure of onsite AC due to cooling water failure, and a seismically induced intermediate LOCA. HPCI works until primary pressure drops below working pressure and early core damage ensues. PDS 7 is composed of two sequences both with a seismically induced LOSP followed by a loss of onsite AC resulting in station blackout. A seismically induced intermediate or small LOCA occurs and high pressure injection fails when RPV pressure drops below the systems working pressures resulting in early core damage.

PDS 5 contributes about half the core damage frequency and PDS 2 about a quarter of the core damage frequency.

S.5 Accident Progression Analysis

S.5.1 Description of the Accident Progression Analysis

The accident progression analysis is performed by means of a large and detailed event tree, the accident progression event tree (APET). This event tree forms a high level model of the accident progression, including the response of the containment to the loads placed upon it. The APET is not meant to be a substitute for detailed, mechanistic computer simulation codes. Rather, it is a framework for integrating the results of these codes together with experimental results and expert judgment. The detailed, mechanistic codes require too much computer time to be run for all the possible accident progression paths. Further, no single available code treats all the important phenomena in a complete and thorough manner that is acceptable to all those knowledgeable in the field. Therefore, the results from these codes, as interpreted by experts, are summarized in an event tree. The resulting APET can be evaluated quickly by computer, so that the full diversity of possible accident progressions can be considered and the uncertainty in the many phenomena involved can be included.

The APET treats the progression of the accident from the onset of core damage through the core-concrete interaction (CCI). It accounts for the various events that may lead to the release of fission products due to the accident. The Peach Bottom APET consists of 145 questions, most of which have more than two branches. Five time periods are considered in the tree. The recovery of offsite power is considered both before vessel failure as well as after vessel failure. The possibility of arresting the core degradation process before failure of the vessel is explicitly considered. Core damage arrest may occur following the recovery of offsite power or when depressurization of the RPV allows injection by a low pressure injection system that previously could not function with the RPV at high pressure. Containment failure is considered before vessel breach, around the time of vessel breach and late in the accident. The dominant events that can cause containment failure are drywell meltthrough and the accumulation of steam and/or noncondensibles in the containment.

The APET is so large and complex that it cannot be presented graphically and must be evaluated by computer. A computer code, EVNTRE, has been written for this purpose. In addition to evaluating the APET, EVNTRE, sorts the myriad possible paths through the tree into a manageable number of outcomes, denoted accident progression bins (APBs).

S.5.2 Results of the Accident Progression Analysis

Results of the accident progression analysis at Peach Bottom are summarized in Figures S-3, S-4, and S-5. Figure S-3 shows the mean distribution among the summary accident progression bins for the summary PDS groups. Technically, this figure displays the mean probability of a summary APB conditional on the occurrence of a PDS group. Since only mean values are shown, Figure S-3 gives no indication of the range of values encountered.

SUMMARY ACCIDENT PROGRESSION BIN GROUP	SUMMARY PDS GROUP (Mean Core Damage Frequency)						
	Internal Initiators						
	LOSP (2.08E-06)	LOCAs (1.50E-07)	ATWS (1.93E-06)	Transients (1.81E-07)	All (4.34E-06)	Fire (1.98E-05)	Seismic (7.52E-05)
VB > 200psi, early WWF	0.045		0.006		0.022	0.045	0.028
VB < 200 psi, early WWF	0.012	0.028	0.006	0.026	0.011	0.004	0.027
VB > 200 psi, early DWF	0.436		0.330		0.341	0.529	0.369
VB < 200 psi, early DWF	0.133	0.360	0.194	0.356	0.183	0.070	0.489
VB, late WWF	0.007			0.002	0.003	0 009	0.006
VB, late DWF	0.061	0.074	0.015	0.074	0.047	0.086	0.074
VB, CV	0.074	0.003	0.207	0.016	0.110	0.020	0.007
No CF	0.121	0.536	0.127	0.512	0.184	0.159	
No VB	0.112		0.091	0.014	0.089	0.078	
No Core Damage			0.024		0.010		

VB = Vessel Breach
WWF = Wetwell Failure
DWF = Drywell Failure
CV = Containment Venting
CF = Containment Failure

Peach Bottom

Figure S-3
Conditional Probability of Collapsed APBs for Collapsed PDS Groups

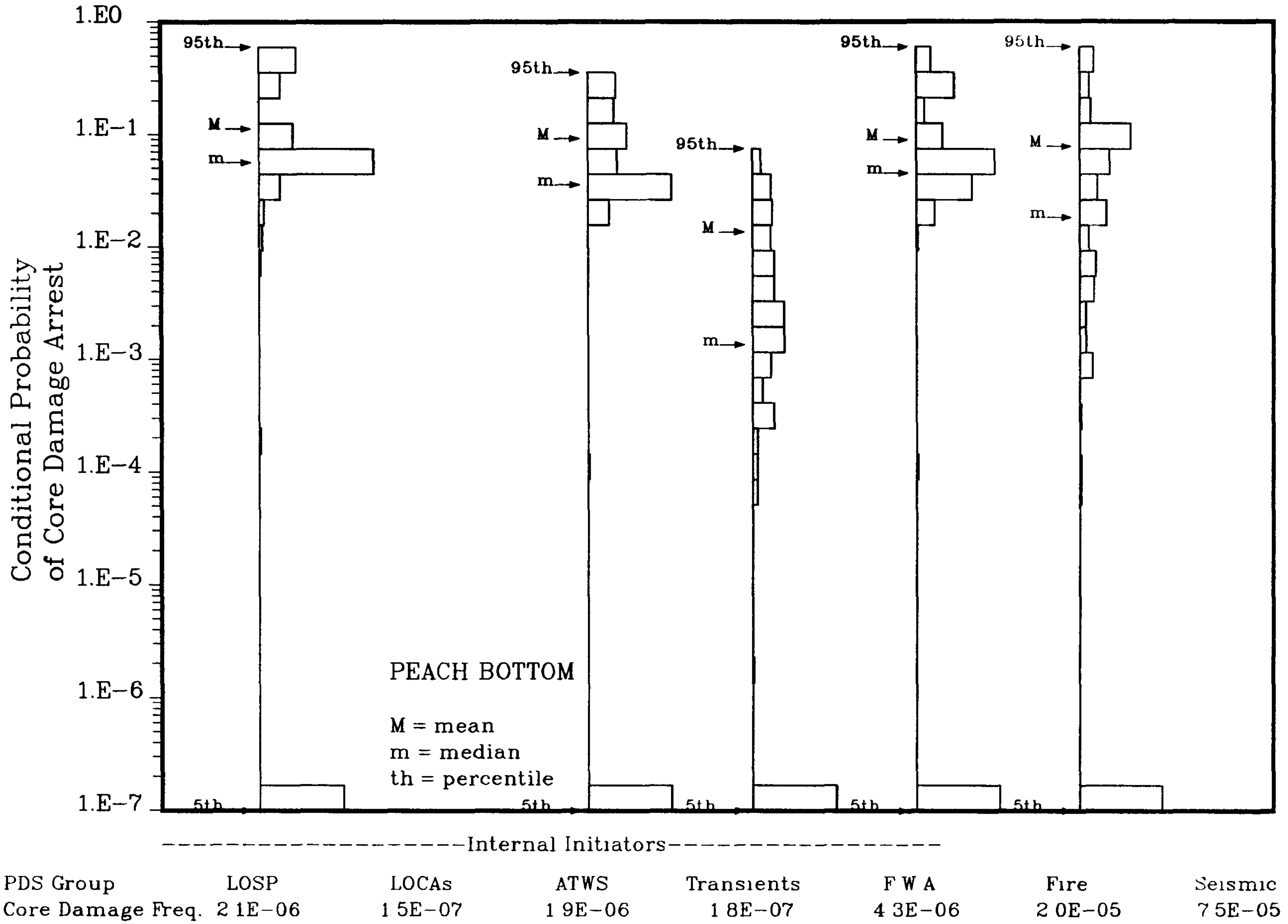

Figure S-4
Conditional Probability of Core Damage Arrest for Collapsed PDS Groups

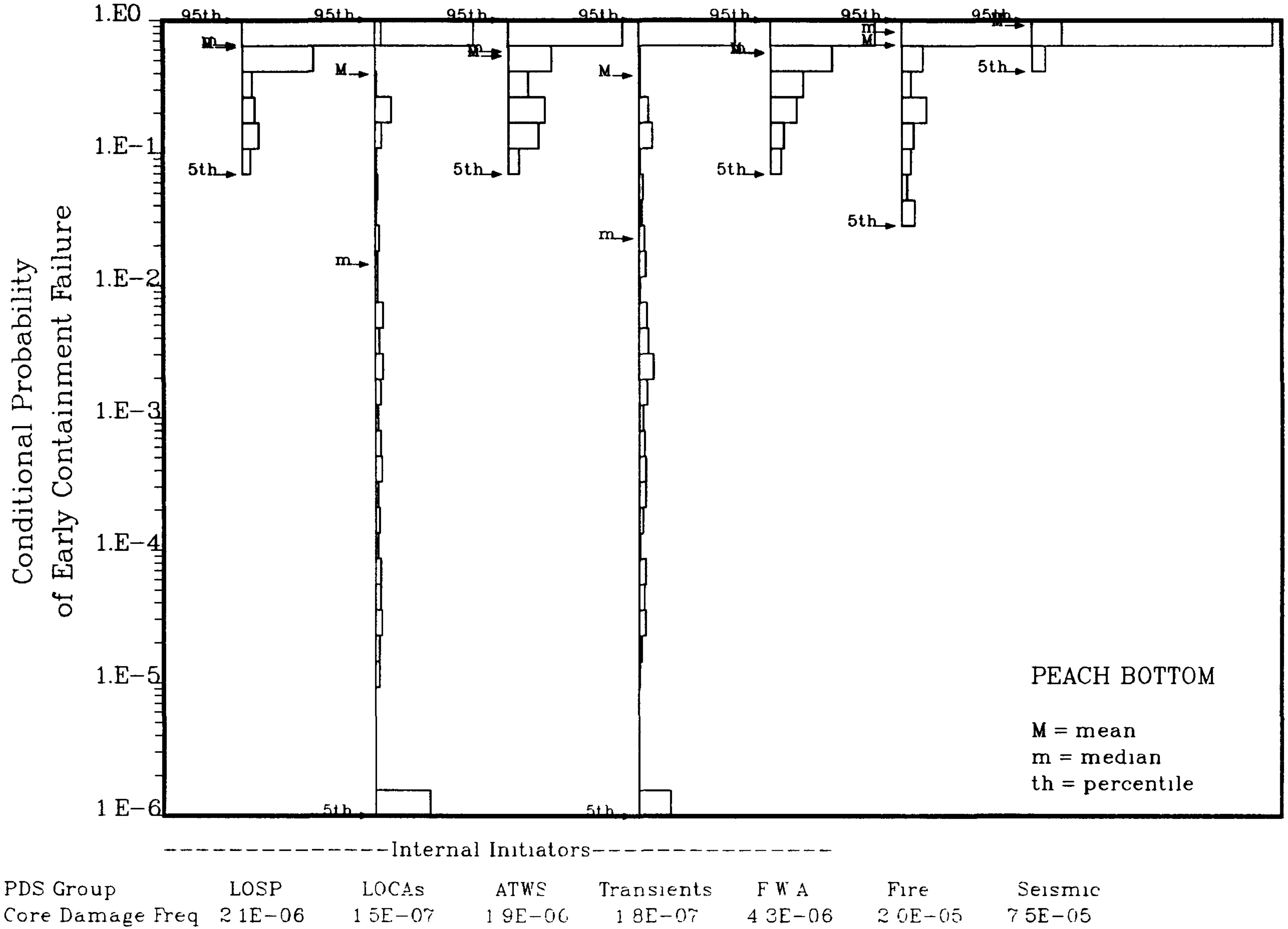

Figure S-5
Conditional Probability of Early Containment Failure for Collapsed PDS Groups

The distributions of the expected conditional probability for core damage arrest for a given summary PDS group are shown in Figure S-4. Similarly, the distributions of the expected conditional probability for early containment failure (CF) for a given summary PDS group are displayed in Figure S-5. Early CF means CF before or around the time of vessel breach (VB).

Figure S-3 indicates the mean probability of the possible outcomes of the accident progression analysis. The width of each box in the figure indicates how likely each accident progression outcome is for each type of accident.

S.5.2.1 Internal Initiators

Because the Level I analysis did not resolve some of the ATWS sequences all the way to core damage, the ATWS group has a probability of 2.4% of no core damage. These involve sequences where low pressure injection is being used to cool the core and injection does not fail from severe environments or injection valve cycling. In the Level I analysis, these were conservatively assumed to go to core damage.

The LOSP group is composed of two PDSs representing a short-term station blackout with no DC power (PDS 4) and a long-term station blackout (PDS 5). These two PDSs are 46.7% of the mean core damage frequency and PDS 5 is 90% of the group frequency so that its characteristics dominate. There is a 0.112 probability of recovering AC power during core degradation and arresting core damage. The high probability of early drywell failure (0.569) is mostly from drywell shell meltthrough. The dominant APBs for this group have no recovery of AC power and the vessel breach occurs at high RPV pressure. The next highest APBs have AC recovery but no core damage arrest and vessel breach occurs at low RPV pressure. In either case, drywell failure by meltthrough is the dominant containment failure mechanism (although the relative probability is lower in the AC recovered cases because the drywell can be flooded by containment sprays). If drywell meltthrough does not occur then there is still some probability of failure by overpressure, venting, or pedestal failure. In 12.1% of the cases, AC power is recovered, vessel breach occurs, and the sprays provide sufficient heat removal and reduced CCI to prevent containment failure altogether.

The LOCA group is composed only of PDS 1 representing 5.8% of the mean core damage frequency. In order to get core damage all injection had to fail and there is no possibility of recovering injection; therefore, core damage arrest is not possible. There are no high pressure RPV vessel breach scenarios because of the LOCA depressurizing the vessel. Since the drywell is flooded by water from the vessel, drywell meltthrough is less likely in this case (only 0.36). There is some probability of overpressure failure or venting; but, the availability of containment heat removal in this sequence results in a high probability of no containment failure at all (0.536).

The ATWS group is composed of four PDSs (PDSs 6, 7, 8, 9). This group is 43.1% of the core damage frequency. PDS 8 is 77% of the group frequency, PDS 6 is 16%, PDS 7 is 6%, and PDS 9 is 2%. Since PDSs 7, 8, and 9 are almost the same, 85% of this group is represented by PDS 8. PDSs 7, 8, and 9 were not resolved all the way to core damage in the Level I analysis and there is a group average of 2.4% no core damage. All the PDSs have some chance of recovery of injection during core damage and arresting vessel breach. The group average is 9.1%. If vessel breach is not avoided, most accident progression bins (about 75%) will have containment venting before core damage (PDS 7, 8, and 9). Drywell meltthrough can still occur, mainly in cases were the RPV is at high pressure at vessel breach (about 50% of the time usually concurrent with wetwell venting).

The Transient group is composed of two PDSs (PDS 2 and 3). This group is 5% of the core damage frequency and PDS 2 is 98% of the group frequency. PDS 2 is very similar to the LOCA group with containment heat removal working but no injection recovery. PDS 3 does not have containment heat removal but does have some possibility of recovering injection. It can be seen that there is a small possibility of core damage arrest (1.4%) for the group. The rest is identical to the LOCA group and for the same reasons.

The frequency weighted average results are about equally weighted between the LOSP and ATWS groups which are dominated by PDS 5 and 8, respectively. For accidents which proceed to core damage and vessel breach, there is still a significant probability that the core debris will be cooled by an overlying pool of water and either no CCI will occur or the CCI releases will be scrubbed through the water.

S.5.2.2 Fire Initiators

The fire PDSs are dominated by scenarios (66%) that do not allow for the recovery of injection or containment heat removal (CHR) and they look much like short or long-term station blackout sequences. The impossibility of recovering injection or CHR, however, means that the containment failure probability will be very high from overpressure related events since the base pressure in containment can not be reduced before vessel breach and long term containment failure from overpressure can not be mitigated.

For the fire initiated PDSs, only in PDS 1 is there a significant probability of being able to cool the core debris by adding water and thereby preventing CCI.

S.5.2.3 Seismic Initiators

The seismic PDSs are dominated by scenarios (100%) that do not allow for the recovery of injection or containment heat removal (CHR) and they look much like short or long-term station blackout sequences. The impossibility of recovering injection or CHR, however, means that the containment failure probability will be very high from overpressure related events since the base pressure in containment can not be reduced before vessel breach and long term containment failure from overpressure can not be mitigated.

For the seismically initiated PDSs, no PDS has a significant probability of being able to cool the core debris by adding water and thereby preventing CCI. All have a dry CCI with only a possibility in some cases of an initial layer of water from a LOCA or CRD leakage.

S.5.2.4 Global Insights

There are significant differences between the internal events results and the external events results. Both of the external events had a much lower probability (if any at all) for recovering injection during core damage and for having continuous water flow onto the debris in the cavity and drywell. These two differences imply that the external events PDSs will, in general, have a higher probability of early containment failure, a higher probability of drywell meltthrough, that ultimately the containment will almost certainly fail by some mechanism, and that core damage arrest will not be likely. The external events PDSs are mainly like short term station blackout sequences with no recovery of AC power and can have compounding events, such as LOCAs, in addition.

In the sensitivity analysis performed for no drywell shell meltthrough, removing the possibility of drywell meltthrough will decrease the probability of early containment failure but not as much as would seem to be possible from its calculated frequency because of the fact that multiple failure modes are possible and if one does not occur than another will. Also the probability of containment failure at some time in the accident is not much affected since the probability of the late failure modes will increase to compensate for eliminating drywell meltthrough. For internal events, the total containment failure probability decreases from 0.82 to 0.70; for fire events, it decreases from 0.84 to 0.78; and, for seismic events, it does not change from 1.0.

S.5.2.5 Core Damage Arrest

Figure S-4 shows the conditional probability of core damage arrest for the PDS summary groups. That is, given that the PDS group occurs what is the probability of core damage arrest.

Internal Initiators

For the LOSP collapsed PDS group, the probability of core damage arrest is driven directly by the conditional probability of recovering AC power between the time core damage starts and vessel breach occurs. Because of the many available injection systems, injection into the RPV is possible in most cases immediately after AC is restored. While the probability of recovering AC power is high (0.9) in PDS 4, the probability of recovery in PDS 5 is only 0.37 (for long-term station blackout, the probability of recovering AC power within the time window of core damage is about 1/3 that of the short-term case) and it is the dominant PDS. Since the probability of core damage arrest is about 25% given injection is restored, the average for this collapsed PDS group is only .112. Many factors must be considered in determining if core damage arrest is possible even if injection is restored. In particular, six major factors were considered in the APET. First, the timing of the injection recovery with respect to the time between the start of core damage and vessel breach. Second, the fraction of core participating in core slump. Third, the probability of in-vessel steam explosions. Fourth, the amount of core debris which is mobile in the lower plenum. Fifth, depending upon the accident scenario, the RPV pressure may also be a factor and, sixth, the probability of the core going recritical during reflood. All of these contribute to our estimate of the fraction of time injection recovery can result in core damage arrest.

For the LOCA collapsed PDS group, injection is not recoverable in the dominant PDSs. If injection was recoverable core damage would in most cases not even have occurred. The possibility of core damage arrest is, therefore, zero.

In the ATWS collapsed PDS group, injection recovery depends upon the conditions allowing the operator to be able to depressurize and then that he does it. PDS 8 dominates this PDS group. In PDS 8, injection is recovered with a probability of 0.33 and core damage arrest is 0.1. In the other PDSs the probability of core damage arrest is the same or lower, so that the overall probability for this collapsed PDS group is 0.09.

In the transient collapsed PDS group, injection is recoverable in one of the PDSs but the other is like the LOCA PDS and injection can not be recovered. The frequency of the PDS where injection is not recovered dominates and the probability of core damage arrest for transients is only 0.014. Operator error dominates the recovery probability.

It must be remembered that core damage arrest does not necessarily mean that there will be no radionuclide releases during the accident. Both hydrogen and radionuclides are released to the containment during the core damage process through the SRVs to the suppression pool. In the majority of the cases, the release is small because, when injection is restored, containment heat removal is also restored and, if the mass of hydrogen released is small, containment pressure remains low. This implies radionuclides get released only through the nominal containment leakage paths. However, in some cases, either a large amount of non-condensibles are generated and containment venting is required or containment heat removal is not restored and venting or containment failure occurs.

Fire Initiators

For the dominant PDSs in the fire analysis, only PDS 1 has a possibility of recovering injection after core damage has begun. For PDS 2 to 4, the failure of injection in a non-recoverable manner was necessary to get core damage in the first place. The average conditional probability for core damage arrest for all the fire PDSs together is 0.078.

Seismic Initiators

For the dominant PDSs in the seismic analysis, no PDS has a possibility of recovering injection after core damage has begun. Damage from the seism was assessed to be non-recoverable for off-site power within the time frame of interest. Recovery of onsite power from none seismic failures in order to prevent core damage was allowed in the Level I analyses; but no further credit was taken in the accident progression analysis because the failures were either easy to recover and so would have been recovered before core damage took place or so difficult that recovery within the time frame of interest was negligible.

S.5.2.6 Early Containment Failure

Figure S-5 shows the conditional probability distribution for early CF at Peach Bottom for the PDS summary groups. The probability distributions displayed in this figure are conditional on core damage and vessel breach. That is, the probability of early CF is conditional on the accident proceeding to core damage and then on to vessel breach.

Internal Initiators

The early fatality risk depends strongly on the probability of early containment failure (CF). Early containment failure includes both failures that occur before vessel breach and those that occur at or shortly after vessel breach. The Peach Bottom containment is a relatively strong containment with the suppression pool being able to absorb large amounts of energy if not released to quickly. The design pressure is 56 psig; but, after evaluation by the experts, an assessed mean failure pressure of 150 psig was determined. Because of its high failure pressure combined with its energy absorbing capabilities in the suppression pool, the containment is unlikely to fail early from overpressure in most accidents. The containment has a significant probability of early overpressure failure only in those sequences where containment heat removal and venting are failed or inadequate (ATWS) and the suppression pool becomes saturated. This can result in a significant base pressure before core damage begins and then the pressure increase from hydrogen generation during core damage or events at vessel breach can result in peak containment pressures in the failure range.

For non-ATWS sequences, early containment failure is most likely to occur from drywell meltthrough and in ATWS sequences to occur from wetwell venting before core damage (drywell meltthrough is the second most likely).

Fire Initiators

For fire initiated events, the probability of early containment failure is high. This is driven by the nature of the dominant PDSs, most of which do not have AC power or injection. This leads to a high probability of drywell meltthrough since the drywell will, at most, only have the water in the reactor cavity sump and this is the most favorable condition for drywell meltthrough.

Seismic Initiators

For seismically initiated events, the probability of early containment failure is high (70% or greater). This is driven by the nature of the seismic event which does not allow AC power recovery and the characteristics of the dominant PDSs which do not have any continuing injection or containment heat removal. This leads to a high probability of drywell meltthrough since the drywell will, at most, only have the water in the reactor cavity sump or on the drywell floor and this is the most favorable condition for drywell meltthrough (i.e. as opposed to having some continuous supply of covering water).

S.6 Source Term Analysis

S.6.1 Description of the Source Term Analysis

The source term for a given bin consists of the release fractions for the nine radionuclide classes for the early release and for the late release, and additional information about the timing of the releases, the energy associated with the releases, and the height of the releases. It comprises the information required for the calculation of consequences in the succeeding analysis. A source term is calculated for each APB for each observation in the sample. The nine radionuclide classes are: inert gases, iodine, cesium, tellurium, strontium, ruthenium, lanthanum, cerium, and barium.

The source term analysis is performed by a relatively small computer code: PBSOR. The purpose of this code is not to calculate the behavior of the fission products from their chemical and physical properties and the flow and temperature conditions in the reactor and the containment. Instead, PBSOR provides a means of incorporating into the analysis the results of the more detailed codes that do consider these quantities. This approach is needed because the detailed codes require too many computer resources to be able to compute source terms for the numerous accident progression bins and the 200 observations that result from the sampling approach used in NUREG-1150.

PBSOR is a fast-running, parametric computer code used to calculate the source terms for each APB for each observation for Peach Bottom. As there are typically about a 450 bins for each observation, and 200 observations in the sample, the need for a source term calculation method that requires few computer resources for one evaluation is obvious. PBSOR provides a framework for synthesizing the results of experiments and mechanistic codes, as interpreted by experts in the field. The reason for "filtering" the detailed code results through the experts is that no code available treats all the phenomena in a manner generally acceptable to those knowledgeable in the field. Thus, the experts are used to extend the code results in areas where the codes are deficient and to judge the applicability of the model predictions. They also factor in the latest experimental results and modify the code results in areas where the codes are known or suspected of oversimplifying. Since the majority of the parameters used to compute the source term are derived from distributions determined by an expert panel, the dependence of PBSOR on various detailed codes reflects the preferences of the experts on the panel.

It is not possible to perform a separate consequence calculation for each of the approximately 93,000 source terms computed for the Peach Bottom integrated risk analysis. Therefore, the interface between the source term analysis and the consequence analysis is formed by grouping the source terms into a much smaller number of source term groups. These groups are defined so that the source terms within them have similar health effect weights, and a single consequence calculation is performed for the mean source term for each group. This grouping of the source terms is performed with the PARTITION program, and the process is referred to as "partitioning".

The partitioning process involves the following steps: definition of an early health effect weight (EH) for each source term, definition of a chronic health effect weight (CH) for each source term, subdivision (partitioning) of the source terms on the basis of EH and CH, a further subdivision on the basis of the time the evacuation starts relative to the start of the release, and calculation of frequency-weighted mean source terms.

The result of the partitioning process is that the source term for each accident progression bin is assigned to a source term group. In the risk computations, each accident progression bin is represented by the mean source term for the group to which it is assigned, and the consequences calculated for that mean source term.

S.6.2 Results of the Source Term Analysis

When all the internally-initiated accidents at Peach Bottom are considered together, the plots shown in Figure S-6 are obtained. These plots show four statistical measures of the 200 curves (one for each observation in the sample) that give the frequencies with which release fractions are exceeded. Figure S-6 summarizes the complementary cumulative distribution functions (CCDFs) for all of the radionuclide groups except for the nobel gases. The mean frequency of exceeding a release fraction of 0.10 for I and Cs is on the order of 10-6/year and for Te and Sr it is on the order of

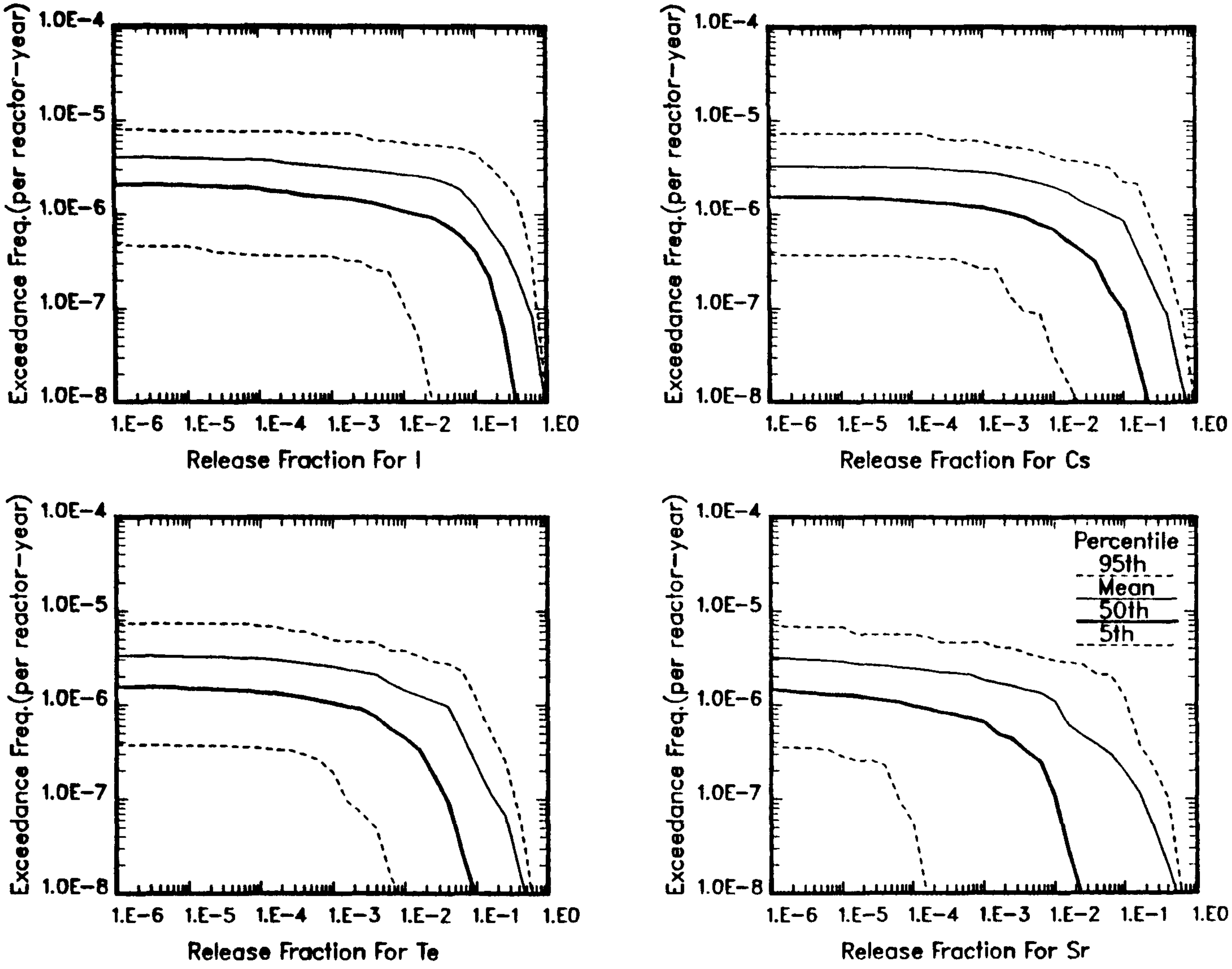

Figure S-6a
Peach Bottom: Total Internal
Source Term CCDF

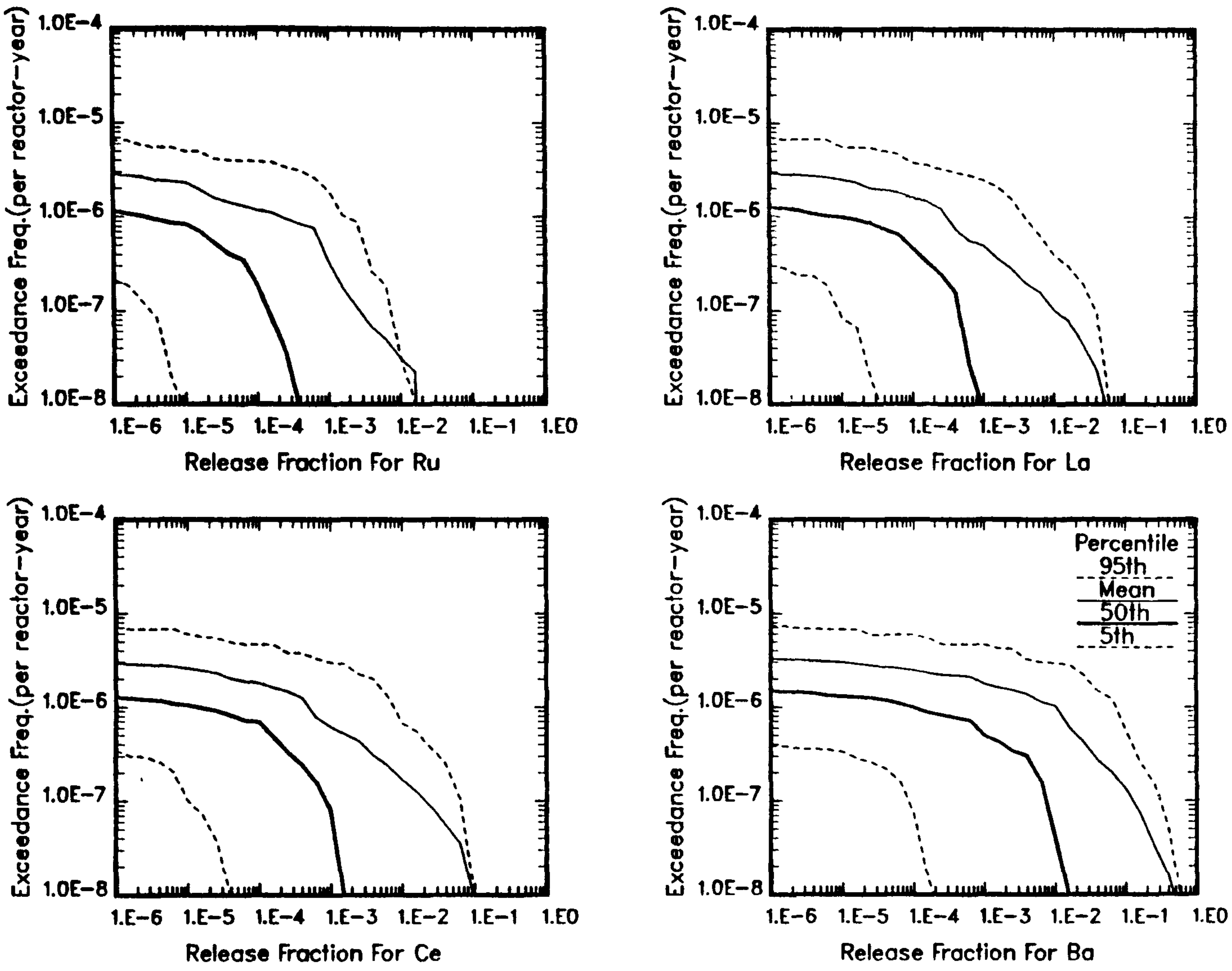

Figure S-6b
Peach Bottom: Total Internal
Source Term CCDF

10-7/year. The mean frequency of exceeding a release fraction of 0.01 for the La radionuclide class is on the order of 10-8/year.

Similar results are displayed in Figure S-7, S-8, and S-9 for the fire, LLNL seismic hazard curve, and the EPRI hazard curve, respectively.

S.7 Consequence Analysis

S.7.1 Description of the Consequence Analysis

Offsite consequences are calculated with MACCS for each of the source term groups defined in the partitioning process. MACCS tracks the dispersion of the radioactive material in the atmosphere from the plant and computes its deposition on the ground. MACCS then calculates the effects of this radioactivity on the population and the environment. Doses and the ensuing health effects from 60 radionuclides are computed for the following pathways: immersion or cloudshine, inhalation from the plume, groundshine, deposition on the skin, inhalation of resuspended ground contamination, ingestion of contaminated water and ingestion of contaminated food.

MACCS treats atmospheric dispersion by the use of multiple, straight-line Gaussian plumes. Each plume can have a different direction, duration, and initial radionuclide concentration. Cross-wind dispersion is treated by a multi-step function. Dry and wet deposition are treated as independent processes. The weather variability is treated by means of a stratified sampling process.

For early exposure, the following pathways are considered: immersion or cloudshine, inhalation from the plume, groundshine, deposition on the skin, and inhalation of resuspended ground contamination. For the long-term exposure, MACCS considers following four pathways: groundshine, inhalation of resuspended ground contamination, ingestion of contaminated water and ingestion of contaminated food. The direct exposure pathways, groundshine, and inhalation of resuspended ground contamination, produce doses in the population living in the area surrounding the plant. The indirect exposure pathways, ingestion of contaminated water and food, produce doses in those who ingest food or water emanating from the area around the accident site. The contamination of water bodies is estimated for the washoff of land-deposited material as well as direct deposition. The food pathway model includes direct deposition onto the crop species and uptake from the soil.

Both short-term and long-term mitigative measures are modeled in MACCS. Short-term actions include evacuation, sheltering and emergency relocation out of the emergency planing zone. Long-term actions include relocation and restrictions on land use and crops. Relocation and land decontamination, interdiction, and condemnation are based on projected long-term doses from groundshine and the inhalation of resuspended radioactivity. The disposal of agricultural products and the removal of farmland from crop production are based on ground contamination criteria.

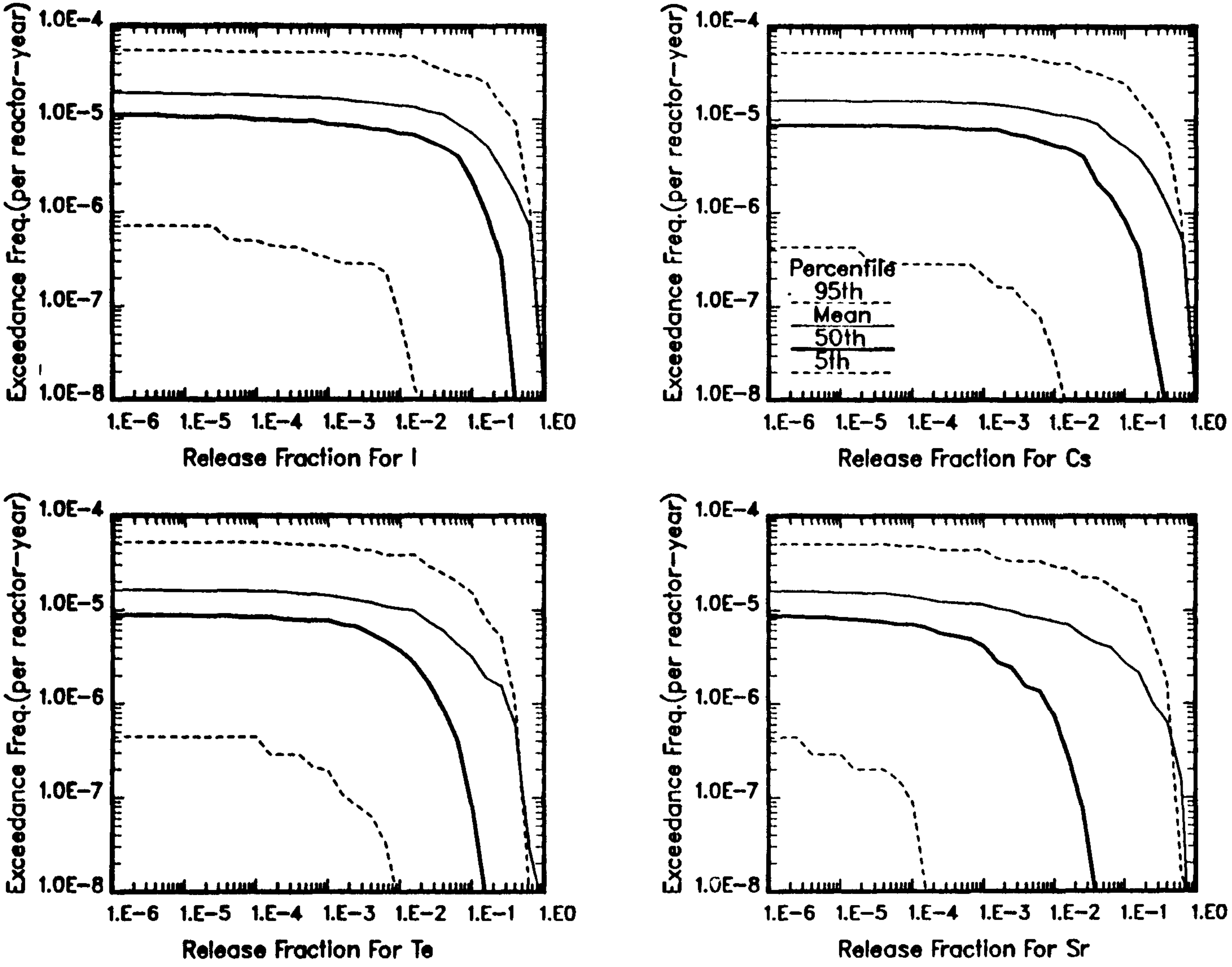

Figure S-7a
Peach Bottom: Total Fire
Source Term CCDF

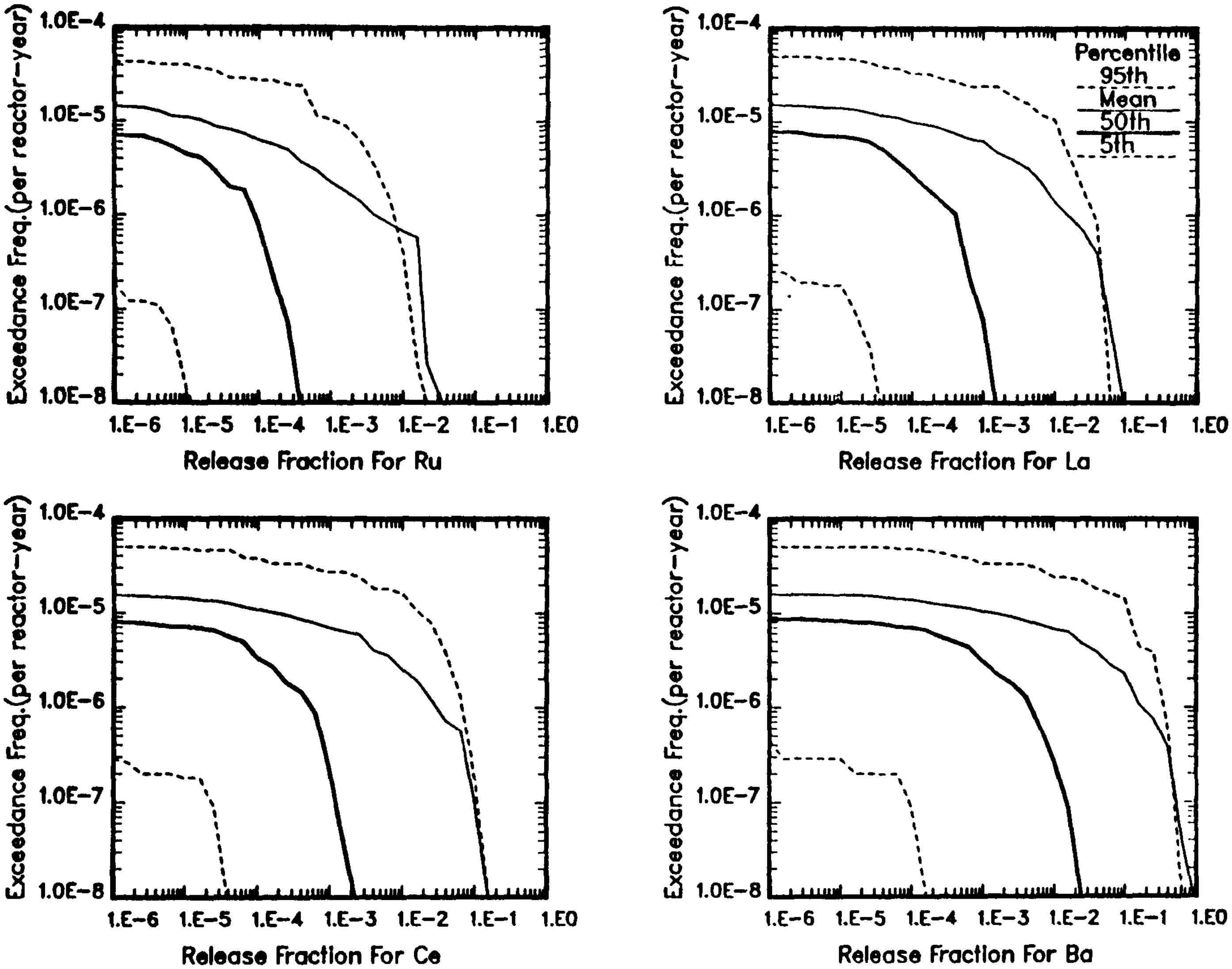

Figure S-7b
Peach Bottom: Total Fire
Source Term CCDF

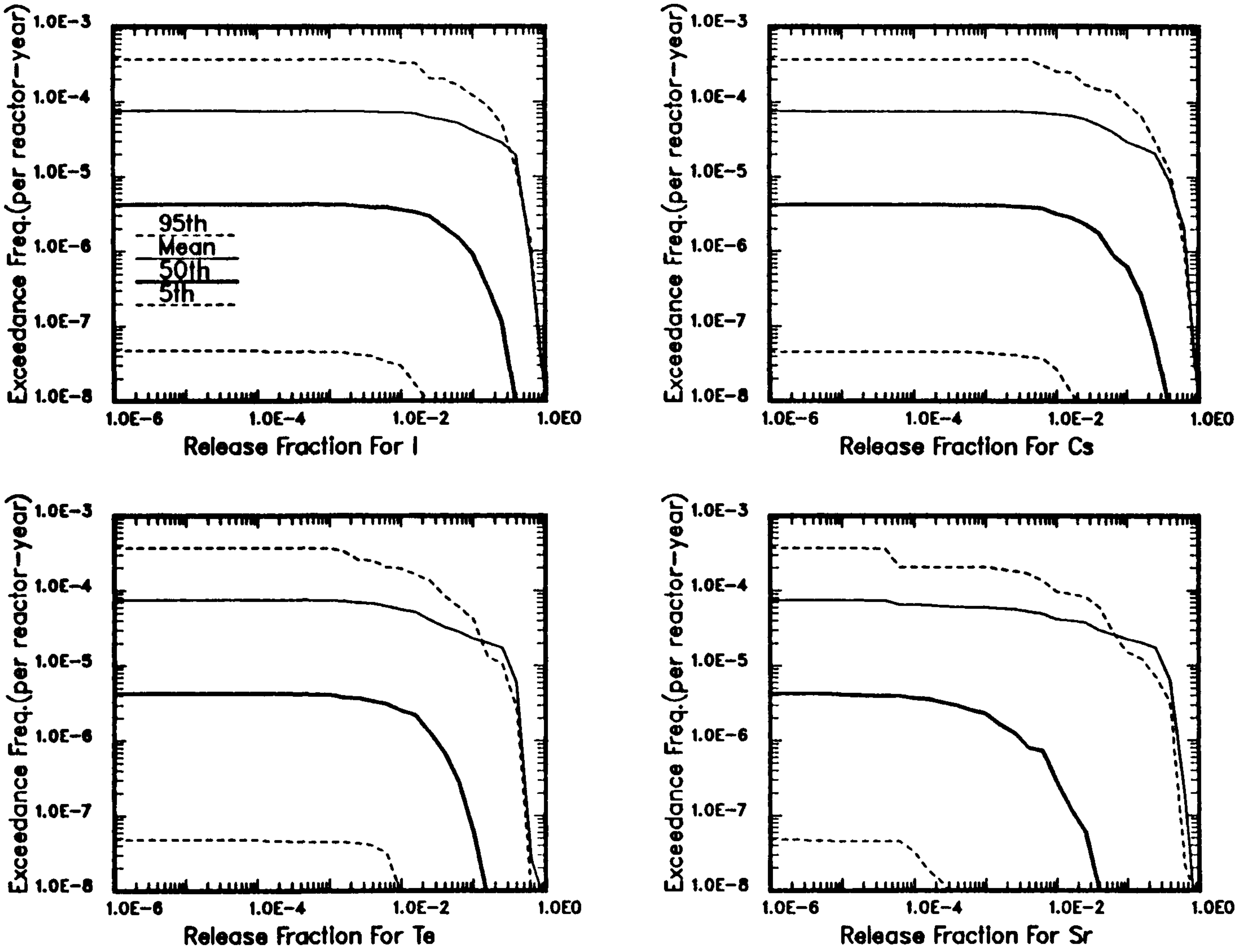

Figure S-8a
Peach Bottom: Total LLNL Seismic
Source Term CCDF

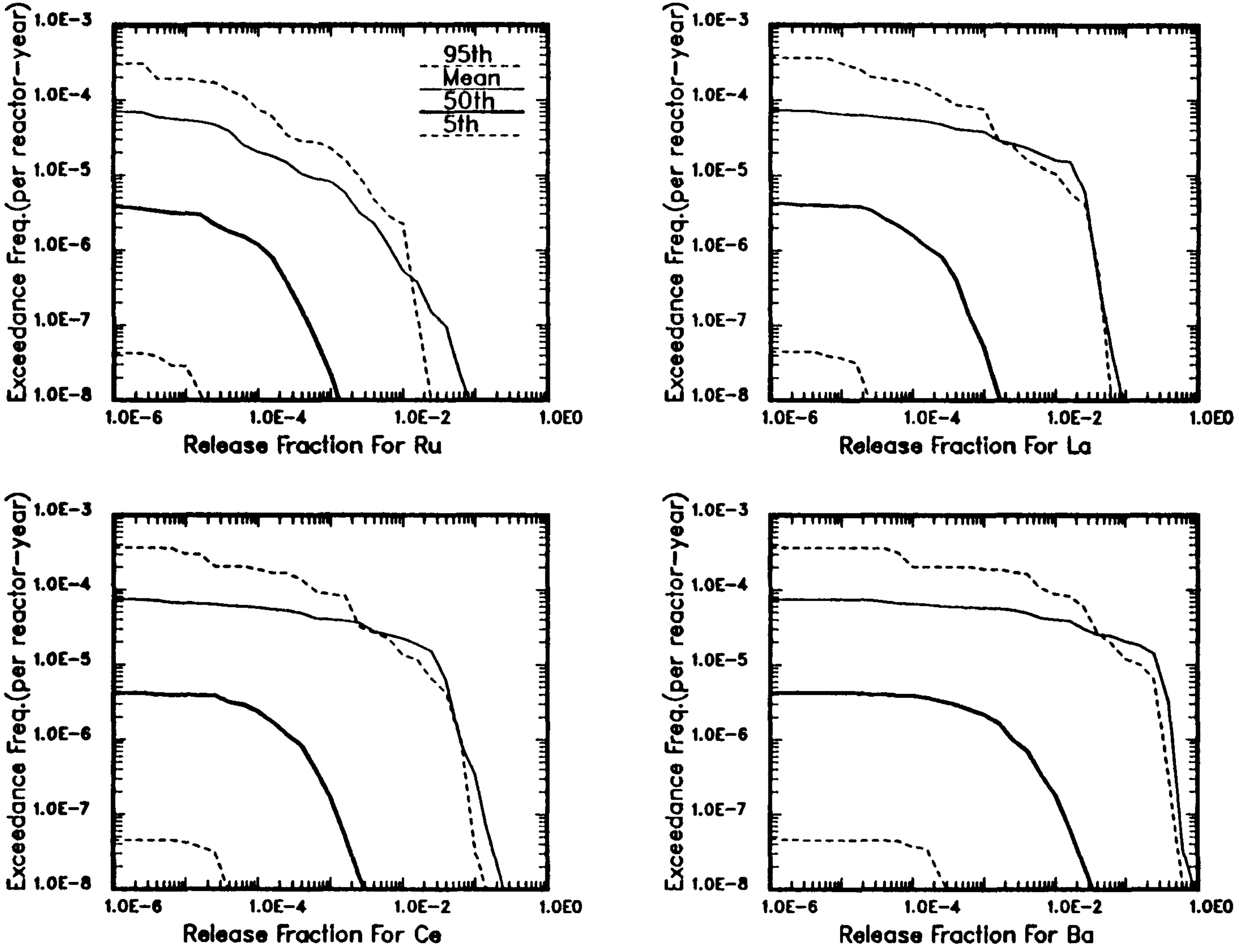

Figure S-8b
Peach Bottom: Total LLNL Seismic
Source Term CCDF

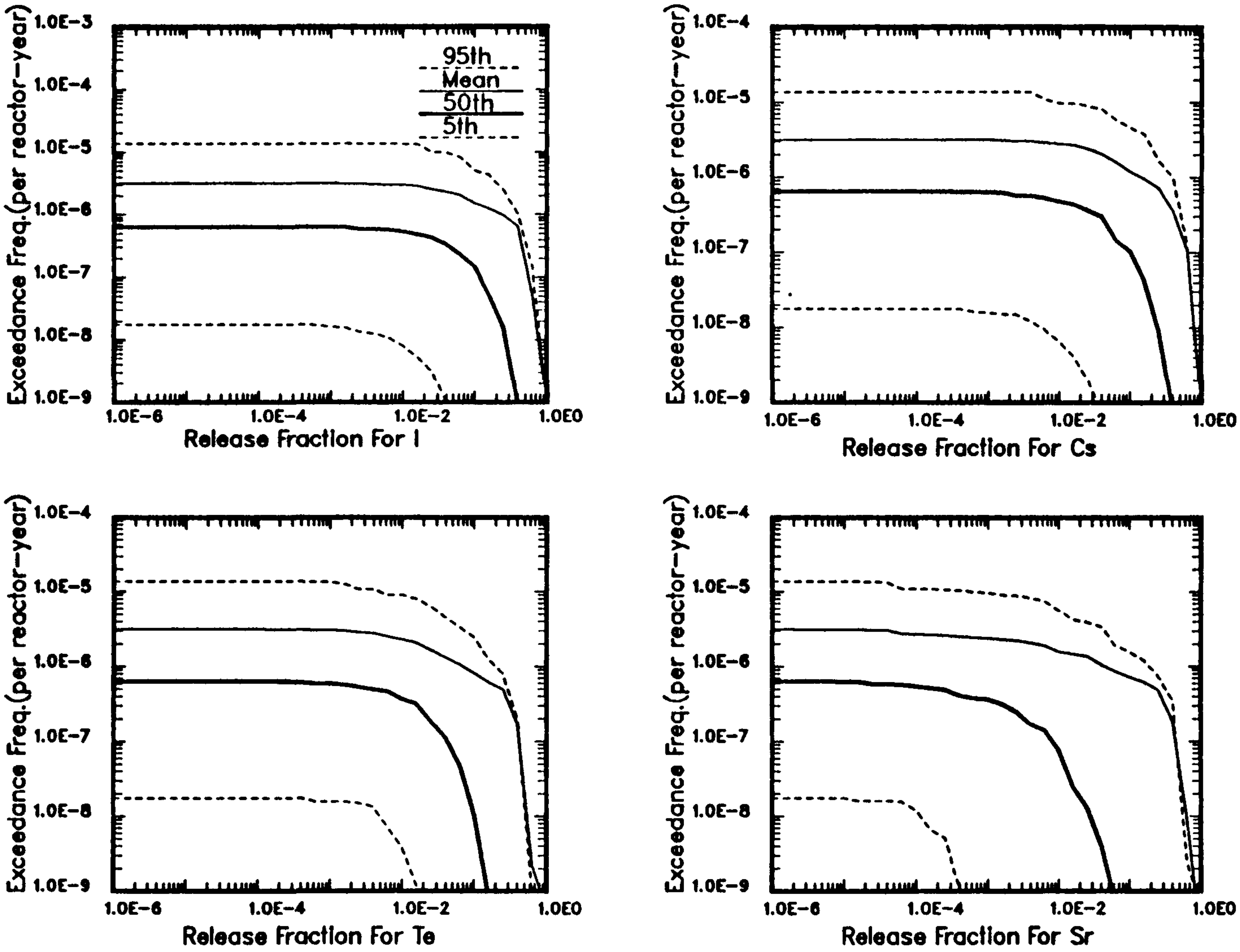

Figure S-9a
Peach Bottom: Total EPRI Seismic
Source Term CCDF

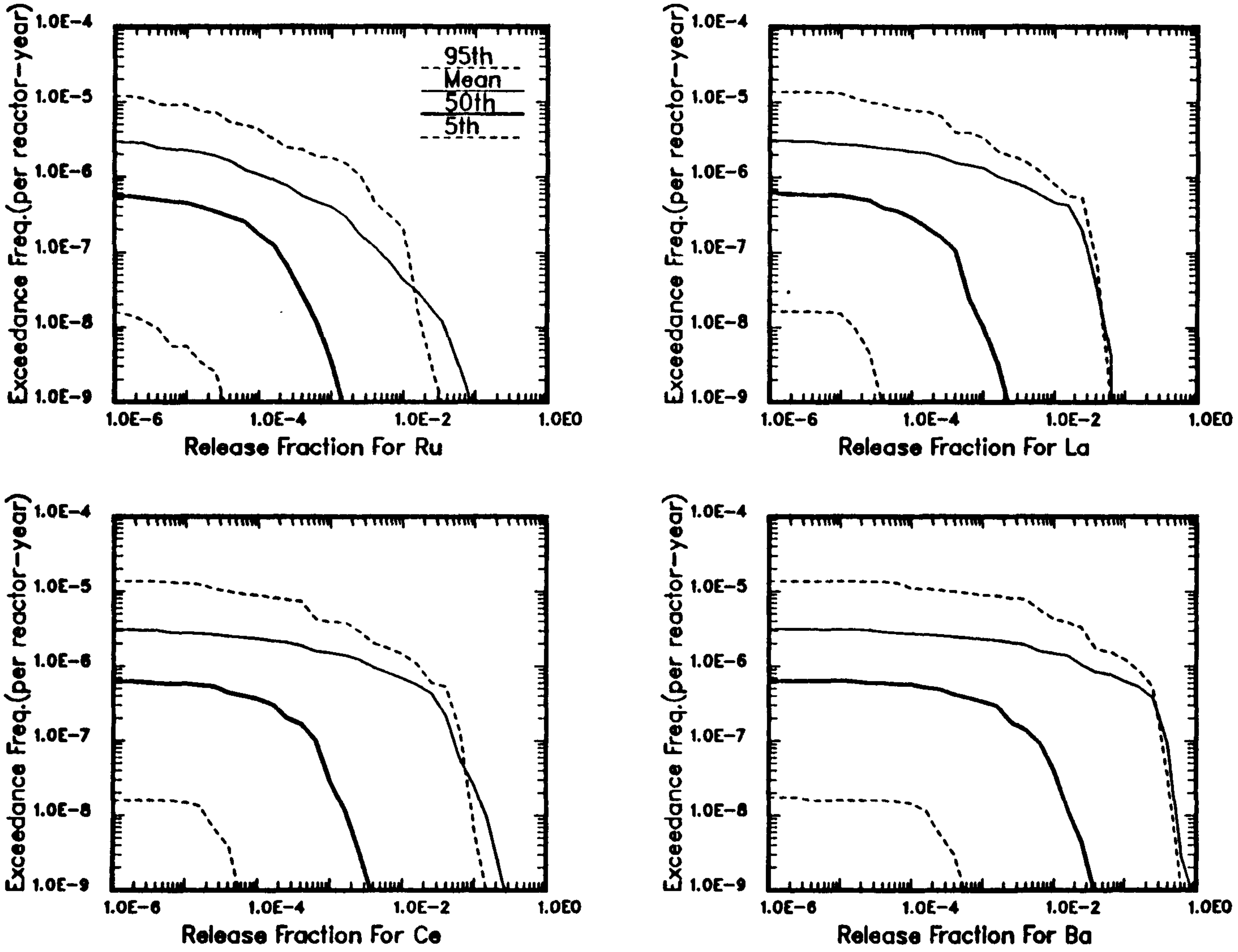

Figure S-9b
Peach Bottom: Total EPRI Seismic
Source Term CCDF

The health effects models link the dose received by an organ to morbidity or mortality. The models used in MACCS calculate both short-term and long-term effects to a number of organs.

Although the variables thought to be the largest contributors to the uncertainty in risk are sampled from distributions in the accident frequency, accident progression, and source term analyses, there is no analogous treatment of uncertainties in the consequence analysis. Variability in the weather is fully accounted for, but the uncertainty in other parameters such as the dry deposition velocity or the evacuation rate is not considered.

The MACCS consequence model calculates a large number of different consequence measures. Results for the following six consequence measures are given in this report: early fatalities, total latent cancer fatalities, population dose within 50 miles, population dose for the entire region, early fatality risk within 1 mile, and latent cancer fatality risk within 10 miles. For NUREG-1150, 99.5% of the population evacuates and 0.5% of the population continues normal activity. For internal initiators at Peach Bottom, the evacuation delay time between warning and the beginning of evacuation is 1.5 hours.

S.7.2 Results of the Consequence Analysis

The results presented in this section are conditional on the occurrence of a source term group. That is, given that a release takes place, with release fractions and other characteristics as defined by one of the source term groups, then the tables and figures in this section give the consequences expected. This section contains no indication at all about the frequency with which these consequences may be expected. Implicit in the results given in this section are that 0.5% of the population does not evacuate and that there is a 1.5 hour delay between the warning to evacuate and the actual start of the evacuation.

CCDFs display the results of the consequence calculation in a compact and complete form. The CCDFs in Figures S-10, S-11, S-12, S-13, S-14, and S-15 for early fatalities and latent cancer fatalities display the relationship between consequence size and consequence frequency due to variability in the weather for each source term group which has a non-zero frequency. These figures give the results for the Internal, Fire, LLNL High PGA, LLNL Low PGA, EPRI High PGA, and EPRI Low PGA cases, respectively. Conditional on the occurrence of a release, each of these CCDFs gives the probability that individual consequence values will be exceeded due to the uncertainty in the weather conditions that will exist at the time of an accident. The figures show that there is considerable variability in the consequences that is solely due to the weather. There is, of course, considerable variability among the consequences that is due to the size and timing of the release as well.

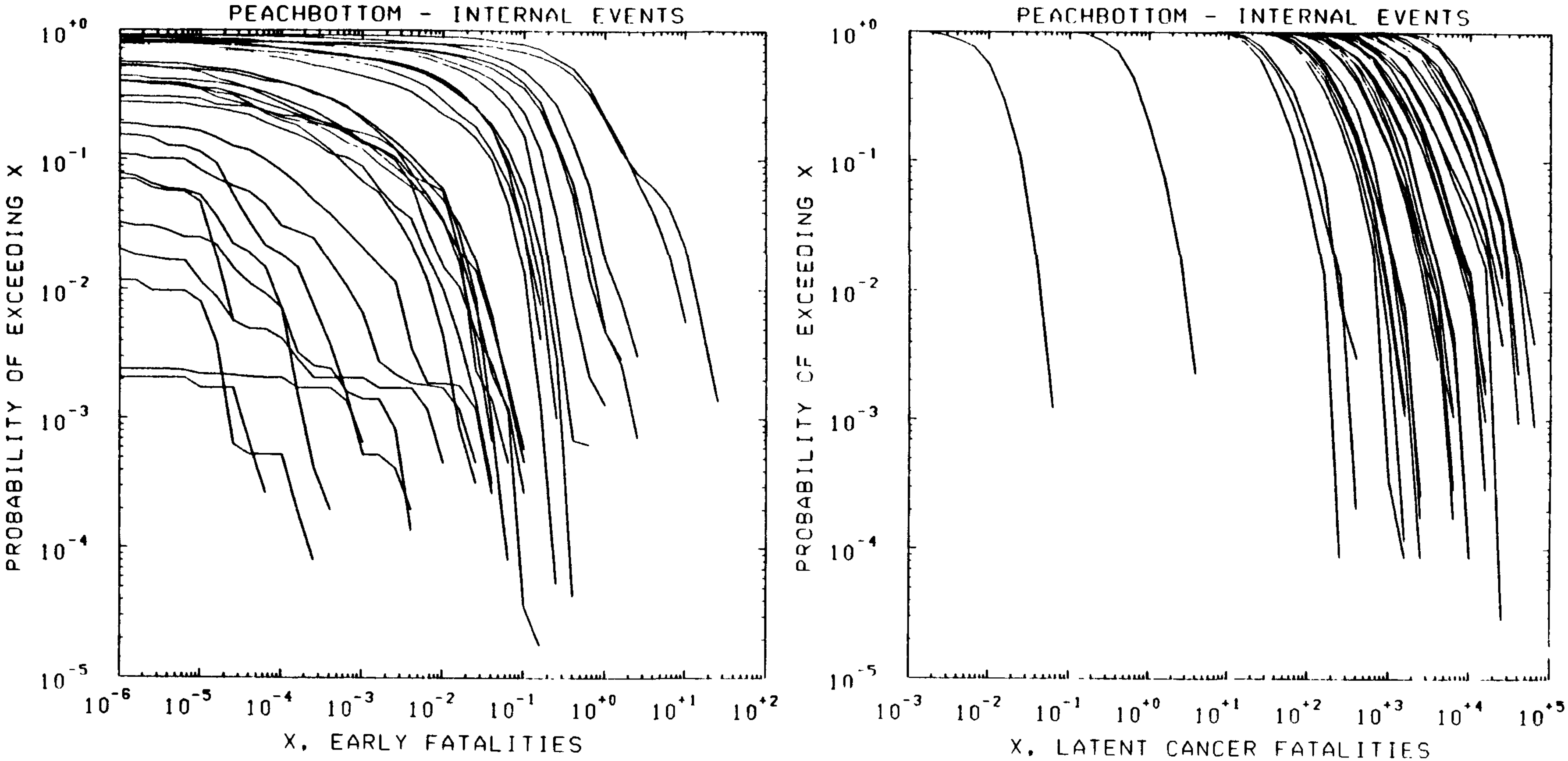

Figure S-10
Consequence CCDFs for Internal Source Term Groups

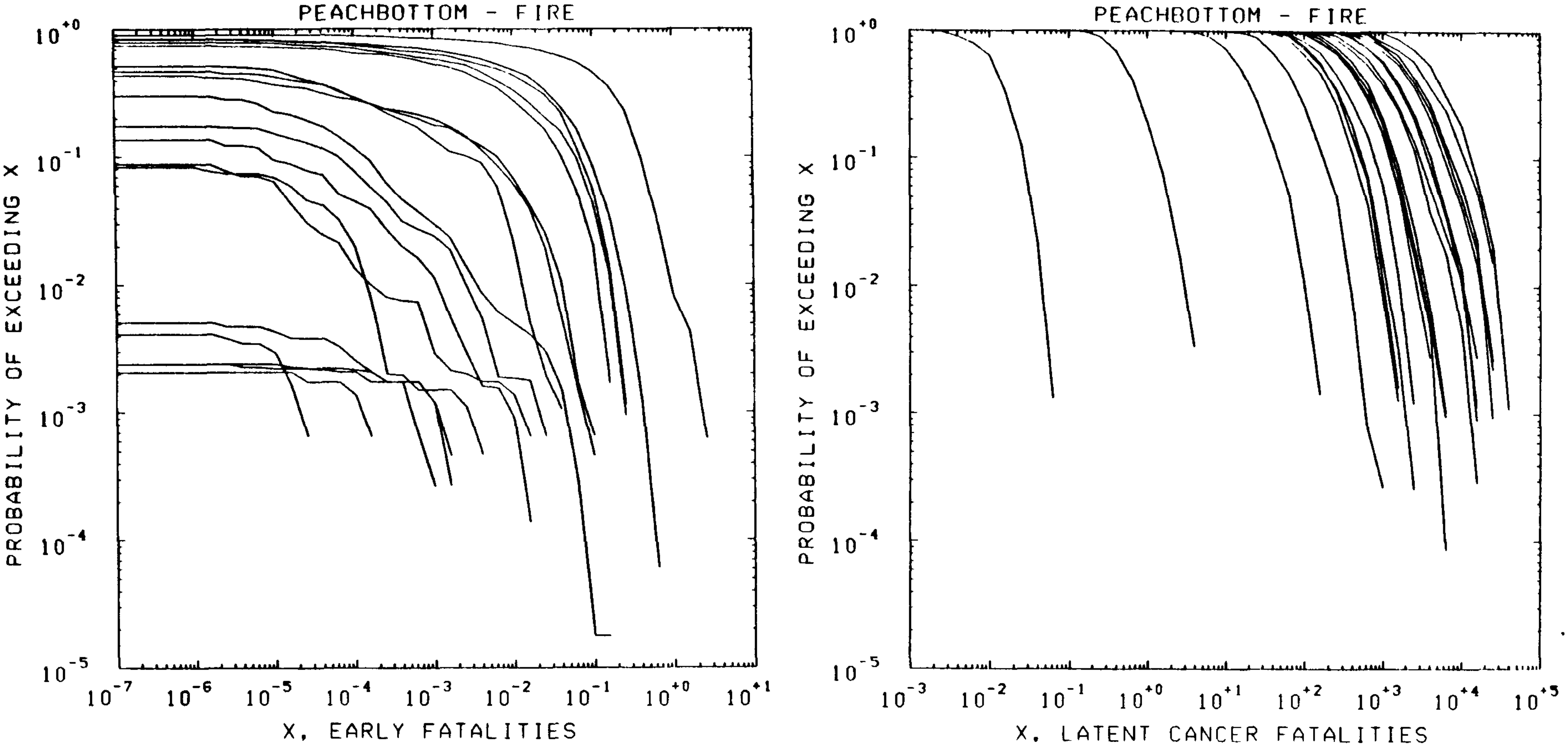

Figure S-11
Consequence CCDFs for Fire Source Term Groups

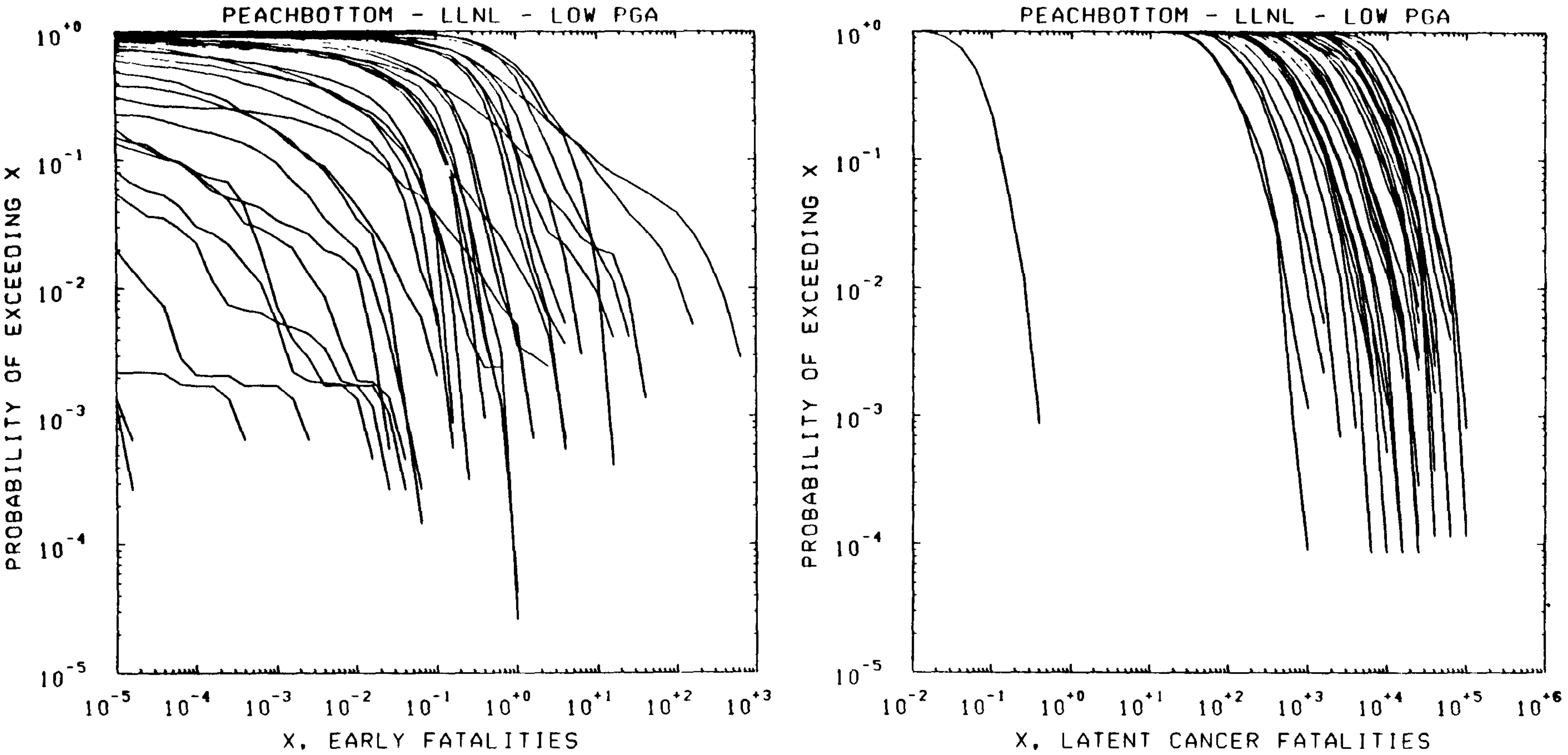

Figure S-12
Consequence CCDFs for LLNL Low PGA Source Term Groups

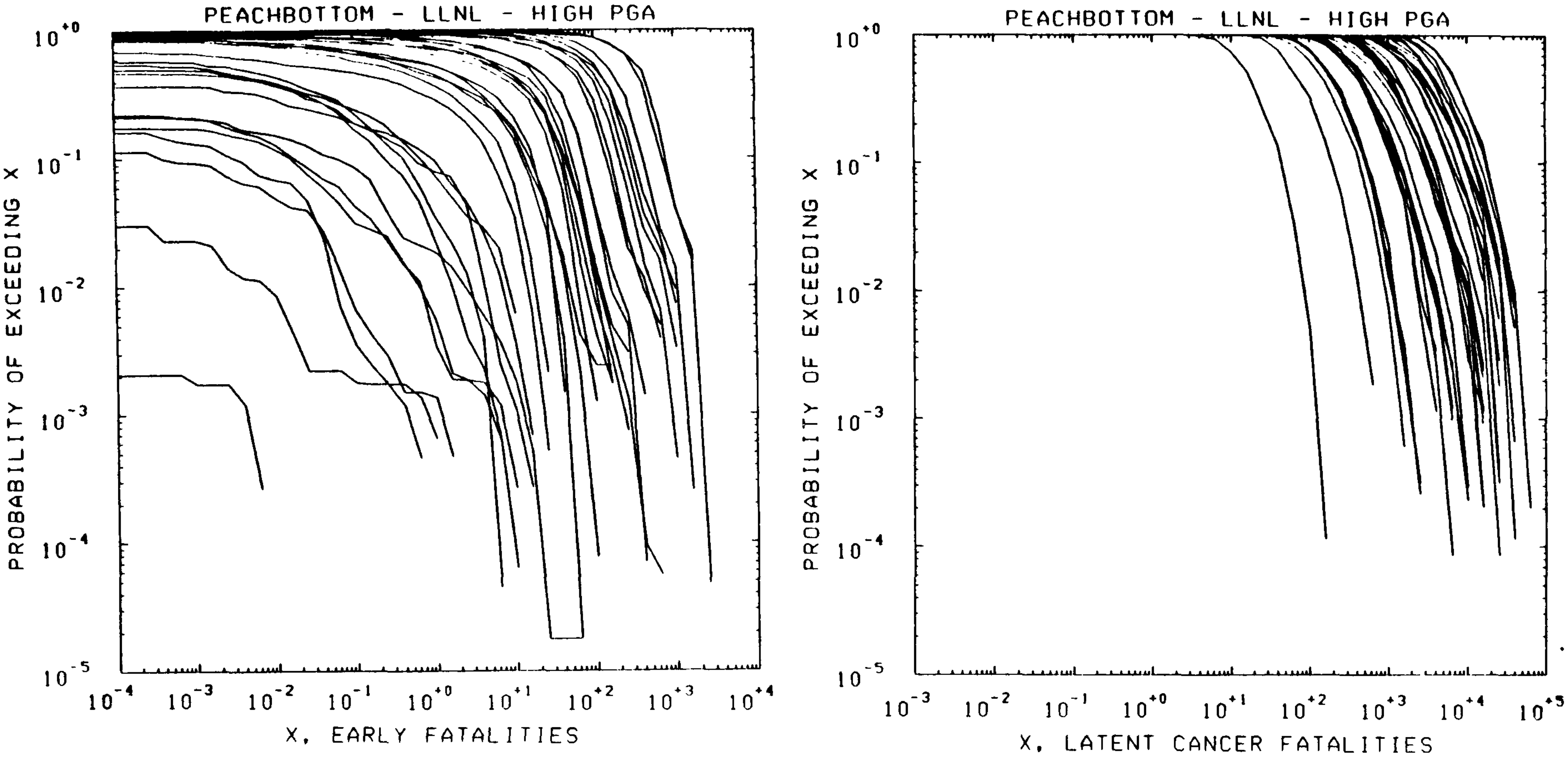

Figure S-13
Consequence CCDFs for LLNL High PGA Source Term Groups

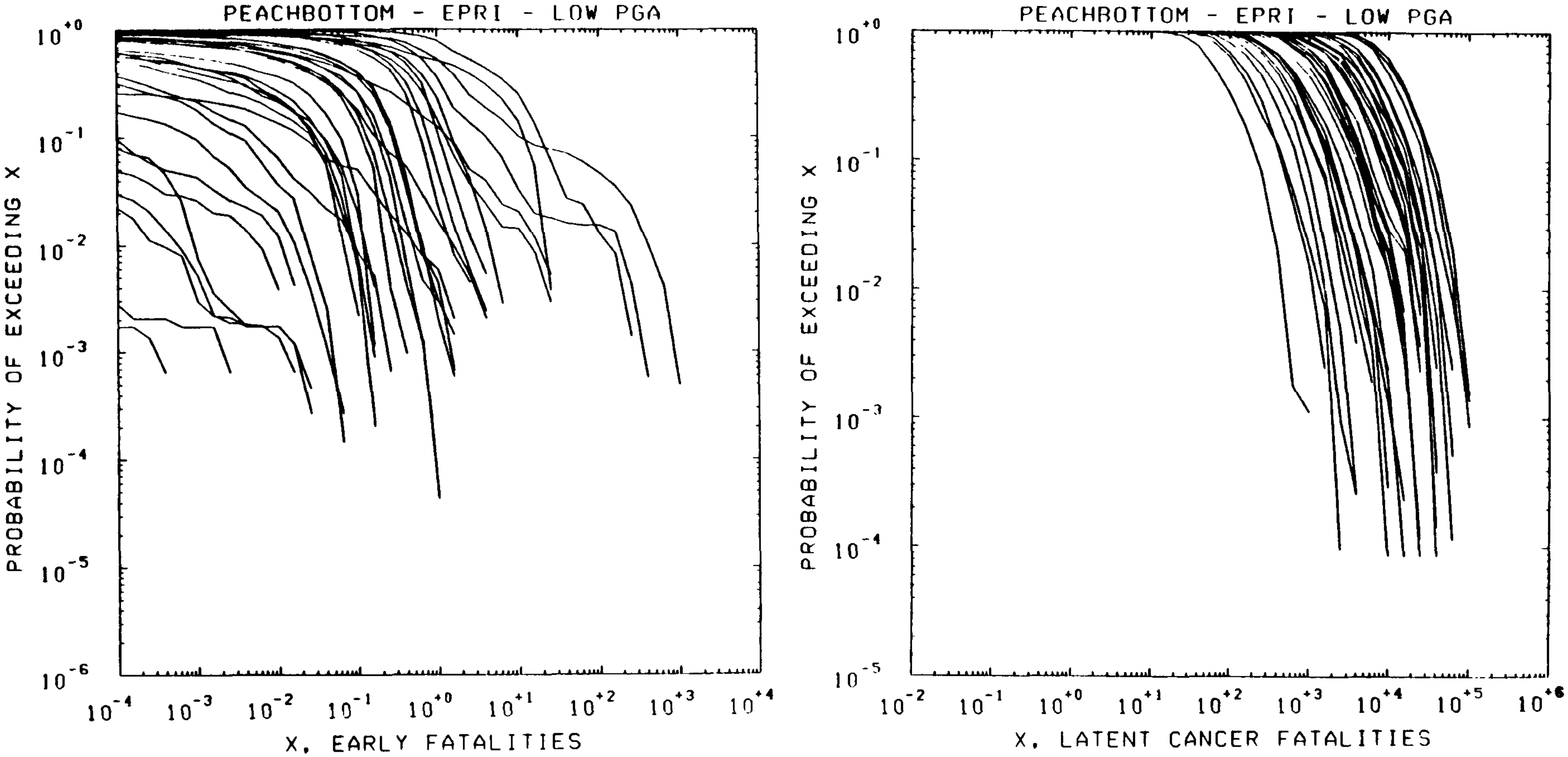

Figure S-14
Consequence CCDFs for EPRI Low PGA Source Term Groups

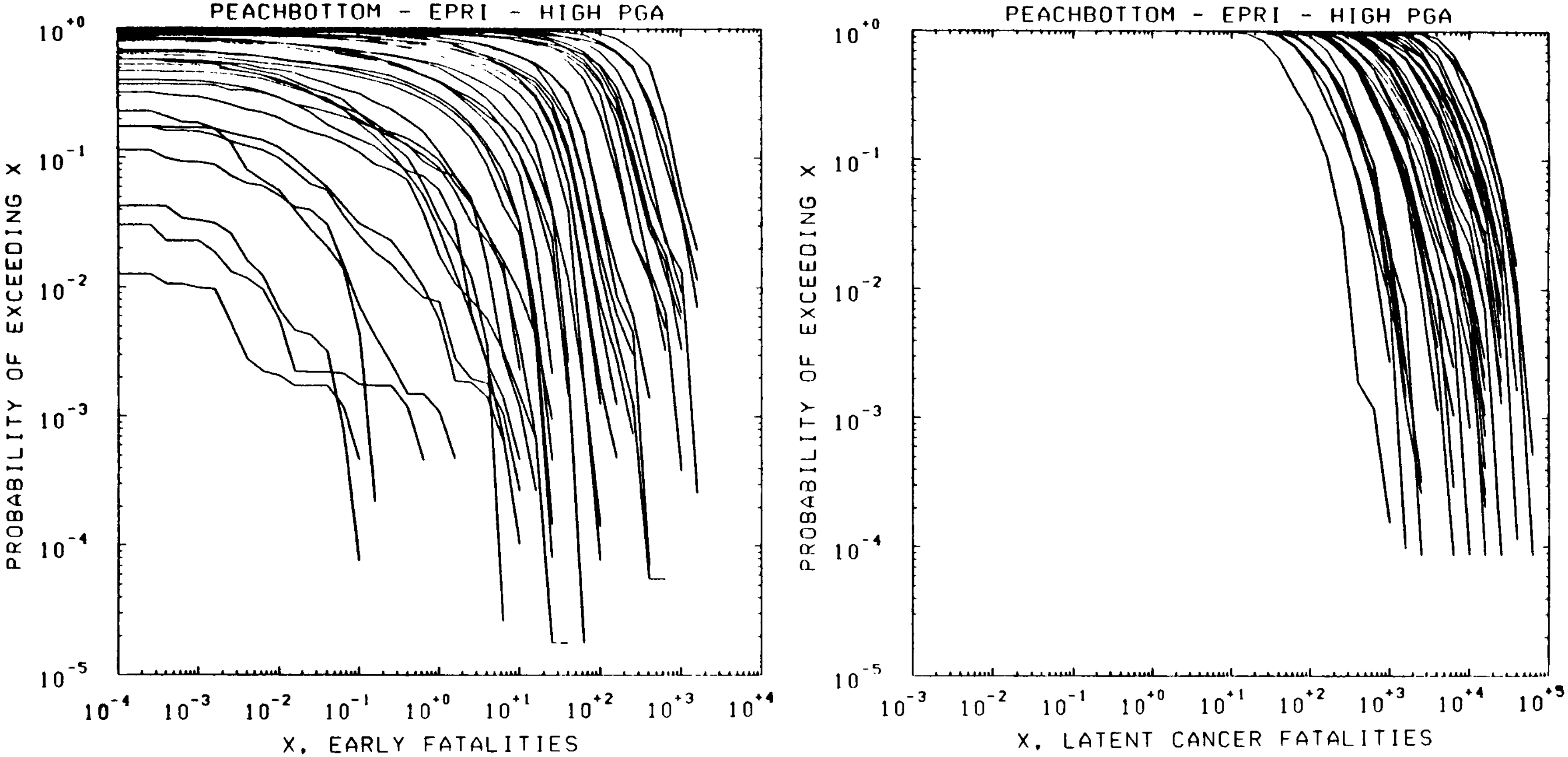

Figure S-15
Consequence CCDFs for EPRI High PGA Source Term Groups

S.8 Integrated Risk Analysis

S.8.1 Determination of Risk

Risk is determined by bringing together the results of the four constituent analyses: the accident frequency analysis, the accident progression analysis, the source term analysis, and the consequence analysis. This process is described in general terms in Section S.2 of this summary, and in mathematical terms in Section 1.4 of this volume. Specifically, the accident frequency analysis produces a frequency for each PDS for each observation, and the accident progression analysis results in a probability for each APB, conditional on the occurrence of the PDS group. The absolute frequency for each bin for each observation is obtained by summing the product of the PDS frequency for that observation and the conditional probability for the APB for that observation over all the PDSs.

For each APB for each observation, a source term is calculated; this source term is then assigned to a source term group in the partitioning process. The consequences are then computed for each source term group. The overall result of the source term calculation, the partitioning, and the consequence calculation is that a set of consequence values is identified with each APB for each observation. As the absolute frequency of each APB is known from the accident frequency and accident progression results, both frequency and consequences are known for each APB. The risk analysis assembles and analyzes all these separate estimates of offsite risk.

S.8.2 Results of the Risk Analysis

Measures of Risk. Figures S-16, S-17, S-18, and S-19 show the basic results of the integrated risk analysis for the internal, fire, LLNL seismic, and EPRI seismic initiators at Peach Bottom. These figures show four statistical measures of the families of complementary cumulative distribution functions (CCDFs) for early fatalities, latent cancer fatalities, individual risk of early fatality within one mile of the site boundary, and individual risk of latent cancer fatality within ten miles of the plant. The CCDFs display the relationship between the frequency of the consequence and the magnitude of the consequence. As there are 200 observations in the sample for Peach Bottom, the actual risk results at the most basic level are 200 CCDFs for each consequence measure. These figures display the 5th percentile, median, mean, and 95th percentile for these 200 curves, and shows the relationship between the magnitude of the consequence and the frequency at which the consequence is exceeded, as well as the variation in that relationship.

The 5th and 95th percentile curves provide an indication of the spread between observations, which is often large. This spread is due to uncertainty in the sampled variables, and not to differences in the weather at the time of the accident. As the magnitude of the consequence measure increases, the mean curve typically approaches or exceeds the 95th percentile curve. This results when the mean is dominated by a few observations,

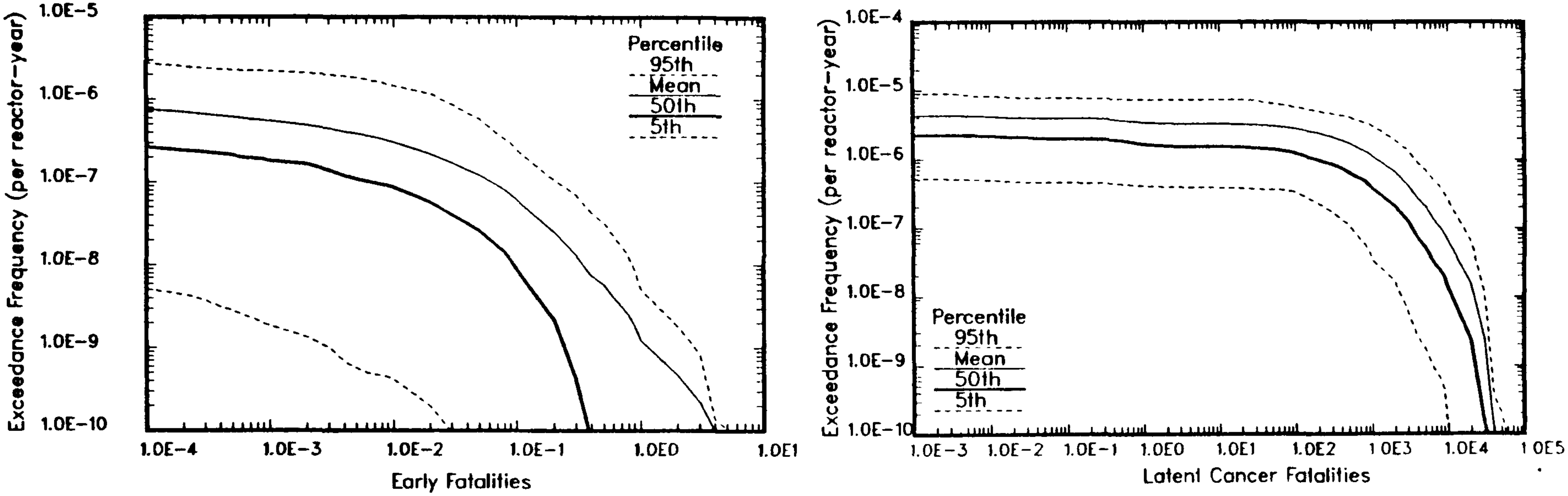

Figure S-16a
Peach Bottom: Internal Events
Early Fatalities and Latent Cancer Risk

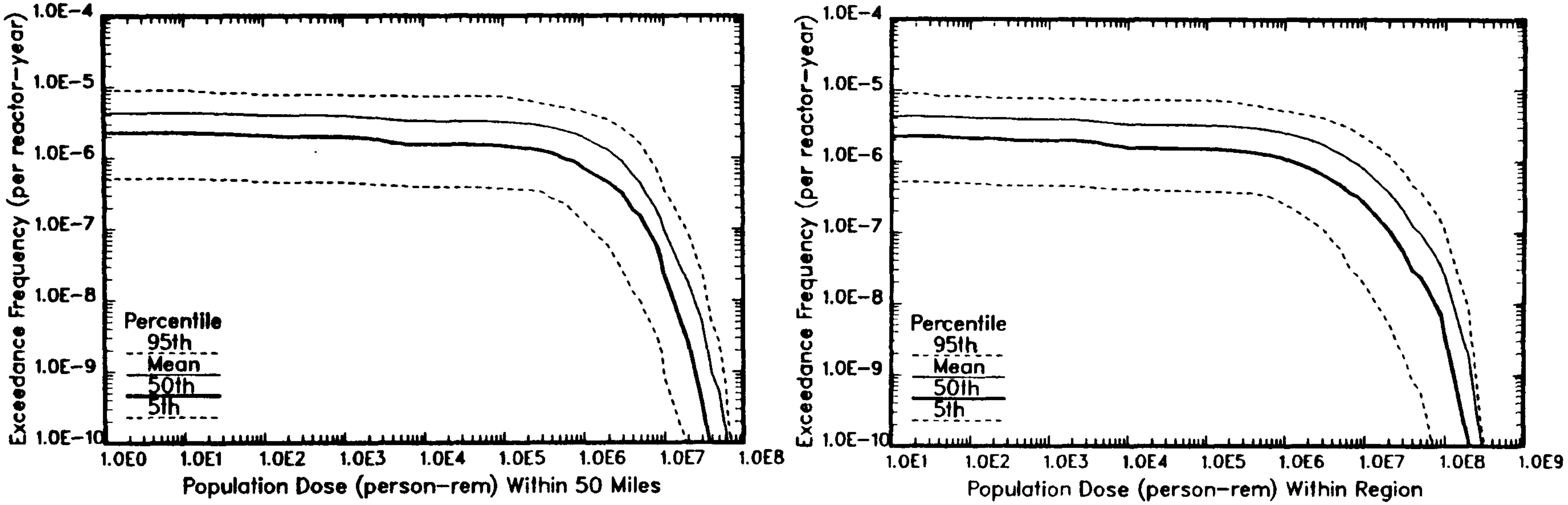

Figure S-16b
Peach Bottom: Internal Events
Population Dose Within 50 Mi. and Region

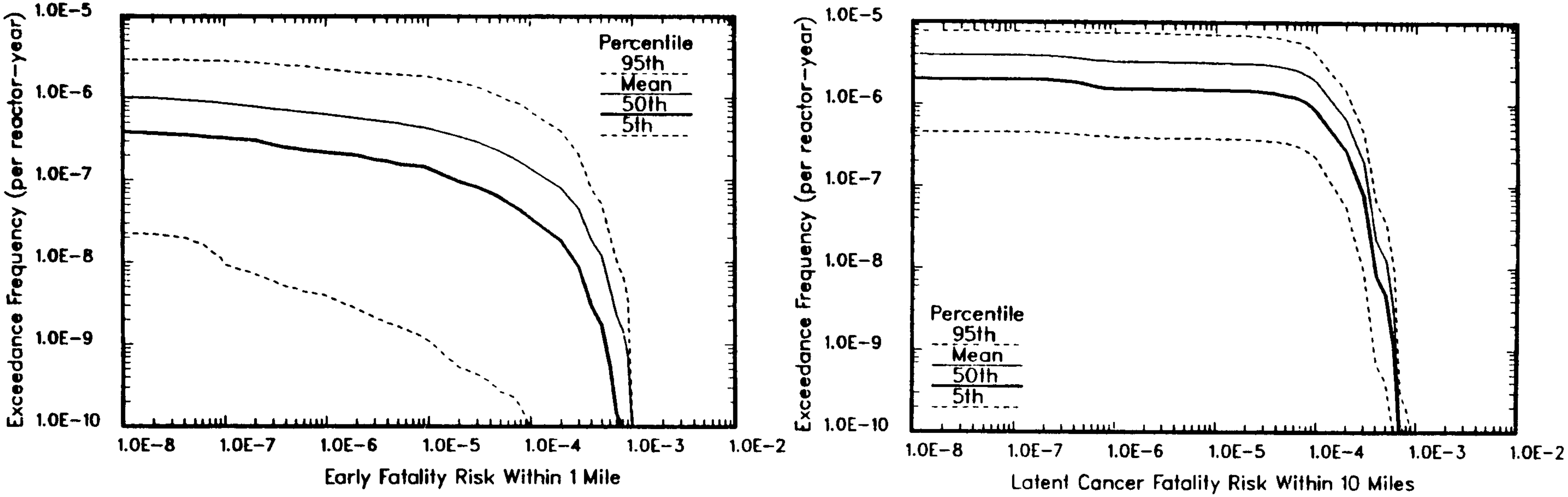

Figure S-16c
Peach Bottom: Internal Events
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

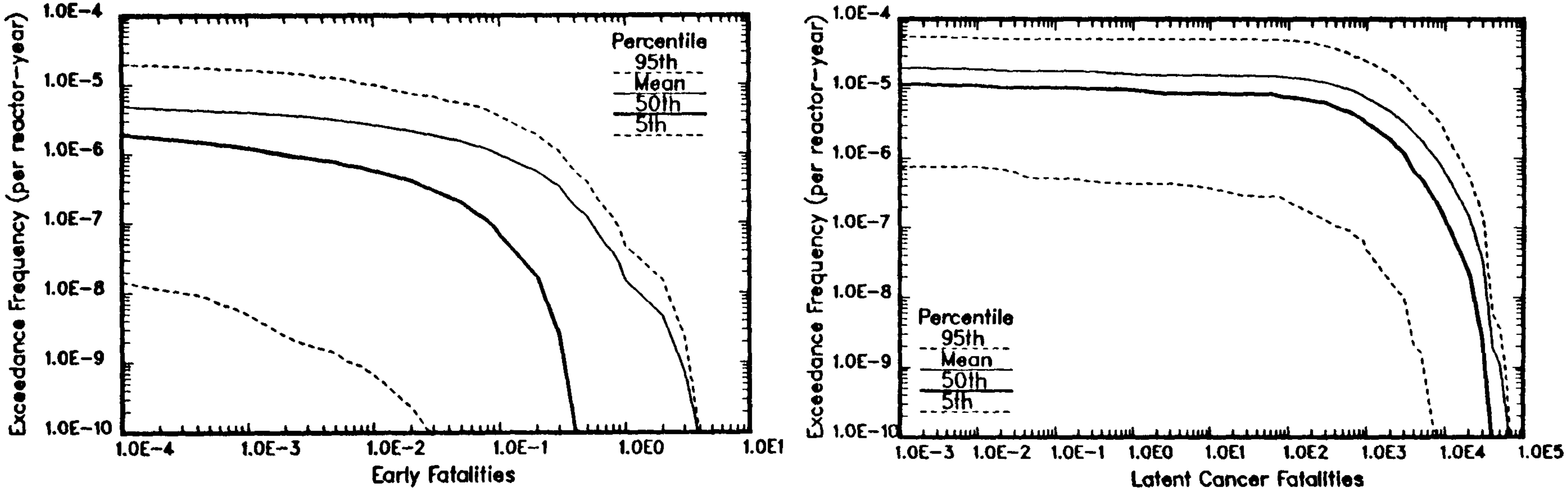

Figure S-17a
Peach Bottom: Fire
Early Fatalities and Latent Cancer Risk

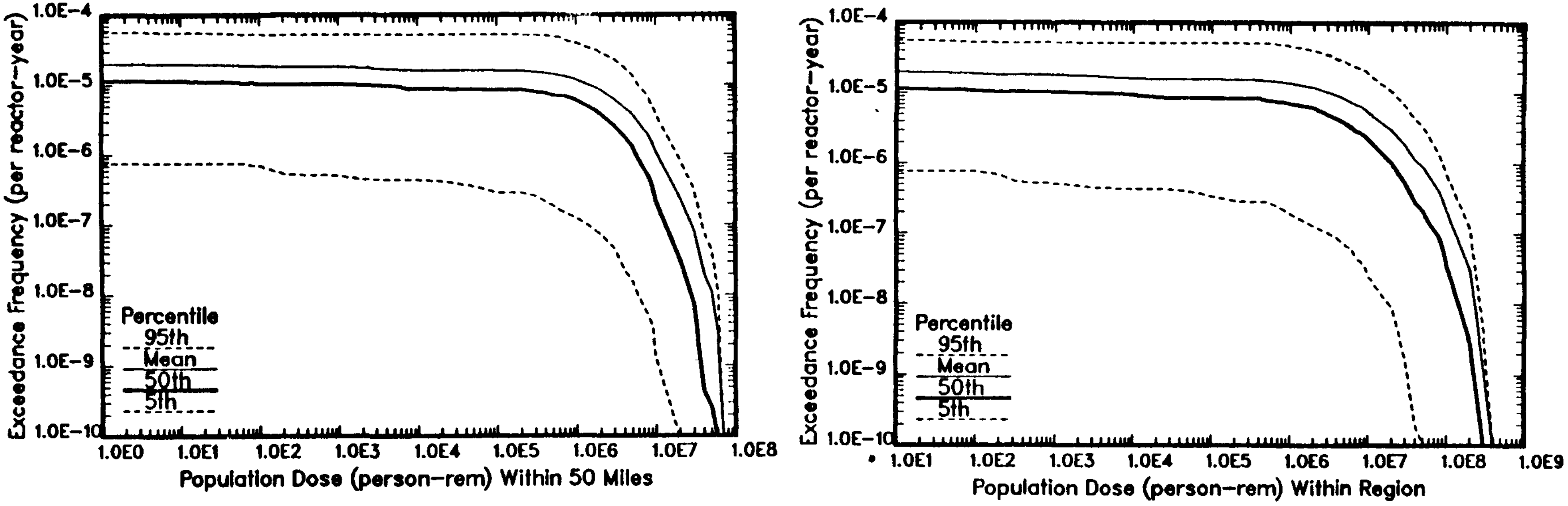

Figure S-17b
Peach Bottom: Fire
Population Dose Within 50 Mi. and Region

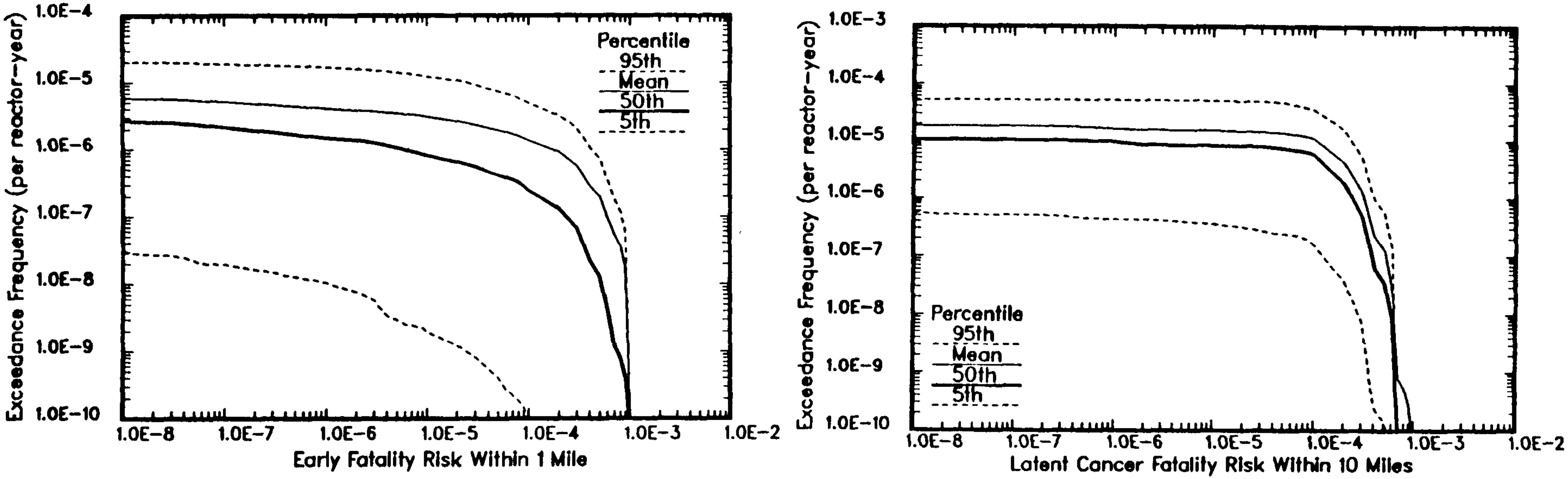

Figure S-17c
Peach Bottom: Fire
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

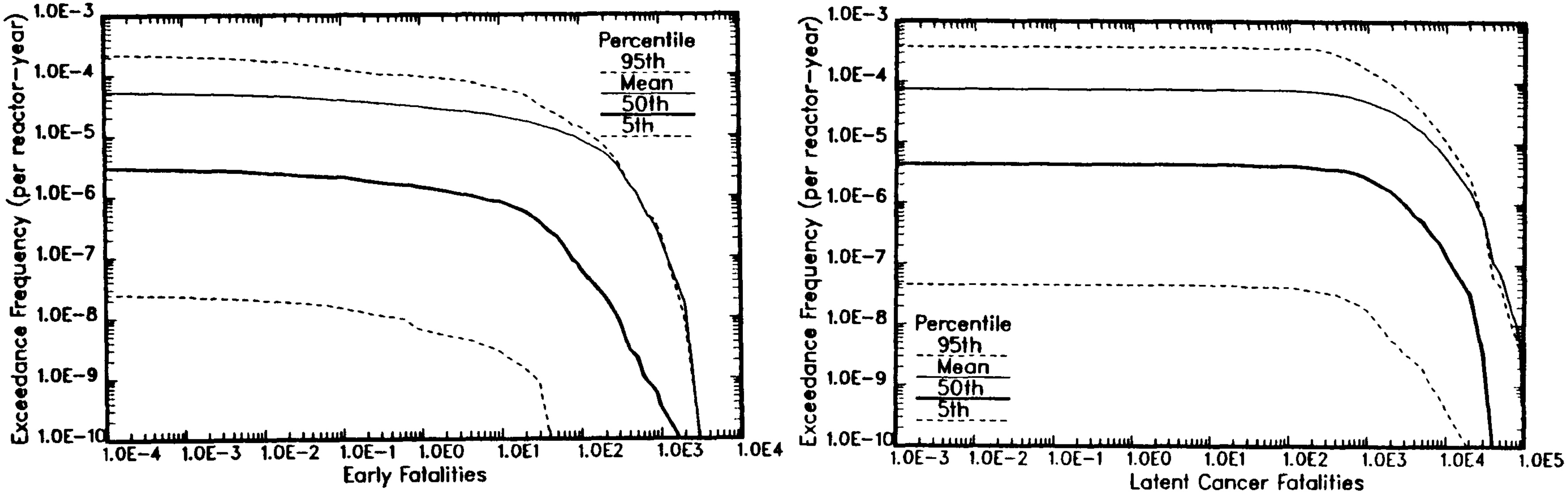

Figure S-18a
Peach Bottom: LLNL Hazard Curve
Early Fatalities and Latent Cancer Risk

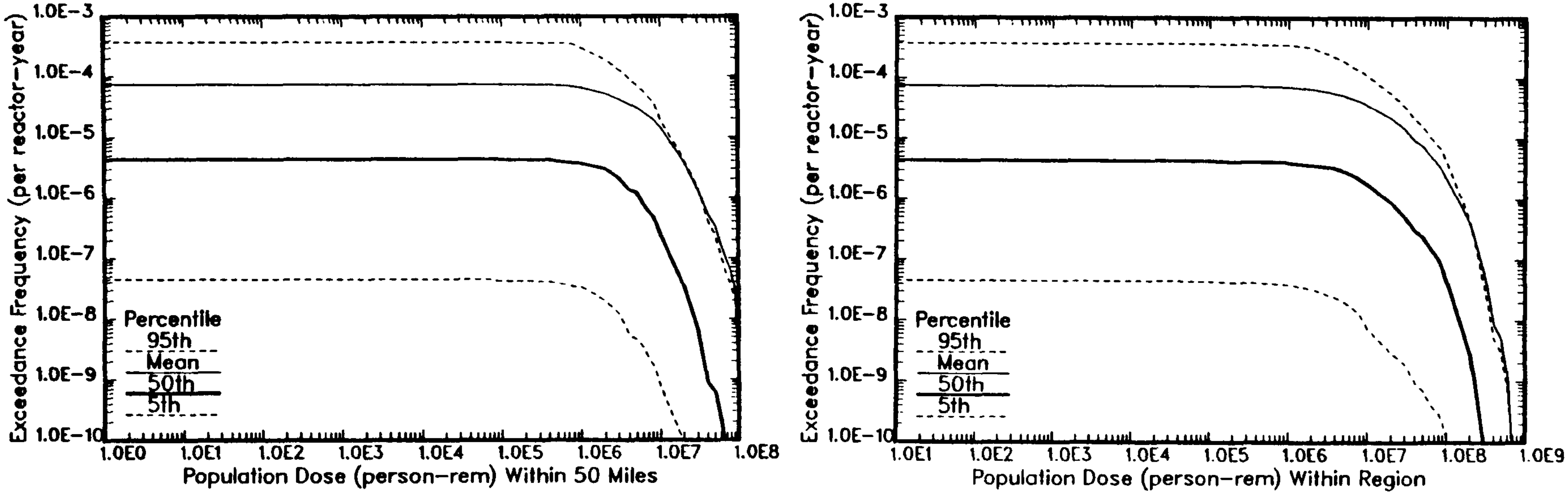

Figure S-18b
Peach Bottom: LLNL Hazard Curve
Population Dose Within 50 Mi. and Region

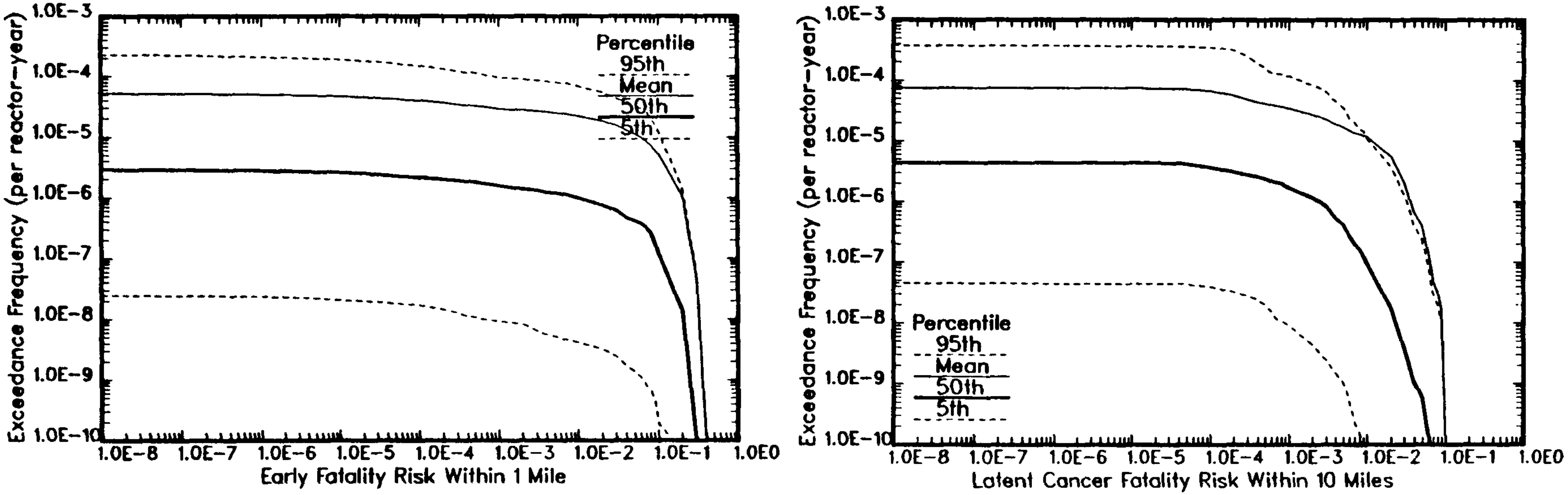

Figure S-18c
Peach Bottom: LLNL Hazard Curve
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

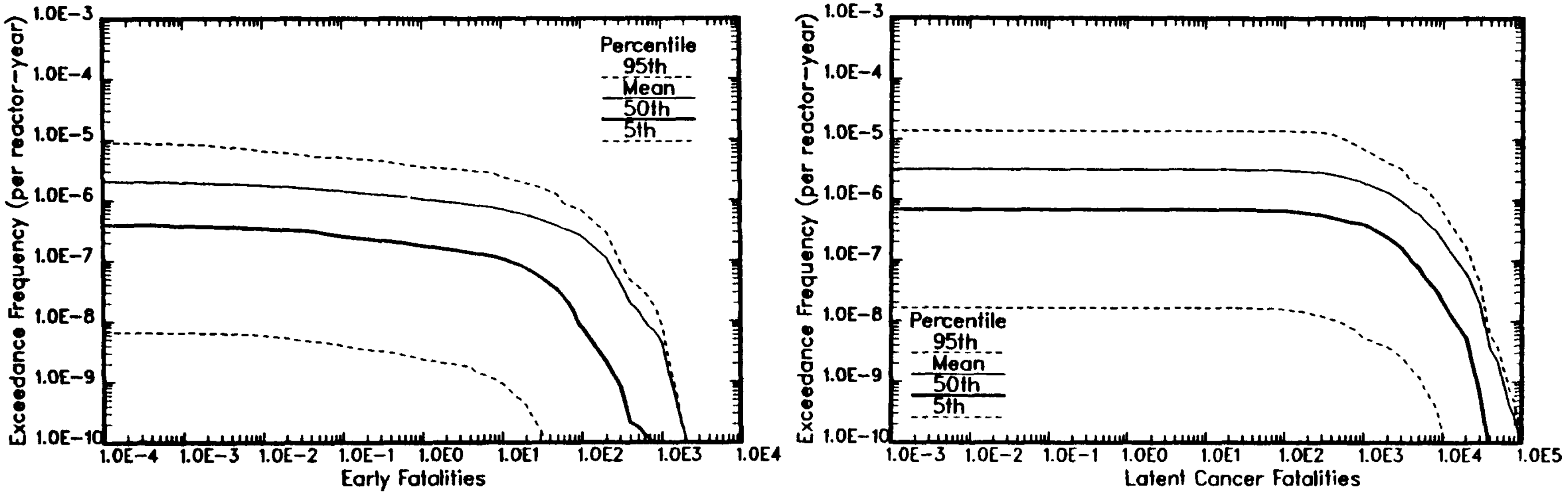

Figure S-19a
Peach Bottom: EPRI Hazard Curve
Early Fatalities and Latent Cancer Risk

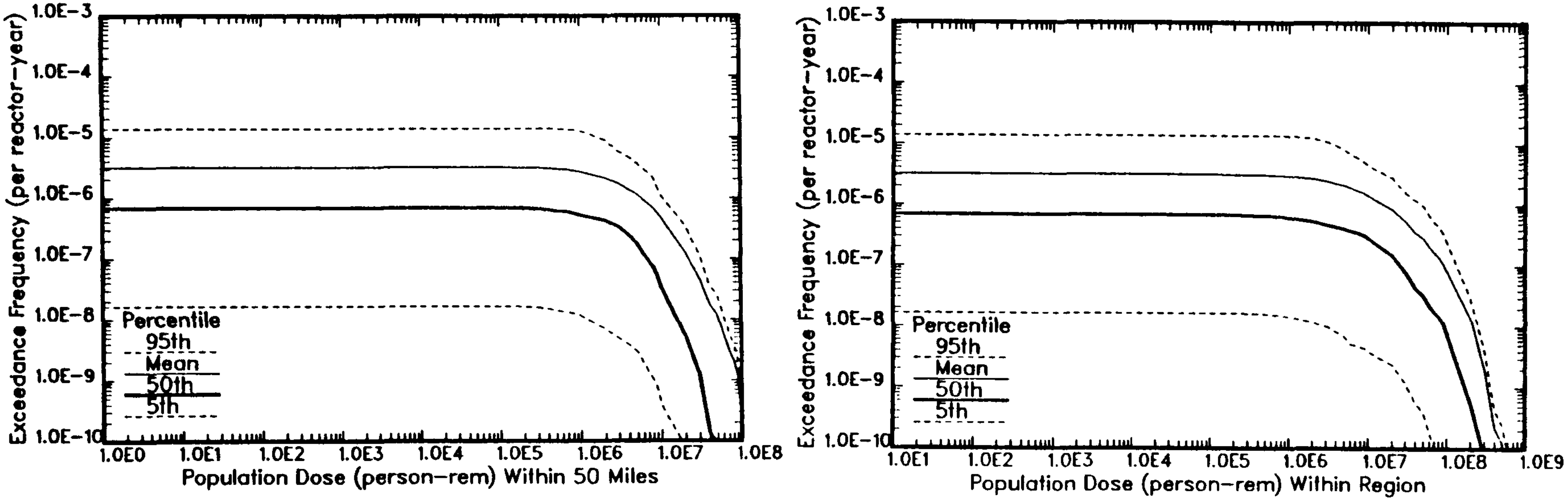

Figure S-19b
Peach Bottom: EPRI Hazard Curve
Population Dose Within 50 Mi. and Region

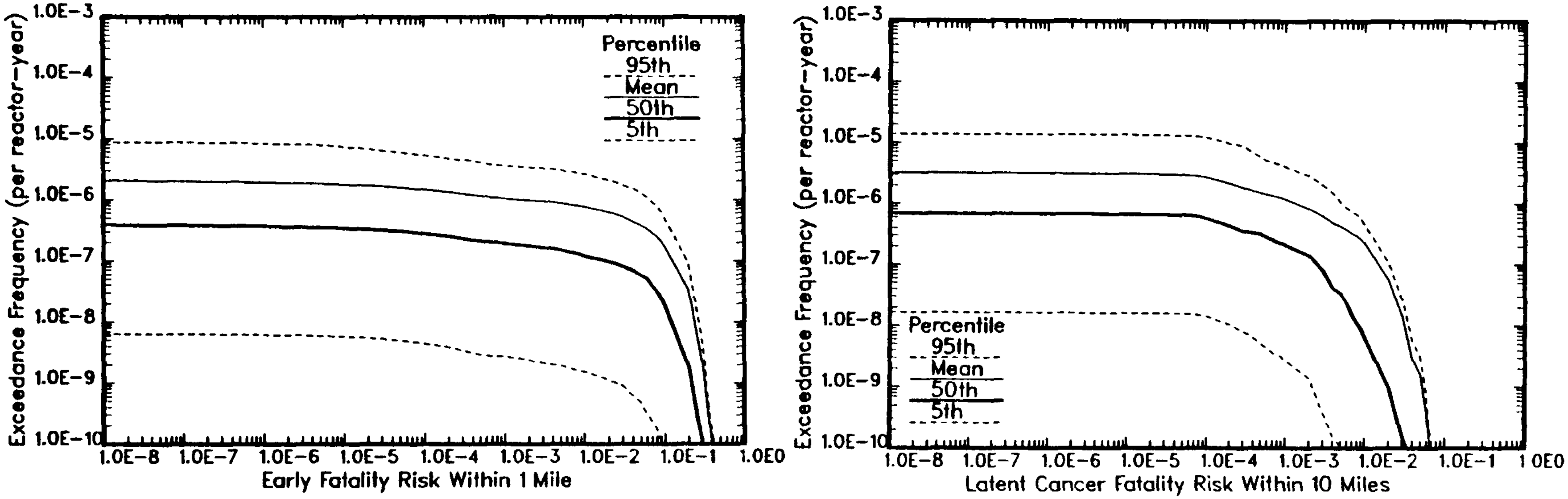

Figure S-19c
Peach Bottom: EPRI Hazard Curve
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

which often happens for large values of the consequences. Only a few observations have non-zero exceedance frequencies for these large consequences. Taken as a whole, the results of the figures indicate that large consequences are relatively unlikely to occur.

Although the CCDFs convey the most information about the offsite risk, summary measures are also useful. Such a summary value, denoted expected risk, may be determined for each observation in the sample by summing the product of the frequencies and consequences for all the points used to construct the CCDF. This has the effect of averaging over the different weather states as well as over the different types of accidents that can occur. Since the complete analysis consisted of a sample of 200 observations, there are 200 values of expected risk for each consequence measure. These 200 values may be ranked and plotted as histograms, which is done in Figures S-20, S-21, S-22, and S-23. The same four statistical measures utilized above are shown on these plots as well. Note that considerable information has been lost in going from the CCDFs in Figures S-16 to S-19 to the histograms of expected values in Figures S-20 to S-23; the relationship between the size of the consequence and its frequency has been sacrificed to obtain a single value for risk for each observation.

The plots in Figures S-20 to S-23 show the variation in the expected risk for internal, fire, LLNL seismic, and EPRI seismic initiators for four consequence measures. Where the mean is close to the 95th percentile, a relatively small number of observations dominate the mean value. This is more likely to occur for the early fatality consequence measures than for the latent cancer fatality or population dose consequence measures due to the threshold effect for early fatalities.

The safety goals are written in terms of individual fatality risks. The plots in Figure S-20 to S-23 for individual early fatality risk and individual latent cancer fatality risk show that for internal and fire initiators the entire risk distribution for Peach Bottom falls below the safety goals. For seismic initiators, the risk distribution falls well above the individual early fatality risk goal for the LLNL hazard curve and the top of the distribution extends above the safety goals for the the LLNL latent cancer risk and the EPRI early fatality risk. For the EPRI latent cancer risk the distribution is below the safety goal.

A single measure of risk for the entire sample may be obtained by taking the mean value of the distribution for expected risk. This measure of risk is commonly called mean risk, although it is actually the average of the expected risk, or the mean value of the mean risk. Mean risk values for internal initiators for four consequence measures are given in Figure S-20 to S-23.

S.8.3 Important Contributors to Risk

There are two ways to calculate the contribution to mean risk. The fractional contribution to mean risk (FCMR) is found by dividing the

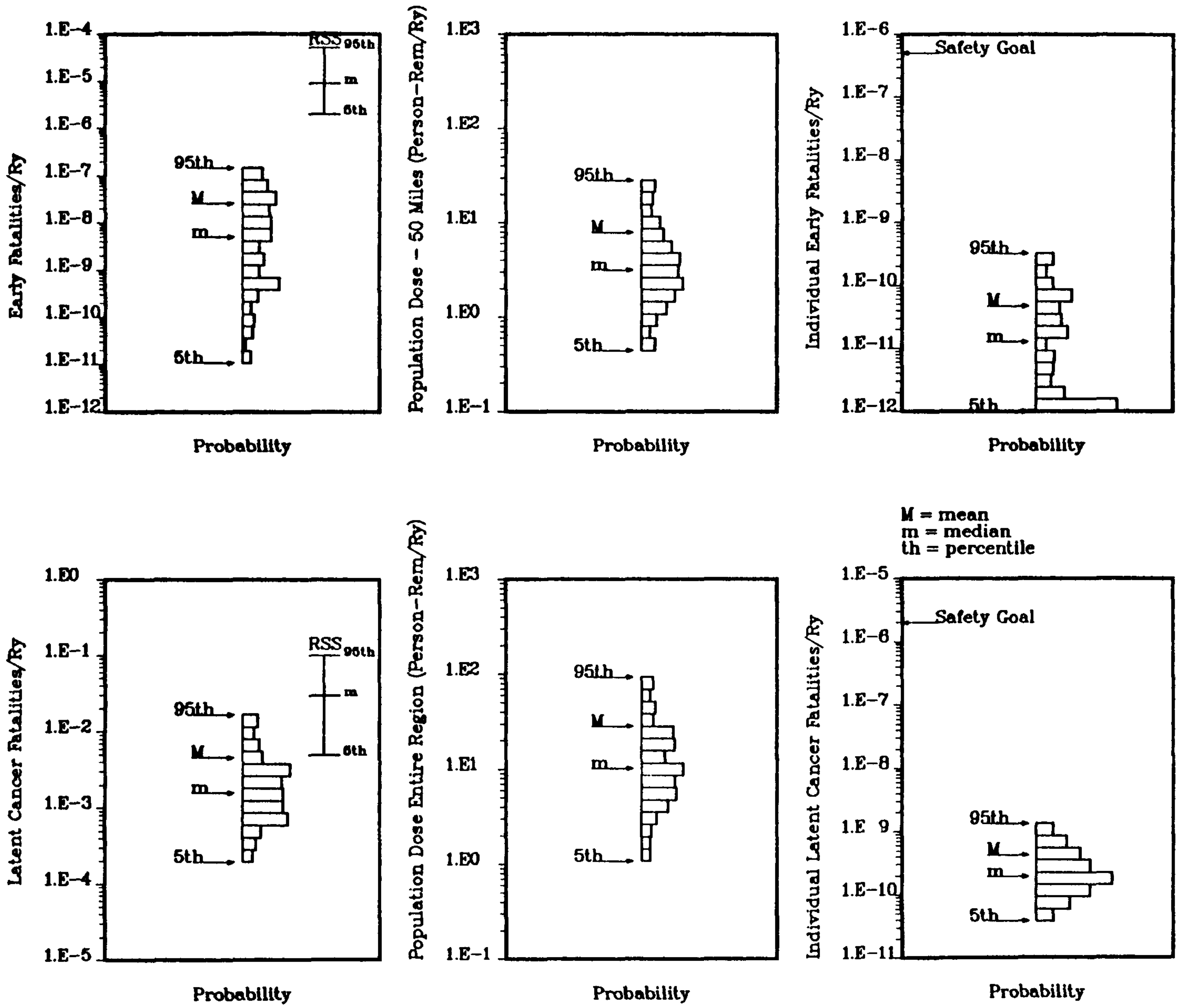

Figure S-20
Peach Bottom: Internal Events Mean Risk Distributions

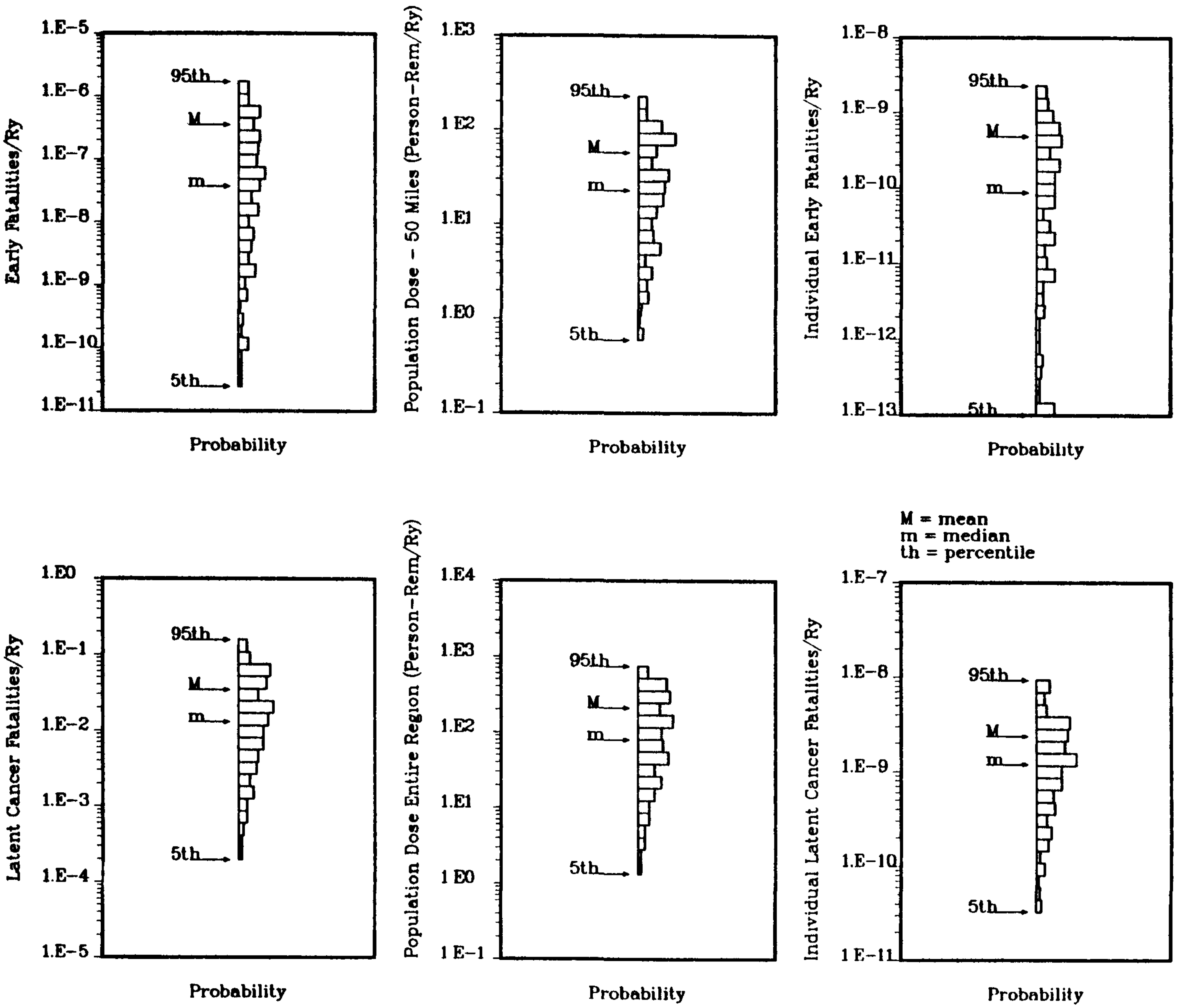

Figure S-21
Peach Bottom: Fire Mean Risk Distributions

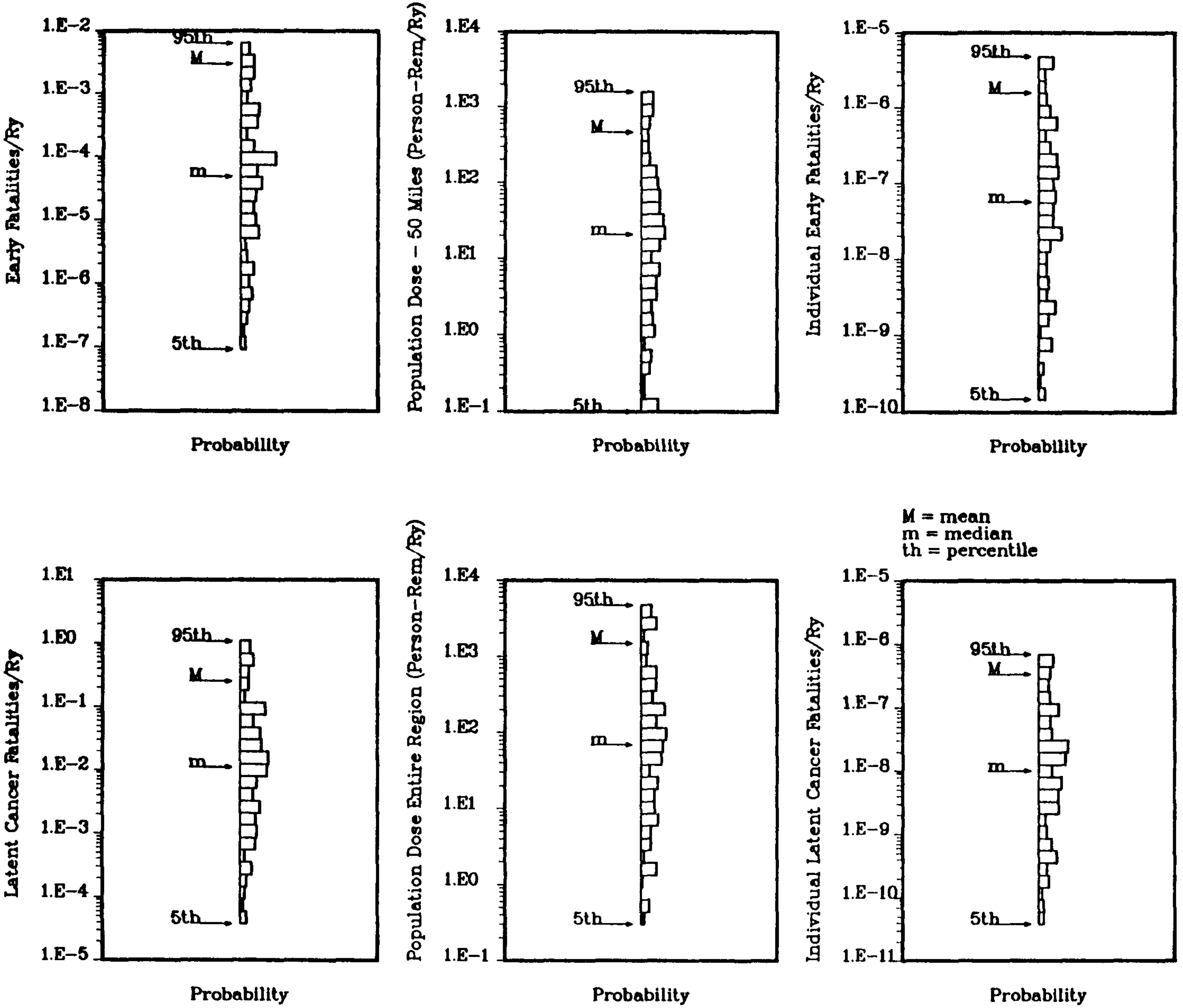

Figure S-22
Peach Bottom: LLNL Hazard Curve Mean Risk Distributions

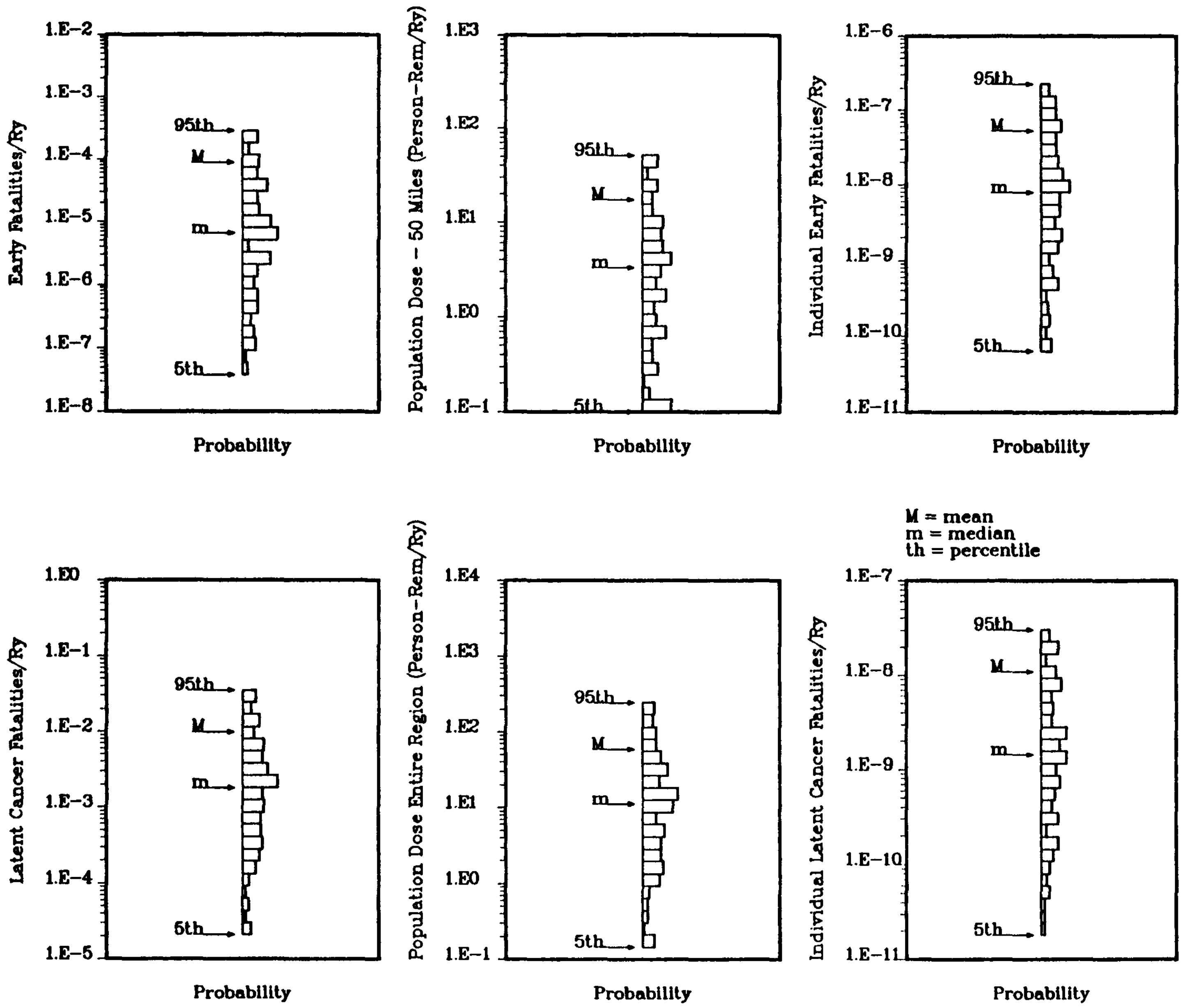

Figure S-23
Peach Bottom: EPRI Hazard Curve Mean Risk Distributions

average risk for the subset of interest for the sample by the average total risk for the sample. The mean fractional contribution to risk (MFCR) is found by determining the ratio of the risk for the subset of interest to the total risk for each observation, and then averaging over the sample.

Results of computing the contributions to the mean risk for internal, fire, LLNL seismic, and EPRI seismic initiators by the two methods are presented in Table S-2, S-3, and S-4 for internal, fire, and seismic initiators. Percentages are shown for early fatalities and latent cancer fatalities for the PDS groups. These results are based on the LHS sample of size 200 used in the Level II/III analysis and the results are not the same as those presented in Table S-1.

Pie charts for the contributions of the PDS groups to mean risk for the internal, fire, LLNL seismic, and EPRI seismic analyses for these two risk measures for both methods are shown in Figures S-24 to S-27, respectively. Figures S-28 to S-31 display similar pie charts for the contributions of the summary APBs to mean risk. Not surprisingly, the two methods of calculating contribution to risk yield different values. Both methods of computing the contributions to risk are conceptually valid, so the conclusion is clear: contributors to mean risk can only be interpreted in a very broad sense. That is, it is valid to say that the long-term SBO group is the major contributor to internal mean early fatality risk at Peach Bottom. It is not valid to state that the long-term SBO group contributes 38.0% of the early fatality risk at Peach Bottom. Although the exact values are different for each method, the basic conclusions that can be drawn from these results are the same.

Internal Initiators

Even though the measures for determining the contributors to mean risk are only approximate, the types of accidents that are the largest contributors to offsite risk at Peach Bottom for internal initiators is clear. For all of the consequence measures, the risk is dominated by long-term SBOs (PDS 5) and the ATWS core vulnerable sequence (PDS 8). These groups are the dominant contributors to the core damage frequency and both result in accidents that involve early containment failure in the drywell. Thus, these accidents are not only the most frequent but they also involve accidents that can potentially result in a large early release.

Fire Initiators

The relative contributions of the types of accidents that are the largest contributors to offsite risk for fire initiators at Peach Bottom can be determined for each risk measure. Unlike the internal events analysis, one or two PDSs do not dominate the risk and, therefore, contribute to all risk measures. For example, using the contribution calculated based upon the MFCR method, for early fatalities, PDS 2 is about 33%, PDS 1 and 4 are about 26% each, and PDS 3 is about 16%. For latent cancers, PDS 2 is about 46%, PDS 3 is about 23%, PDS 1 is about 16%, and PDS 4 is about 13%. One

Table S-2a
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Internal Initiators

PDS	Method	Core Damage	Early Fatalities	Latent Cancer Fatalities	Population Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
1 LOCA	FCMR	3.5	2.9	2.4	2.5	2.4	3.3	2.2
	MFCR	6.4	4.9	3.3	3.6	3.3	5.0	3.7
2 Fast Trans	FCMR	4.1	2.9	1.8	2.0	1.8	3.3	1.8
	MFCR	6.4	3.8	2.6	3.0	2.7	4.0	3.2
3 Fast Trans	FCMR	0.06	0.06	0.04	0.05	0.04	0.07	0.06
	MFCR	0.11	0.08	0.06	0.08	0.06	0.09	0.11
4 Fast Blackout	FCMR	4.6	2.4	1.7	2.0	1.8	2.8	2.0
	MFCR	7.0	7.6	3.0	3.3	3.1	7.4	3.3
5 Slow Blackout	FCMR	43.4	45.2	57.0	53.7	56.5	41.2	48.2
	MFCR	39.6	38.0	51.2	49.4	50.8	38.1	46.4
6 Fast ATWS	FCMR	8.1	3.3	2.2	2.4	2.2	3.4	2.4
	MFCR	5.7	3.6	1.6	1.8	1.6	3.4	1.9
7 ATWS CV	FCMR	2.3	2.7	2.1	2.3	2.2	2.9	2.7
	MFCR	2.7	3.5	2.9	3.0	2.9	3.5	3.2
8 ATWS CV	FCMR	32.9	39.5	31.7	33.9	32.0	41.7	39.5
	MFCR	31.0	37.2	34.2	34.7	34.3	37.1	36.9
9 ATWS CV	FCMR	1.1	1.2	1.0	1.1	1.0	1.3	1.3
	MFCR	1.1	1.4	1.2	1.2	1.2	1.4	1.3

Table S-2b
Fractional APB Contributions (in percent) to Annual Risk at Peach Bottom Due to Internal Initiators

Summary Accident Progression	Method	Early Fatalities	Latent Cancer Fatalities	Population Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
VB, Early CF, WW Failure, RPV>200 psia at VB	FCMR	0.24	0.96	1.2	0.97	0.4	2.0
	MFCR	0.35	1.9	2.1	1.9	0.44	3.0
VB, Early CF, WW Failure, RPV<200 psia at VB	FCMR	0.12	0.45	0.66	0.47	0.23	1.2
	MFCR	0.25	0.53	0.66	0.53	0.29	1.1
VB, Early CF, DW Failure, RPV>200 psia at VB	FCMR	64.2	67.1	61.2	66.5	58.4	45.6
	MFCR	55.6	58.9	55.6	58.6	54.5	48.0
VB, Early CF, DW Failure, RPV<200 psia at VB	FCMR	28.2	23.6	25.8	23.9	30.4	27.0
	MFCR	32.2	22.3	22.6	22.5	31.6	21.0
VB, Late CF, WW Failure	FCMR	0.0	0.1	0.13	0.09	0.0	0.32
	MFCR	0.01	0.18	0.22	0.19	0.01	0.44
VB, Late CF, DW Failure	FCMR	1.8	1.5	2.0	1.6	2.1	3.2
	MFCR	3.3	5.1	5.9	5.2	4.0	7.0
VB, Vent	FCMR	5.3	5.9	8.4	6.1	1.0	18.6
	MFCR	7.9	10.2	11.8	10.4	2.1	17.0
VB, No CF	FCMR	0.0	0.0	0.02	0.01	0.0	0.06
	MFCR	0.0	0.02	0.05	0.03	0.0	0.09
No VB	FCMR	0.22	0.37	0.58	0.37	0.36	2.1
	MFCR	0.38	0.81	1.0	0.81	0.39	2.5
No CD	FCMR	0.0	0.0	0.0	0.0	0.0	0.0
	MFCR	0.0	0.0	0.0	0.0	0.0	0.0

Table S-3a
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Fire Initiators

PDS	Method	Core Damage	Early Fatalities	Latent Cancer Fatalities	Population Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
1 Fast Trans	FCMR	30.0	8.4	7.4	8.8	7.7	10.8	10.6
	MFCR	37.9	25.2	16.8	18.5	17.1	25.2	21.4
2 Slow SBO	FCMR	30.4	37.1	40.2	39.3	40.0	36.8	38.8
	MFCR	36.1	32.4	46.3	46.0	46.2	33.8	46.5
3 Slow SBO	FCMR	34.8	39.9	42.2	42.2	42.2	38.9	44.0
	MFCR	20.2	15.2	23.0	23.0	23.0	16.0	23.7
4 Transient CV	FCMR	4.8	14.7	10.2	9.8	10.1	13.5	6.6
	MFCR	5.8	27.2	13.9	12.5	13.8	24.9	8.4

Table S-3b
Fractional APB Contributions (in percent) to Annual Risk at Peach Bottom Due to Fire Initiators

Summary Accident Progression	Method	Early Fatalities	Latent Cancer Fatalities	Population Dose Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
VB, Early CF, WW Failure, RPV>200 psia at VB	FCMR	0.44	2.0	2.5	2.0	0.93	5.0
	MFCR	1.2	3.1	3.6	3.2	1.5	5.3
VB, Early CF, WW Failure, RPV<200 psia at VB	FCMR	0.00	0.01	0.02	0.01	0.00	0.06
	MFCR	0.02	0.27	0.29	0.27	0.03	0.36
VB, Early CF, DW Failure, RPV>200 psia at VB	FCMR	92.0	87.9	86.1	87.7	89.4	77.3
	MFCR	81.2	77.7	74.9	77.4	79.9	68.3
VB, Early CF, DW Failure, RPV<200 psia at VB	FCMR	5.2	3.7	4.5	3.9	6.4	5.2
	MFCR	10.8	5.8	6.6	6.0	10.9	7.5
VB, Late CF, WW Failure	FCMR	0.01	0.5	0.74	0.49	0.01	2.5
	MFCR	0.01	0.46	0.57	0.46	0.01	1.1
VB, Late CF, DW Failure	FCMR	1.8	4.7	4.9	4.7	2.5	8.1
	MFCR	4.3	9.5	10.6	9.6	5.0	13.2
VB, Vent	FCMR	0.5	1.2	1.3	1.2	0.79	1.8
	MFCR	2.5	3.1	3.3	3.2	2.7	4.0
VB, No CF	FCMR	0.0	0.0	0.01	0.0	0.0	0.06
	MFCR	0.0	0.03	0.08	0.05	0.0	0.23
No VB	FCMR	0.0	0.0	0.0	0.0	0.0	0.01
	MFCR	0.0	0.0	0.01	0.0	0.0	0.02
No CD	FCMR	0.0	0.0	0.0	0.0	0.0	0.0
	MFCR	0.0	0.0	0.0	0.0	0.0	0.0

Table S-4a
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom due to Seismic Initiators

Summary PDS	Hazard Distrb.	Method	Core Damage	Early Fatal-ities	Latent Cancer Fatal-ities	Popu-lation Dose - 0-50 mi.	Popu-lation Dose - Region	Ind. E. F. Risk - 0-1 mi.	Ind. L.C.F. Risk - 0-10 mi.
1	LLNL	FCMR	11.7	29.4	15.8	16.2	15.7	24.2	22.0
		MFCR	9.90	14.5	10.9	10.8	10.9	15.2	12.6
	EPRI	FCMR	10.4	27.5	14.1	14.3	13.9	22.8	20.6
		MFCR	9.20	14.7	10.3	10.1	10.2	15.4	12.3
2	LLNL	FCMR	22.5	38.5	23.5	23.7	23.5	36.4	30.6
		MFCR	22.4	34.5	24.3	24.4	24.1	33.8	28.8
	EPRI	FCMR	20.2	38.2	21.6	21.9	21.5	36.9	30.9
		MFCR	19.6	33.5	21.4	21.4	21.2	32.8	26.8
3	LLNL	FCMR	4.0	6.2	3.6	3.7	3.7	6.6	5.2
		MFCR	6.4	9.6	6.8	6.8	6.7	9.5	8.5
	EPRI	FCMR	4.2	7.4	3.9	4.0	3.9	7.6	6.2
		MFCR	5.2	8.7	5.6	5.6	5.5	8.6	7.5
4	LLNL	FCMR	49.2	20.3	49.4	49.1	49.2	22.9	35.4
		MFCR	41.6	11.7	38.8	38.8	39.1	14.6	28.4
	EPRI	FCMR	51.0	18.9	50.5	50.1	50.6	20.2	33.2
		MFCR	47.7	14.0	44.7	44.8	45.1	16.9	32.6
5	LLNL	FCMR	4.2	1.1	2.7	2.5	2.8	2.2	1.6
		MFCR	5.0	3.6	4.8	4.7	4.8	3.9	3.5
	EPRI	FCMR	6.2	1.9	4.3	4.1	4.4	3.4	2.5
		MFCR	6.2	4.1	5.7	5.7	5.7	4.4	4.1
6	LLNL	FCMR	6.2	3.7	3.9	3.8	4.0	6.3	4.2
		MFCR	11.5	22.1	12.0	11.9	11.9	19.3	15.0
	EPRI	FCMR	5.9	4.8	4.3	4.2	4.3	7.0	5.0
		MFCR	9.6	21.0	10.1	10.0	10.0	18.4	13.6
7	LLNL	FCMR	2.1	0.8	1.1	1.1	1.1	1.5	1.1
		MFCR	2.8	4.1	2.5	2.6	2.5	3.6	3.2
	EPRI	FCMR	2.2	1.5	1.4	1.4	1.4	2.0	1.6
		MFCR	2.6	4.0	2.2	2.3	2.2	3.6	3.2

Table S-4b
Fractional APB Contributions (in percent) to Annual Risk at Peach Bottom due to Seismic Initiators

Summary Accident Progression Bin	Hazard Distrb.	Method	Early Fatal-ities	Latent Cancer Fatal-ities	Popu-lation Dose - 0-50 mi.	Popu-lation Dose - Region	Ind. E. F. Risk - 0-1 mi.	Ind. L.C.F. Risk - 0-10 mi.
VB, Early CF, WW Failure, RPV>200 psia at VB	LLNL	FCMR	1.5	5.0	7.2	5.9	4.9	3.7
	LLNL	MFCR	0.3	1.4	1.7	1.5	0.7	1.0
	EPRI	FCMR	1.2	3.9	5.6	4.6	3.5	2.9
	EPRI	MFCR	0.4	1.6	1.9	1.7	0.7	1.1
VB, Early CF, WW Failure, RPV<200 psia at VB	LLNL	FCMR	0.5	0.9	1.0	0.9	1.3	1.0
	LLNL	MFCR	0.6	1.1	1.4	1.2	0.9	1.1
	EPRI	FCMR	0.4	0.8	0.9	0.8	1.0	0.9
	EPRI	MFCR	0.6	1.0	1.1	1.0	0.9	1.0
VB, Early CF, DW Failure, RPV>200 psia at VB	LLNL	FCMR	19.5	43.1	40.8	41.9	18.7	30.9
	LLNL	MFCR	14.2	38.4	37.8	38.6	16.8	28.3
	EPRI	FCMR	19.0	47.0	44.8	46.3	18.9	30.5
	EPRI	MFCR	16.9	44.2	43.6	44.4	19.4	32.3
VB, Early CF, DW Failure, RPV<200 psia at VB	LLNL	FCMR	78.0	46.7	46.9	46.7	73.3	61.5
	LLNL	MFCR	83.1	54.5	54.2	54.1	79.4	65.8
	EPRI	FCMR	78.8	44.0	44.3	43.8	75.0	62.7
	EPRI	MFCR	80.2	48.0	47.6	47.6	76.7	61.2
VB, Late CF, WW Failure,	LLNL	FCMR	0.0	0.01	0.01	0.01	0.0	0.0
	LLNL	MFCR	0.0	0.08	0.1	0.08	0.0	0.07
	EPRI	FCMR	0.0	0.02	0.03	0.02	0.0	0.01
	EPRI	MFCR	0.0	0.1	0.2	0.1	0.0	0.09
VB, Late CF, DW Failure	LLNL	FCMR	0.4	4.1	3.8	4.3	1.4	2.6
	LLNL	MFCR	0.5	3.8	4.2	3.9	1.0	2.9
	EPRI	FCMR	0.4	4.0	3.9	4.2	1.2	2.6
	EPRI	MFCR	0.5	4.5	4.9	4.6	1.0	3.4
VB, Vent	LLNL	FCMR	0.2	0.3	0.3	0.3	0.4	0.3
	LLNL	MFCR	1.4	0.8	0.8	0.8	1.3	1.0
	EPRI	FCMR	0.2	0.3	0.4	0.3	0.4	0.4
	EPRI	MFCR	1.5	0.7	0.7	0.7	1.3	0.9
VB, No CF	Approximately Zero							
No VB	Approximately Zero							
No Core Damage	Approximately Zero							

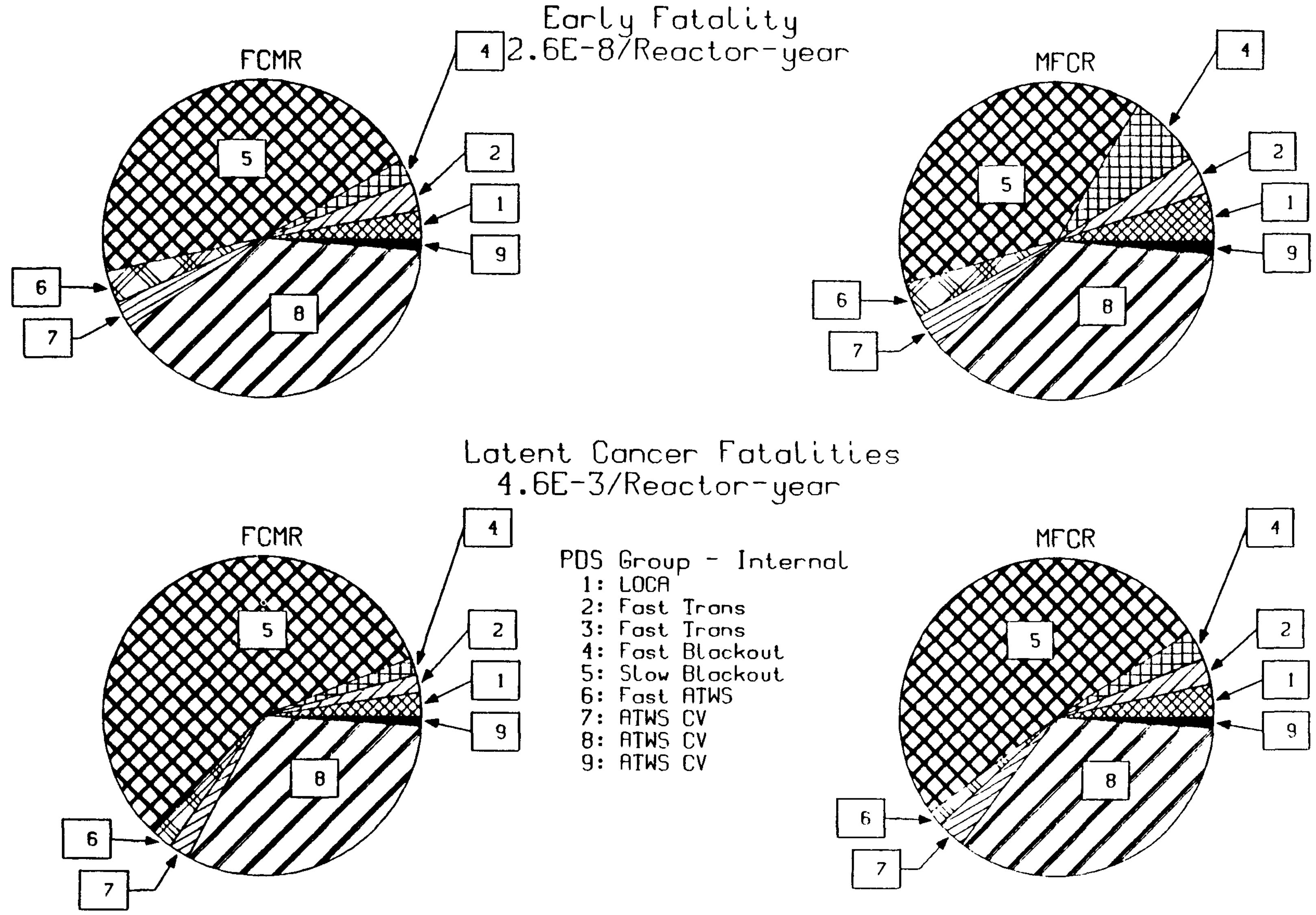

Figure S-24
Peach Bottom PDSs for Internal Initiators: Percent Contribution to Risk

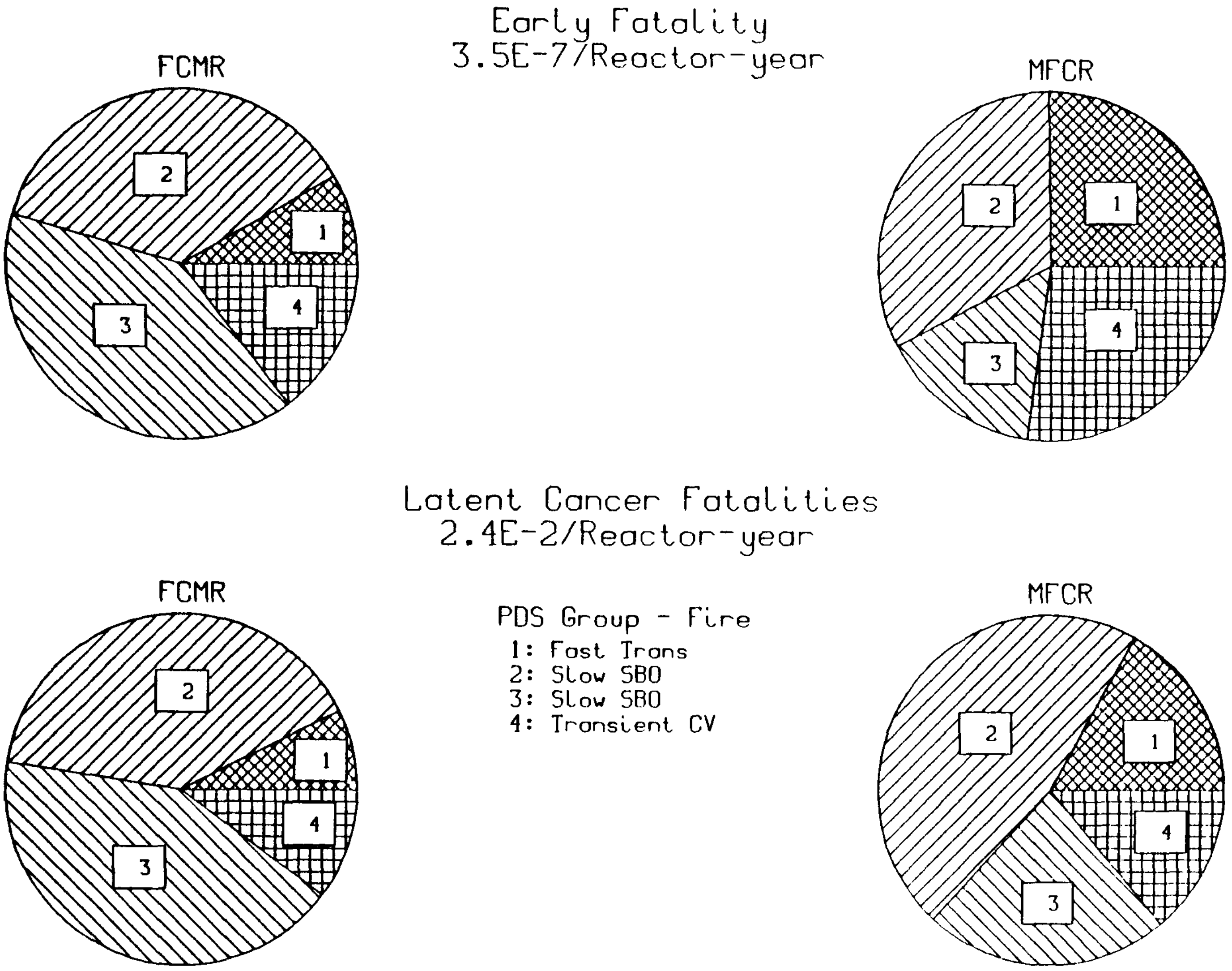

Figure S-25
Peach Bottom PDSs for Fire Initiators: Percent Contribution to Risk

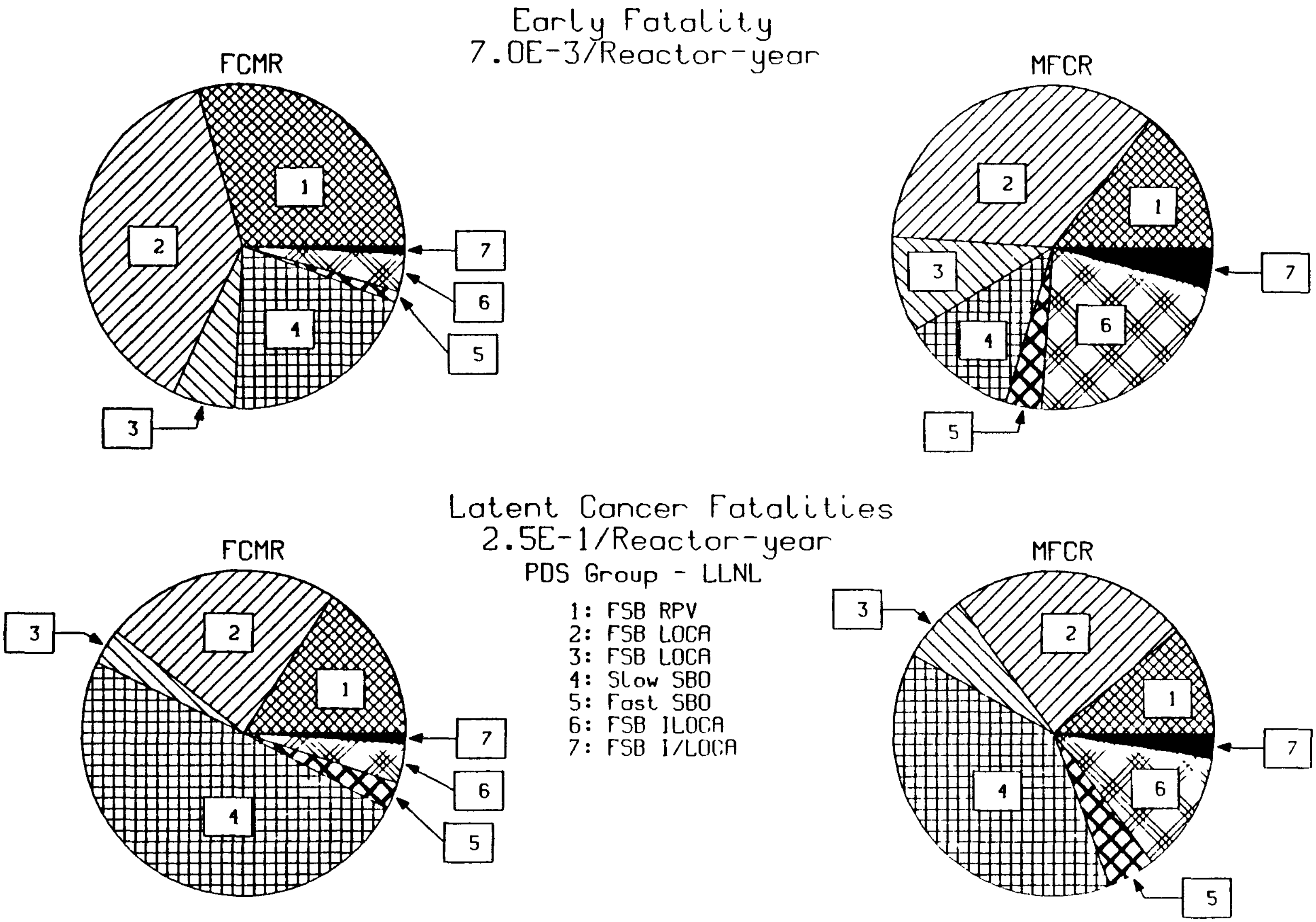

Figure S-26
Peach Bottom PDSs for LLNL Seismic Initiators: Percent Contribution to Risk

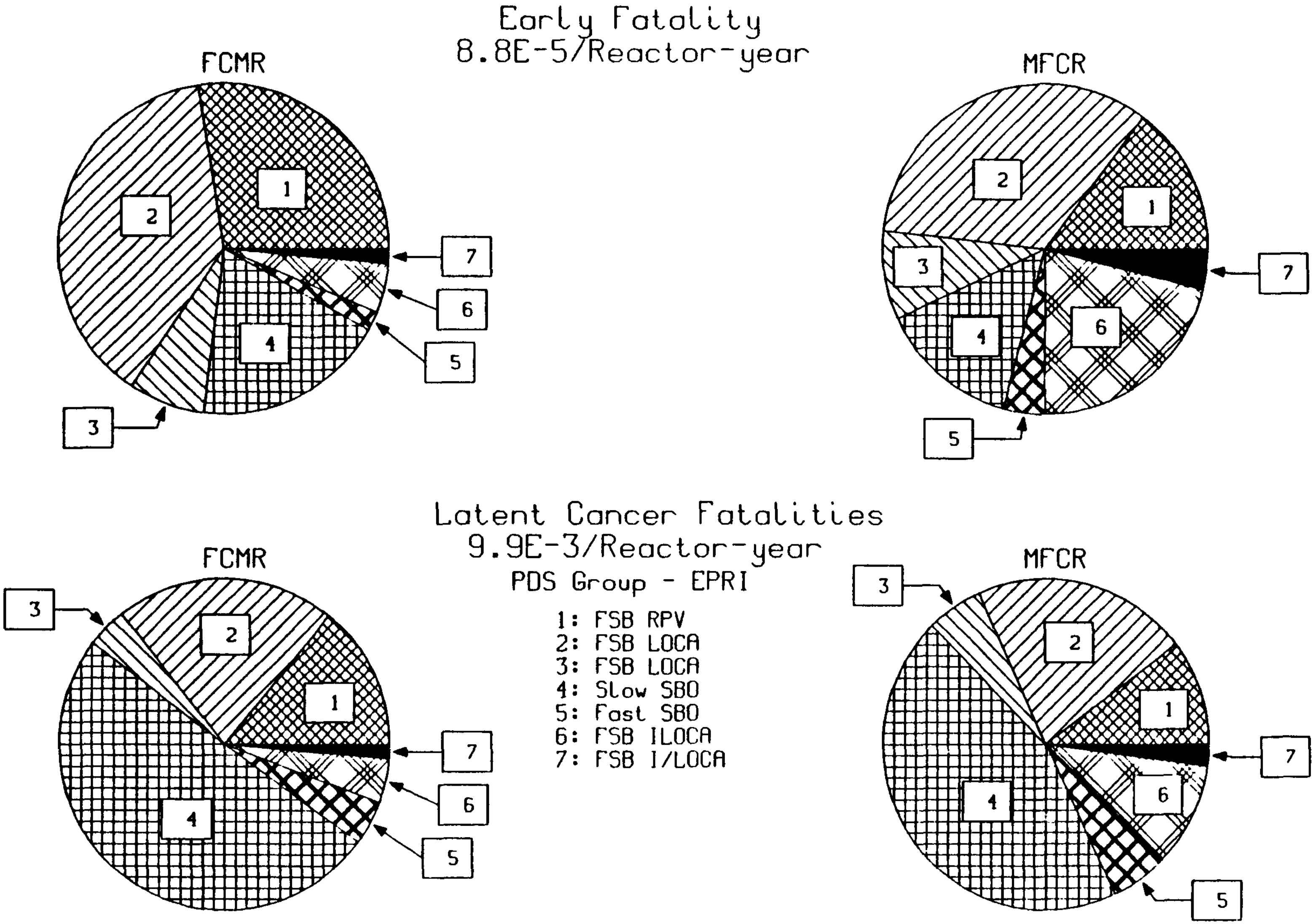

Figure S-27
Peach Bottom PDSs for EPRI Seismic Initiators: Percent Contribution to Risk

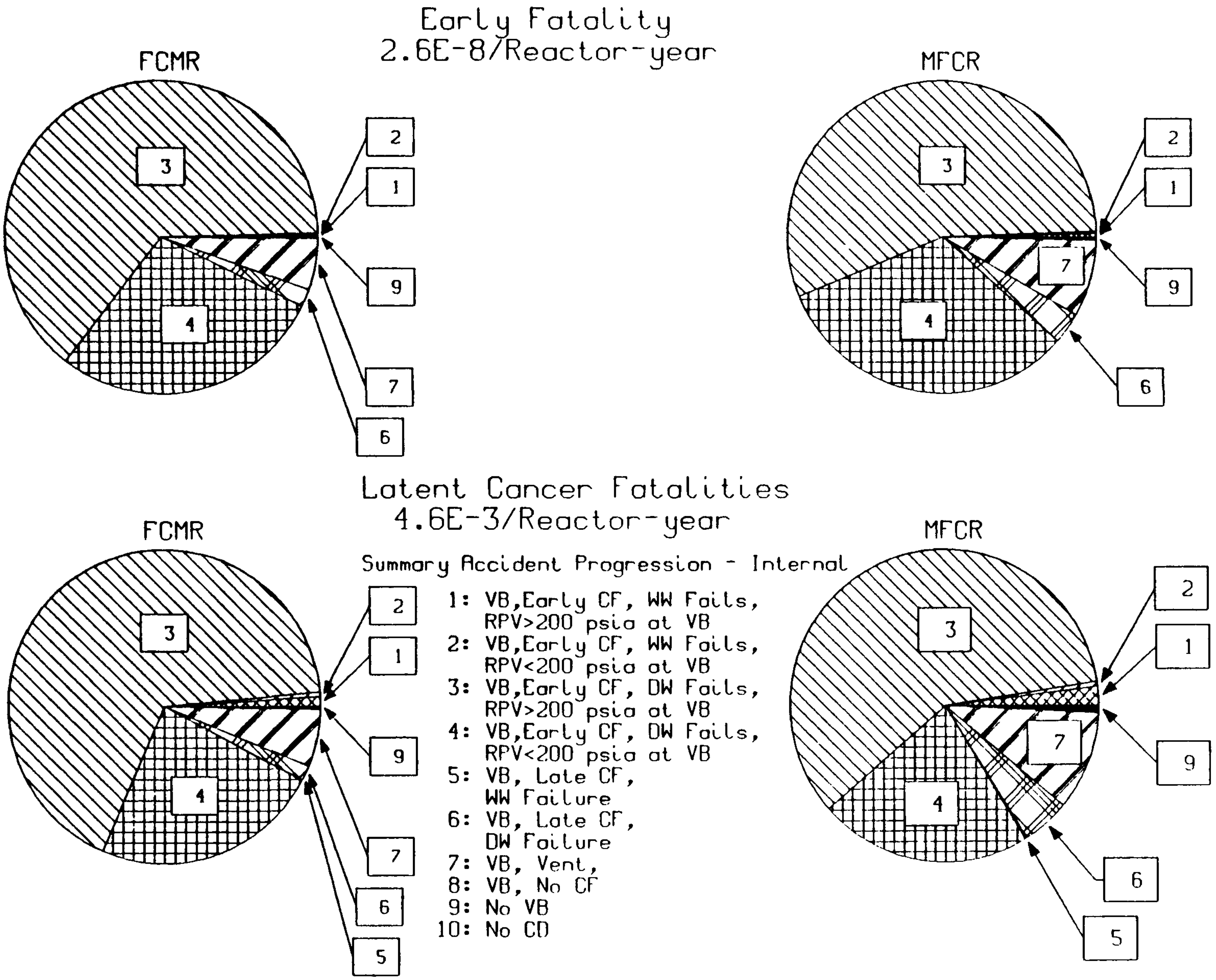

Figure S-28
Peach Bottom Summary Accident Progression Bins for Internal Initiators: Percent Contribution to Risk

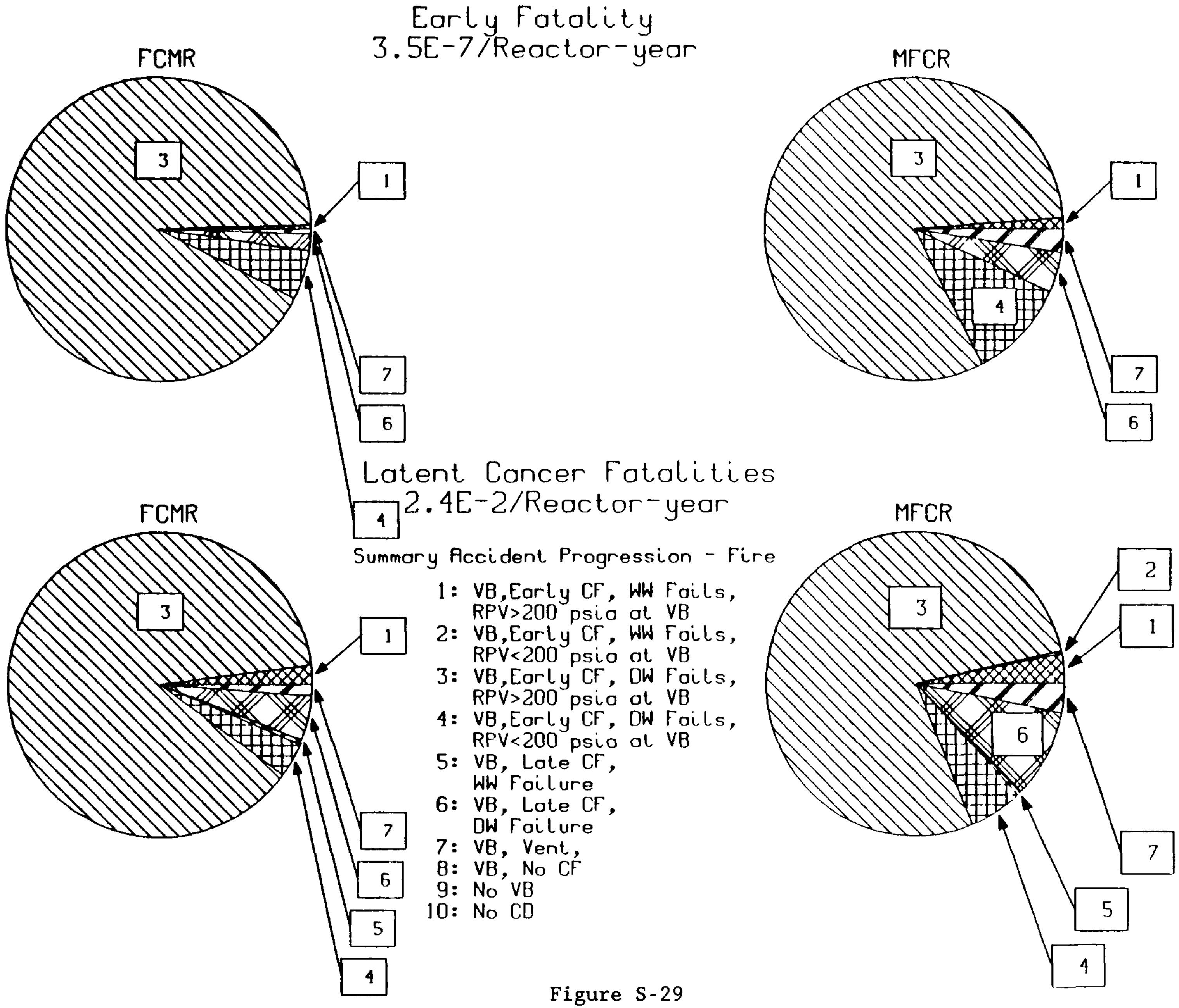

Figure S-29
Peach Bottom Summary Accident Progression Bins for Fire Initiators: Percent Contribution to Risk

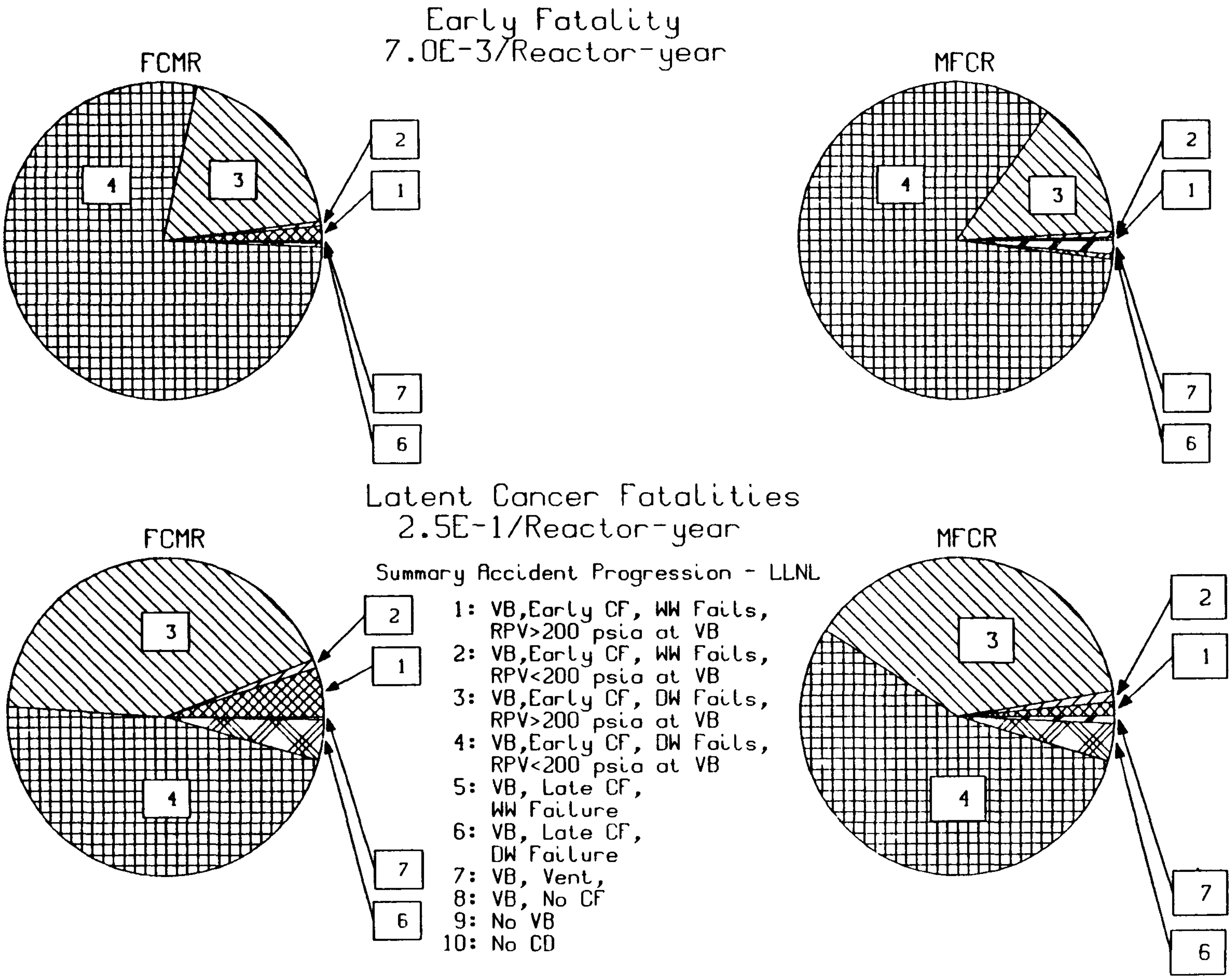

Figure S-30
Peach Bottom Summary Accident Progression Bins for LLNL Seismic Initiators: Percent Contribution to Risk

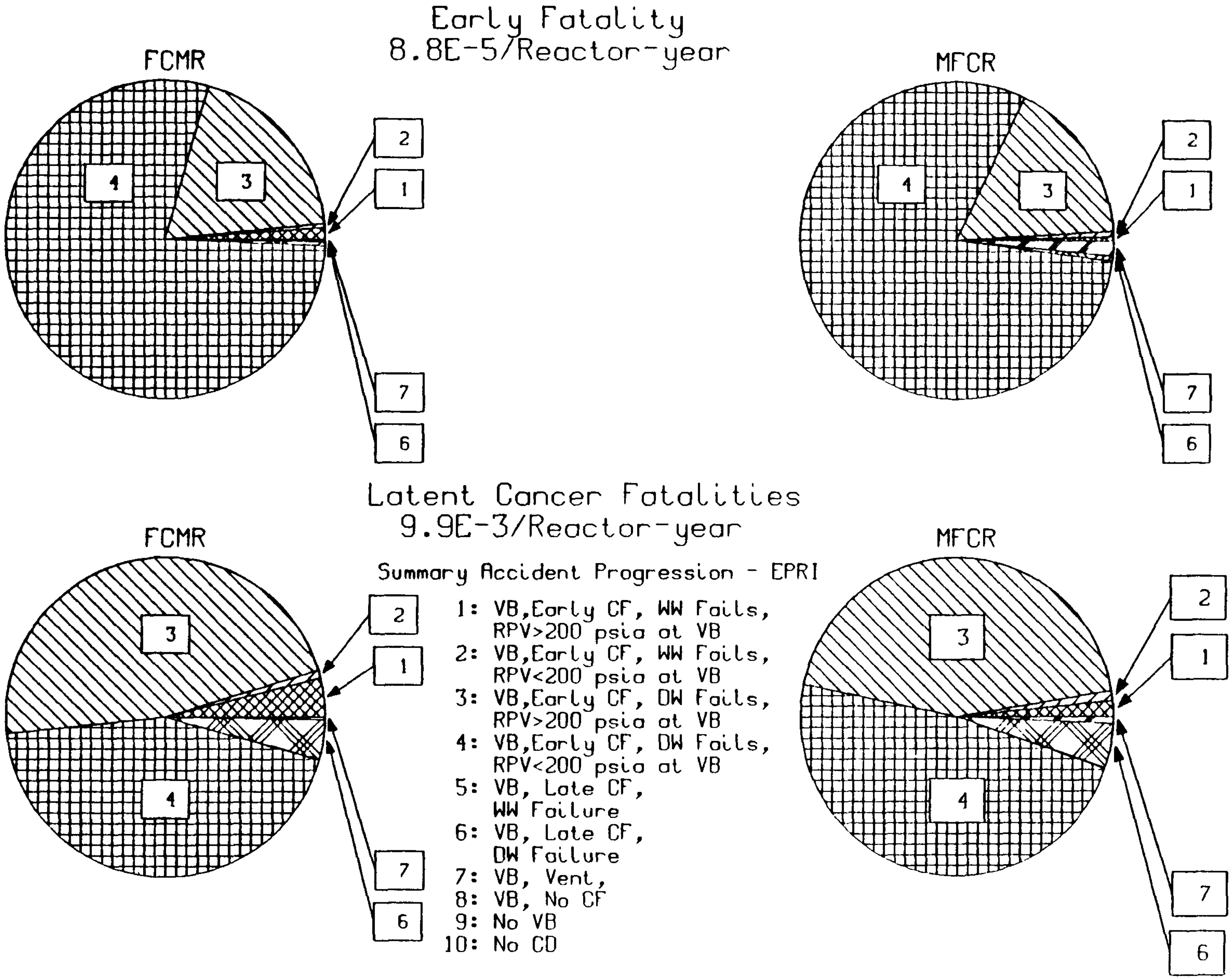

Figure S-31
Peach Bottom Summary Accident Progression Bins for EPRI Seismic Initiators: Percent Contribution to Risk

can see that PDS 1 does not contribute as much as one might expect based upon the fact that it has the highest contribution to core damage frequency; while PDS 4 contributes much more to risk than its core damage frequency would suggest it might.

Seismic Initiators

The relative contributions of the types of accidents that are the largest contributors to offsite risk for seismic initiators at Peach Bottom can be determined for each risk measure. Unlike the internal events analysis, one or two PDSs do not dominate the risk and, therefore, contribute to all risk measures. For example, using the contribution calculated based upon the MFCR method, for early fatalities, PDS 2 is about 34%, PDS 6 is about 22%, and PDSs 4 and 1 are each about 15%. For latent cancers, PDS 4 is about 40%, PDS 2 is about 22%, and PDSs 1 and 6 are about 11%. One can see that PDS 4 does not contribute as much as one might expect to the early fatality risk based upon the fact that it has the highest contribution to core damage frequency; while PDSs 2 and 6 contribute much more to risk than their core damage frequency would suggest they might.

S.8.4 Important Contributors to Uncertainty in Risk

The important contributors to the uncertainty in risk are determined by performing regression-based sensitivity analyses on the mean values for risk.

For internal initiators, the regression analyses account for > 66% of the observed variability. Variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the internal analysis is dominated by source term variable uncertainty (FCOR, FCONC, and FCCI); but, for fire and seismic initiators, the result is different. The reason for this result in the internal analysis is that the risk is determined by two PDSs. The LOSP PDS does not have large uncertainties in the initiating event frequency or in recovery of LOSP. The ATWS PDS has a large uncertainty in the failure to scram frequency; but, since it only contributes one half the risk, that variable is only the 3rd to 4th most important. The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor it is almost certain to occur, its importance to uncertainty is less than its frequency of occurrence would seem to imply.

For fire initiators, the regression analyses account for > 65% of the observed variability. Again, variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the fire analysis is dominated by source term variable uncertainty for early fatalities (FCOR, FCONC, and FCCI); but, for latent cancers, the Level I variables dominate (fire initiating event frequency and diesel generator failure to run). The reason for this result is that the early fatalities depend critically on the magnitude of the source term; but, the latent cancers depend mainly upon whether or not the accident occurs. The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor it is almost certain to occur, its importance to uncertainty is less than its frequency of occurrence would seem to imply.

For seismic initiators, the regression analyses account for > 66% of the observed variability. Again, variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the seismic analysis is dominated by level I variables, in particular, the uncertainty in the seismic hazard curve. The source term variables are the next most important (FCONC and RBDF). The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor it is almost certain to occur, its importance to uncertainty is less than its frequency of occurrence would seem to imply.

S.9 References

1. U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants", Second Draft for Peer Review, NUREG-1150, June, 1989.

2. A. M. Kolaczkowski, W. R. Cramond, T. T. Sype, K. J. Maloney, T. A. Wheeler, and S. L. Daniel," Analysis of Core Damage Frequency: Peach Bottom, Unit 2, Internal Events," NUREG/CR-4550, Vol. 4, Rev. 1, Part 1, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, August 1989.

J. A. Lambright, M. P. Bohn, S. L. Daniel, J. J. Johnson, M. K. Ravindra, P. O. Hashimato, M. J. Mraz, W. H. Tong, and D. A. Brosseau, "Analysis of Core Damage Frequency from Internal Events: Peach Bottom, Unit 2, External Events," NUREG/CR-4550, Vol. 4, Part 3, Rev. 1, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, December 1990.

1. INTRODUCTION

The United States Nuclear Regulatory Commission (NRC) has recently completed a major study to provide a current characterization of severe accident risks from light water reactors (LWRs). The characterization was derived from the analysis of five plants. The report of that work, NUREG-1150[1] has recently been issued as a second draft for comment. NUREG-1150 is based on extensive investigations by NRC contractors. Several series of reports document these analyses as discussed in the Forward.

These risk assessments can generally be characterized as consisting of four analysis steps, an integration step, and an uncertainty step.

1. Accident frequency analysis: the determination of the likelihood and nature of accidents that result in the onset of core damage.

2. Accident progression analysis: an investigation of the core damage process, both within the reactor vessel before it fails and in the containment afterwards, and the resultant impact on the containment.

3. Source term analysis: an estimation of the radionuclide transport within the reactor pressure vessel (RPV) and the containment, and the magnitude of the subsequent releases to the environment.

4. Consequence analysis: the calculation of the offsite consequences in terms of health effects and financial impact.

5. Risk integration: the combination of the outputs of the previous tasks into an overall expression of risk.

6. Uncertainty analysis: the determination of which uncertainties in the preceding analyses contribute the most to the uncertainty in risk.

This volume is one of seven that comprise NUREG/CR-4551. NUREG/CR-4551 presents the details of the last five of the six analyses listed above. The analyses reported here start with the onset of core damage and conclude with an integrated estimate of overall risk and uncertainty in risk. This volume, Volume 4, describes these analyses, the inputs utilized in them, and the results obtained for Peach Bottom Atomic Power Station, Unit 2. The methods utilized in these analyses are described in Volume 1 and are only briefly discussed here.

1.1 Background and Objectives of NUREG-1150

Assessment of risk from the operation of nuclear power plants, involves determination of the likelihood of various accident sequences and their potential offsite consequences. In 1975, the NRC completed the first comprehensive study of the probabilities and consequences of core meltdown accidents--the "Reactor Safety Study" (RSS).[2] This report showed that the probabilities of such accidents were higher than previously believed, but that the consequences were significantly lower. The product of probability and consequence--a measure of the risk of core melt accidents--was estimated to be quite low when compared with natural events such as floods and earthquakes and with other societal risks such as automobile and airplane accidents. Since that time, many risk assessments of specific plants have been performed. In general, each of these has progressively reflected at least some of the advances that have been made in reactor safety and in the ability to predict the frequency of severe accidents, the amount of radioactive material released as a result of such accidents, and the offsite consequences of such a release.

In order to investigate the significance of more recent developments in a comprehensive fashion, it was concluded that the current efforts of research programs being sponsored by the NRC should be coalesced to produce an updated representation of risk for operating nuclear power plants. "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants"[1] is the result of this program. The five nuclear power plants are Surry, Peach Bottom, Sequoyah, Grand Gulf, and Zion. The analyses of the first four plants were performed by Sandia National Laboratories (SNL). The analysis of Zion was performed by Idaho National Engineering Laboratory (INEL) and Brookhaven National Laboratory (BNL).

The following are the overall objectives of the NUREG-1150 program.

1. Provide a current assessment of the severe accident risks to the public from five nuclear power plants, which will:

    a. Provide a "snapshot" of the risks reflecting plant design and operational characteristics, related failure data, and severe accident phenomenological information extant in 1988;

    b. Update the estimates of the NRC's 1975 risk assessment, the "Reactor Safety Study";[2]

    c. Include quantitative estimates of risk uncertainty, in response to the principal criticism of the "Reactor Safety Study"; and

    d. Identify plant-specific risk vulnerabilities, in the context of the NRC's individual plant examination process.

2. Summarize the perspectives gained in performing these risk analyses, with respect to:

    a. Issues significant to severe accident frequencies, consequences, and risk;

    b. Uncertainties for which the risk is significant and which may merit further research; and

   c. Potential for risk reduction.

3. Provide a set of methods for the prioritization of potential safety issues and related research.

These objectives required special considerations in the selection and development of the analysis methods. This report describes those special considerations and the solutions implemented in the analyses supporting NUREG-1150.

1.2 Overview of Peach Bottom Atomic Power Station, Unit 2

The subject of the analyses reported in this volume is the Peach Bottom Atomic Power Station, Unit 2. It is operated by Philadelphia Electric Company (PECO) and is located on the west shore of Conowingo Pond in southeastern Pennsylvania, York County. The plant is 38 miles northwest of Baltimore, Maryland, and 63 miles west-southwest of Philadelphia, Pennsylvania.

The nuclear reactor of Peach Bottom Unit 2 is a 3293 MWt BWR-4 boiling water reactor (BWR) designed and supplied by General Electric Company. Unit 2, constructed by Bechtel Corporation, began commercial operation in July 1974.

Peach Bottom has four diesel generators (DGs) shared between the two units that are used to supply emergency AC power in the event that offsite power from the grid is lost. The DGs supply AC power to four trains of emergency systems for each unit simultaneously. In the event of an accident, there are several systems that can supply coolant injection to the core. Two systems are available to provide high pressure coolant injection: the high pressure coolant injection system (HPCI) and the reactor core isolation cooling system (RCIC). Both systems use turbine-driven pumps with steam obtained from the RPV and can only be used when the vessel pressure is high enough to run the turbines. Both the low pressure core spray system (LPCS) and the low pressure coolant injection system (LPCI) (which is a mode of the residual heat removal system (RHR)) can provide coolant injection to the reactor vessel during accidents in which the system pressure is low. Both systems use motor driven pumps and have two loops with two pumps in each loop. Additional systems that can be used as primary sources of coolant, in special cases, are the main feedwater system (FW) and the condensate system (CDS). For additional backup sources of coolant injection the high pressure service water system (HPSW), the control rod drive system (CRD), and the firewater system (DFW) can be used in some circumstances. To allow any of the low pressure injection systems to supply coolant to the vessel, either a break in the primary system has had to occur of sufficient size to depressurize the RPV or the automatic depressurization system (ADS) is used depressurize the reactor vessel. This system (ADS) uses five relief valves to direct the vessel steam to the suppression pool (as backup another six relief valves or the ADS valves may be opened manually).

The Peach Bottom containment is a Mark I BWR containment. The containment consists of a light-bulb shaped steel pressure vessel forming the drywell which is connected to a toroidal shaped steel pressure vessel forming the suppression chamber (wetwell). In the Mark I design the reactor pressure vessel is housed in the drywell. The drywell and the wetwell communicate through passive vents (downcomers) in the suppression pool. Figure 1-1 shows a section through the Peach Bottom containment. During an accident, steam from the vessel is directed through the safety/relief valves and is discharged through a sparger into the suppression pool. The steam is condensed in the pool and any noncondensible gases pass through the pool into the wetwell atmosphere. Vacuum breakers allow any overpressure in the wetwell to be relieved back into the drywell to keep the pressure difference less than 2 psig. Similarly, any steam and noncondensible gases released into the drywell are vented into the suppression pool through the downcomers. The design pressure of the Peach Bottom containment is 56 psig (487 KPa) and the free volume of the containment is 307,000 cubic feet.

To suppress the pressure in the containment during an accident, two trains of containment sprays are located in the Peach Bottom containment. The containment spray system is one mode of the residual heat removal system (RHR). In the event that the RHR system fails to suppress the pressure in the containment, the containment can be vented.

To reduce the potential of a severe hydrogen combustion event during an accident, the containment is inerted with nitrogen.

Section 2.1 of this volume contains more detail on the plant's features important to the progression of the accident and to the containment's performance.

1.3 Changes Since the Draft Report

The Peach Bottom analyses for the February 1987 draft of NUREG-1150 were presented in Volume 3 of the original "Draft for Comment" versions of NUREG/CR-4551 and NUREG/CR-4700, published in April 1987. The analyses performed for NUREG-1150, Second Draft for Peer Review, June 1989, and reported in this volume, are completely new. While they build on the previous analyses and the basic approach is the same, very little from the first analyses is used directly in these analyses. This section presents the major differences between the two analyses. Essentially, the accident progression analysis and the source term analysis were completely re-done to incorporate new information and to take advantage of expanded methods and analysis capabilities.

Quantification. A major change since the previous analyses is the expert elicitation process used to quantify variables and parameters thought to be large contributors to the uncertainty in risk. This process was used both for the accident progression analysis and the source term analysis. The sizes of the panels were expanded, with each panel containing experts from industry and academia in addition to experts from NRC contractors. The

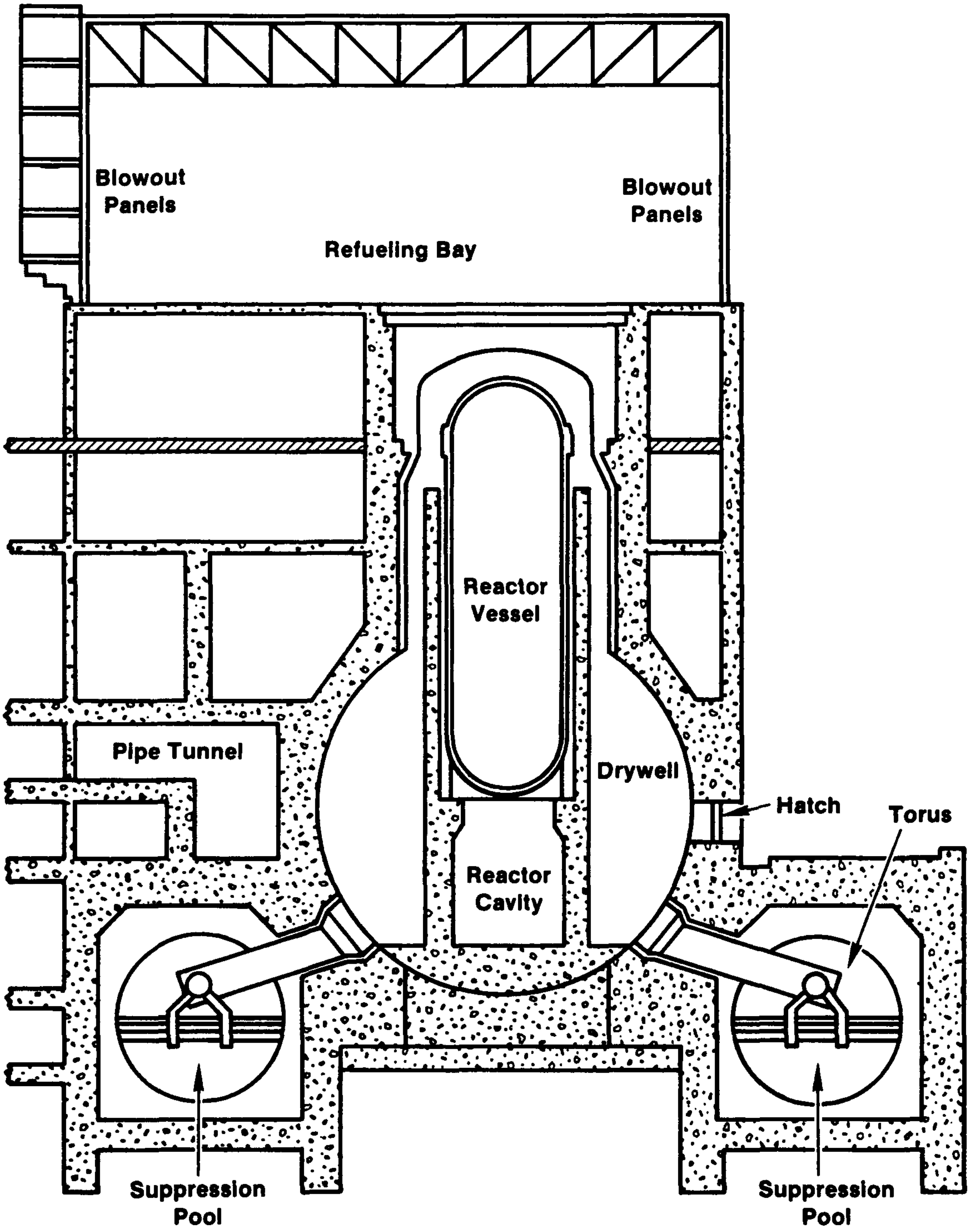

Figure 1-1. Section of the Peach Bottom Containment.

number of issues addressed was also increased, to about thirty. Separate panels of experts were convened for In-Vessel Processes, Containment Loads, Containment Structural Response, Molten Core-Containment Interactions, and Source Term Issues.

To ensure that expert opinion was obtained in a manner consistent with the state of the art in this area, specialists in the process of obtaining expert judgments in an unbiased fashion were involved in designing the elicitation process, explaining it to the experts, and training them in the methods used. The experts were given several months between the meeting at which the problem was defined and the meeting at which their opinions were elicited so that they could review the literature, discuss the problem with colleagues, and perform independent analyses. The results of the elicitation of each expert were carefully recorded, and the reasoning of each expert and the process by which their individual conclusions were aggregated into the final distribution are thoroughly documented.

Accident Progression Analysis. Not only was a substantial fraction of the Accident Progression Event Tree (APET) for Peach Bottom rewritten for this analysis, but the capabilities of EVNTRE, the code that evaluates the APET, were considerably expanded. The major improvements to EVNTRE were the ability to utilize user functions and the ability to treat continuous distributions. A user function is a FORTRAN subprogram which is linked with the EVNTRE code. When referenced in the APET, the user function is evaluated to perform calculations too complex to be handled directly in the APET. In the current Peach Bottom APET, the user function is called to: determine the containment baseline pressure during the various time periods; compute the amount of hydrogen released to the containment at the time of vessel breach and during CCI; calculate the pressure rise in the reactor building due to hydrogen burns; calculate the level of reactor building bypass after containment failure both with and without hydrogen burns; and determine whether the containment fails and the mode of failure. These problems were handled in a much simpler fashion in the previous analysis.

The event tree used for the analysis for the 1987 draft of NUREG-1150 could only treat discrete distributions. In the analysis reported here, continuous distributions are used. Use of continuous distributions removes a significant constraint from the expert elicitations and eliminates any errors introduced by discrete levels in the previous analysis.

The event tree that forms the basis of this analysis was modified to address new issues and to incorporate new information. Thus, not only was the structure of the tree changed but new information was used to quantify the tree. A major modification was the way hydrogen combustion events were modeled and quantified. The amount of hydrogen in the containment is tracked throughout the accident. The ignition frequency, detonation frequency, and the loads from a combustion event are all a function of the hydrogen concentration. In the current APET, loads are assigned to both deflagrations and detonations. These loads are then compared to the structural capacity of the reactor building to determine whether it fails or not and the level of failure. In addition to combustion events, another major change in the APET is the section that addresses vessel breach. In-vessel steam explosions and core damage arrest are now addressed in the tree. Furthermore, the tree was modified to incorporate new information supplied by the Containment Loads Expert Panel on loads accompanying vessel breach. Pressurization of the drywell and the reactor cavity from events occurring at vessel breach are considered. Failure of the reactor pedestal at vessel breach was not included in the previous analysis but is in this analysis. The APET was modified to include the effects of severe environments, produced in the reactor building after containment failure, on systems that were used in the APET with components in the reactor building.

Because of changes in the accident progression analysis and the source term analysis, the definitions of bins used to group the results from the accident progression analysis have also changed.

<u>Source Term Analysis</u>. While the basic parametric approach used in the original version of PBSOR, the code used to compute source terms, has been retained in the present version of PBSOR, the code has been completely rewritten with a different orientation.

The current version of PBSOR is quite different. First, it is not tied to the source term code package (STCP) in any way. It was recognized before the new version was developed that most of the parameters would come from continuous distributions defined by an expert panel. Thus, the current version does not rely on results from the STCP or any other specific code. The experts utilized the results of one or more codes in deriving their distributions, but PBSOR itself merely combines the parameters defined by the expert panel.

Finally, a new method to group the source terms computed by PBSOR has been devised. A source term is calculated for each accident progression bin for each observation in the sample. As a result, there are too many source terms to perform a consequence calculation for each and the source terms have to be grouped before the consequence calculations are performed. The "clustering" method utilized in the previous analysis was somewhat subjective and not as reproducible as desired. The new "partitioning" scheme developed for grouping the source terms in this analysis eliminates these problems.

<u>Consequence Analysis</u>. The consequence analysis for the current NUREG-1150 does not differ so markedly from that for the previous version of NUREG-1150 as does the accident progression analysis and the source term analysis. Version 1.4 of MACCS was used for the original analysis, while version 1.5 is used for this analysis. The major difference between the two versions is in the data used in the lung model. Version 1.4 used the lung data contained in the original version of "Health Effects Models for Nuclear Power Plant Accident Consequence Analysis",[3] whereas version 1.5

of MACCS uses the lung data from Revision 1 (1989) of this report.[4] Other changes were made to the structure of the code in the transition from 1.4 to 1.5, but the effects of these changes on the consequence values calculated are small.

Another difference in the consequence calculation is that the NRC specified evacuation of 99.5% of the population in the evacuation area for this analysis, as compared with the previous analysis in which 95% of the population was evacuated.

Risk Analysis. The risk analysis combines the results of the accident frequency analysis, the accident progression analysis, the source term analysis, and the consequence analysis to obtain estimates of risk to the offsite population and the uncertainty in those estimates. This combination of the results of the constituent analyses was performed essentially the same way for both the previous and the current analyses. The only differences are in the number of variables sampled and the number of observations in the sample.

1.4 Structure of the Analysis

The analysis of the Peach Bottom plant for NUREG-1150 is a level 3 probabilistic risk assessment composed of four constituent analyses:

1. Accident frequency analysis, which estimates the frequency of core damage for all significant initiating events;

2. Accident progression analysis, which determines the possible ways in which an accident could evolve given core damage;

3. Source term analysis, which estimates the source terms (i.e., environmental releases) for specific accident conditions; and

4. Consequence analysis, which estimates the health and economic impacts of the individual source terms.

Each of these analyses is a substantial undertaking in itself. By taking care to carefully define the interfaces between these individual analyses, the transfer of information is facilitated. At the completion of each constituent analysis, intermediate results are generated for presentation and interpretation. An overview of the assembly of these components into an integrated analysis is shown in Figure 1-2.

The NUREG-1150 plant studies are fully integrated probabilistic risk assessments in the sense that calculations leading to both risk and uncertainty in risk are carried through all four components of the individual plant studies. The frequency of the initiating event, the conditional probability of the paths leading to the consequence, and the value of the consequence itself can then be combined to obtain a risk measure. Measures of uncertainty in risk are obtained by repeating the

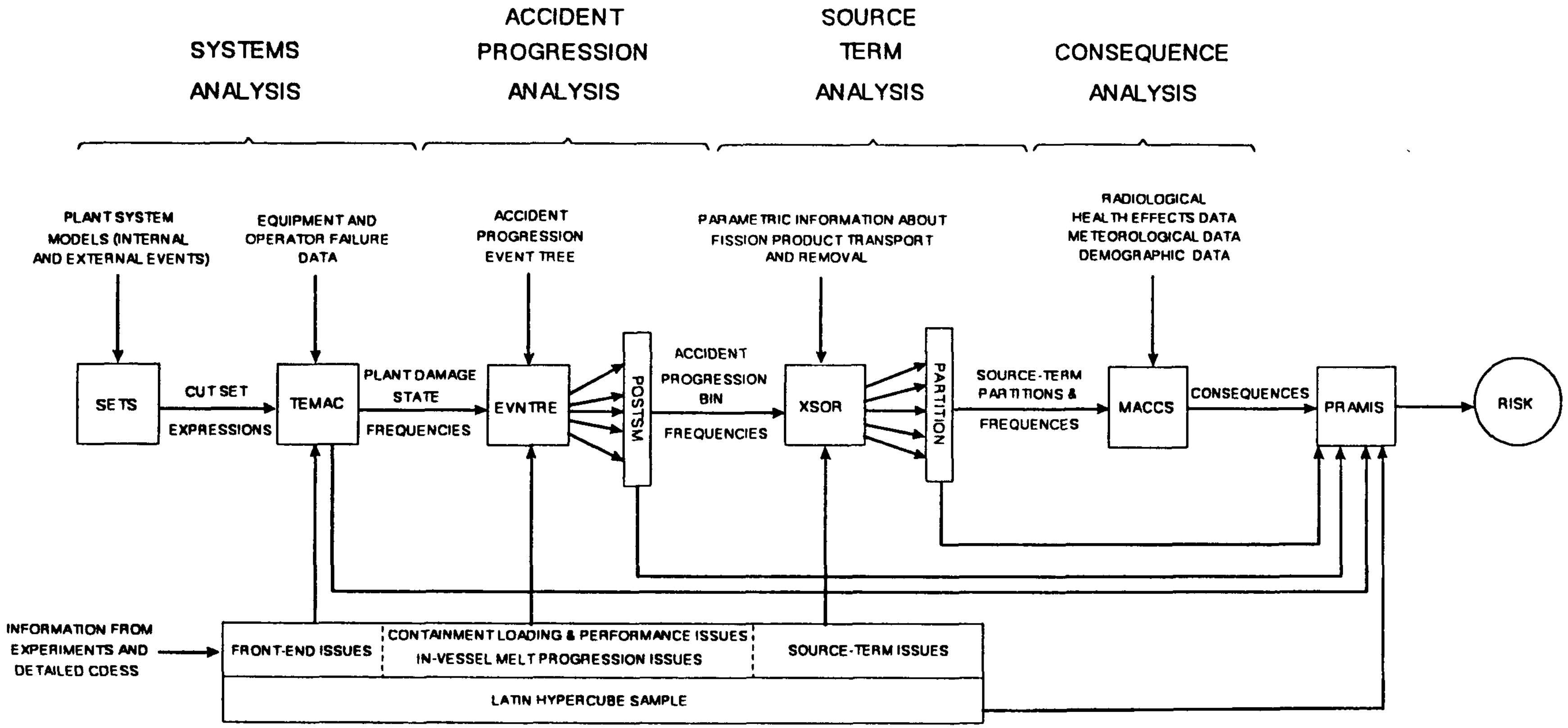

Figure 1-2. Overview of Integrated Plant Analysis in NUREG-1150.

calculation just indicated many times with different values for important parameters. This provides a distribution of risk estimates that is a measure of the uncertainty in risk.

It is important to recognize that a probabilistic risk assessment is a procedure for assembling and organizing information from many sources; the models actually used in the computational framework of a probabilistic risk assessment serve to organize this information, and as a result, are rarely as detailed as most of the models that are actually used in the original generation of this information. In order to capture the uncertainties, the first three of the four constituent analyses attempt to utilize all available sources of information for each analysis component, including past observational data, experimental data, mechanistic modeling and, as appropriate or necessary, expert judgment. This requires the use of relatively quick running models to assemble and manipulate the data developed for each analysis.

To facilitate both the conceptual description and the computational implementation of the NUREG-1150 analyses, a matrix representation[5,6] is used to show how the overall integrated analysis fits together and how the progression of an accident can be traced from initiating event to offsite consequences.

Accident Frequency Analysis. The accident frequency analysis uses event tree and fault tree techniques to investigate the manner in which various initiating events can lead to core damage. In initial detailed analyses, the SETS program[7] is used to combine experimental data, past observational data and modeling results into estimates of core damage frequency. The ultimate outcome of the initial accident frequency analysis for each plant is a group of minimal cut sets that lead to core damage. Detailed descriptions of the systems analyses for the individual plants are available elsewhere.[8,9,10,11,12] For the final integrated NUREG-1150 analysis for each plant, the group of risk-significant minimal cut sets is used as the systems model. In the integrated analysis, the TEMAC program[13,14] is used to evaluate the minimal cut sets. The minimal cut sets themselves are grouped into PDSs, where all minimal cut sets in a PDS provide a similar set of conditions for the subsequent accident progression analysis. Thus, the PDSs form the interface between the accident frequency analysis and the accident progression analysis.

With use of the transition matrix notation, the accident progression analysis may be represented by

$$\mathrm{fPDS} = \mathrm{fIE}\ \mathrm{P(IE{\rightarrow}PDS)}, \tag{1.1}$$

where **fPDS** is the vector of frequencies for the PDSs, **fIE** is the vector of frequencies for the initiating events, and **P(IE→PDS)** is the matrix of transition probabilities from initiating events to the PDSs. Specifically:

$fIE = [fIE_1, \ldots, fIE_{nIE}]$,
fIE_i = frequency (yr^{-1}) for initiating event i,
nIE = number of initiating events,
$fPDS = [fPDS_1, \ldots, fPDS_{nPDS}]$,
$fPDS_j$ = frequency (yr^{-1}) for plant damage state j,
nPDS = number of PDSs,

$$\mathbf{P(IE \rightarrow PDS)} = \begin{bmatrix} pPDS_{11} & \cdots & pPDS_{1,nPDS} \\ \vdots & & \vdots \\ pPDS_{nIE,1} & \cdots & pPDS_{nIE,nPDS} \end{bmatrix}$$

and

$pPDS_{ij}$ = probability that initiating event i will lead to plant damage state j.

The elements $pPDS_{ij}$ of **P(IE→PDS)** are conditional probabilities: given that initiating event i has occurred, $pPDS_{ij}$ is the probability that plant damage state j will also occur. The elements of **P(IE→PDS)** are determined by the analysis of the minimal cut sets with the TEMAC program. In turn, both the cut sets and the data used in their analysis come from earlier studies that draw on many sources of information. Thus, although the elements $pPDS_{ij}$ of **P(IE→PDS)** are represented as though they are single numbers, in practice these elements are functions of the many sources of information that went into the accident frequency analysis.

Accident Progression Analysis. The accident progression analysis uses event tree techniques to determine the possible ways in which an accident might evolve from each PDS. Specifically, a single event tree is developed for each plant and evaluated with the EVNTRE computer program.[15] The definition of each PDS provides enough information to define the initial conditions for the accident progression event tree (APET) analysis. Due to the large number of questions in the Peach Bottom APET and the fact that many of these questions have more than two outcomes, there are far too many paths through each tree to permit their individual consideration in subsequent source term and consequence analysis. Therefore, the paths through the trees are grouped into accident progression bins, where each bin is a group of paths through the event tree that define a similar set of conditions for source term analysis. The properties of each accident progression bin define the initial conditions for the estimation of the source term.

Past observations, experimental data, mechanistic code calculations, and expert judgment were used in the development and parameterization of the model for accident progression that is embodied in the APET. The transition matrix representation for the accident progression analysis is

$$\mathbf{fAPB} = \mathbf{fPDS}\ \mathbf{P(PDS \rightarrow APB)}, \qquad (1.2)$$

where **fPDS** is the vector of frequencies for the PDSs defined in Eq. 1.1, **fAPB** is the vector of frequencies for the accident progression bins, and **P(PDS→APB)** is the matrix of transition probabilities from PDSs to accident progression bins. Specifically:

fAPB = $[fAPB_1, \ldots, fAPB_{nAPB}]$,

$fAPB_k$ = frequency (yr^{-1}) for accident progression bin k,

nAPB = number of accident progression bins,

$$\mathbf{P(PDS\to APB)} = \begin{bmatrix} pAPB_{11} & \cdots & pAPB_{1,nAPB} \\ \vdots & & \vdots \\ pAPB_{nPDS,1} & \cdots & pAPB_{nPDS,nAPB} \end{bmatrix}$$

and

$pAPB_{jk}$ = probability that plant damage state j will lead to accident progression bin k.

The properties of **fPDS** are given in conjunction with Eq. 1.1. The elements $pAPB_{jk}$ of **P(PDS→APB)** are determined in the accident progression analysis by evaluating the APET with EVNTRE for each PDS group.

Source Term Analysis. The source terms are calculated for each APB with a non-zero conditional probability by a fast-running parametric computer code entitled PBSOR. PBSOR is not a detailed mechanistic model and makes no pretense of modeling the fission product transport, physics, and chemistry from first principles. Instead, PBSOR integrates the results of many detailed codes and the conclusions of many experts. The experts, in turn, based many of their conclusions on the results of calculations with codes such as the Source Term Code Package,[16,17] MELCOR, and MAAP. Most of the parameters utilized calculating the fission product release fractions in PBSOR are sampled from distributions provided by an expert panel. Because of the large number of MEAN SOURCE TERMS, use of fast-executing code like PBSOR is absolutely necessary.

The number of APBs for which source terms are calculated is so large that it was not practical to perform a consequence calculation for every source term. That is, the consequence code, MACCS,[18,19,20] required so much computer time to calculate the consequences of a source term that the source terms had to be combined into source term groups. Each source term group is a collection of source terms that result in similar consequences. The frequency of the source term group is the sum of the frequencies of all the APBs which make up the group. The process of determining which APBs go to which source term group is denoted partitioning. It involves considering the potential of each source term group to cause early fatalities and latent cancer fatalities. Partitioning is a complex process; it is discussed in detail in Volume 1 of this report and in the User's Guide for the PARTITION Program.[21]

The transition matrix representation of the source term calculation and the grouping process is

$$\mathbf{fSTG} = \mathbf{fAPB}\ \mathbf{P(APB{\rightarrow}STG)} \tag{1.3}$$

where **fAPB** is the vector of frequencies for the accident progression bins defined in Eq. 1.2, **fSTG** is the vector of frequencies for the source term groups, and **P(APB→STG)** is the matrix of transition probabilities from accident progression bins to source term groups. Specifically,

$\mathbf{fSTG} = [fSTG_1, \ldots, fSTG_{nSTG}]$,

$fSTG_\ell$ = frequency (yr^{-1}) for source term group ℓ,

nSTG = number of source term groups,

$$\mathbf{P(APB{\rightarrow}STG)} = \begin{bmatrix} pSTG_{11} & \cdots & pSTG_{1,nSTG} \\ \vdots & & \vdots \\ pSTG_{nAPB,1} & \cdots & pSTG_{nAPB,nSTG} \end{bmatrix}$$

and

$$pSTG_{k\ell} = \text{probability that accident progression bin k will be assigned to source term group } \ell.$$

$$= \begin{cases} 1 & \text{if accident progression bin k is assigned to source term group } \ell \\ 0 & \text{otherwise.} \end{cases}$$

The properties of **fAPB** are given in conjunction with Eq. 1.2. Note that the source terms themselves do not appear in Eq. 1.4. The source terms are used only to assign an APB to a source term group. The consequences for each APB are computed from the average source term for the group to which the APB has been assigned.

<u>Consequence Analysis</u>. The consequence analysis is performed for each source term group by the MACCS program. The results for each source term group include estimates for both mean consequences and distributions of consequences. When these consequence results are combined with the frequencies for the source term groups, overall measures of risk are obtained. The consequence analysis differs from the preceding three constituent analyses in that uncertainties are not explicitly treated in the consequence analysis. That is, important values and parameters are determined from distributions by a sampling process in the accident

frequency analysis, the accident progression analysis, and the source term analysis. This is not the case for the consequences in the analyses performed for NUREG-1150.

In the transition matrix notation, the risk may be expressed by

$$\mathbf{rC} = \mathbf{fSTG}\ \mathbf{cSTG} \tag{1.4}$$

where **fSTG** is the vector of frequencies for the source term groups defined in Eq. 1.3, **rC** is the vector of risk measures, and **cSTG** is the matrix of mean consequence measures conditional on the occurrence of individual source term groups. Specifically,

$\mathbf{rC} = [rC_1, \ldots, rC_{nC}]$,

rC_m = risk (consequence/yr) for consequence measure m,

nC = number of consequence measures,

$$\mathbf{cSTG} = \begin{bmatrix} cSTG_{11} & \cdots & cSTG_{1,nC} \\ \vdots & & \vdots \\ cSTG_{nSTG,1} & \cdots & cSTG_{nSTG,nC} \end{bmatrix}$$

and

$cSTG_{\ell m}$ = mean value (over weather) of consequence measure m conditional on the occurrence of source term group ℓ.

The properties of **fSTG** are given in conjunction with Eq. 1.3. The elements $cSTG_{\ell m}$ of **cSTG** are determined from consequence calculations with MACCS for individual source term groups.

Computation of Risk. Equations 1.1 through 1.4 can be combined to obtain the following expression for risk:

$$\mathbf{rC} = \mathbf{fIE}\ \mathbf{P(IE \rightarrow PDS)}\ \mathbf{P(PDS \rightarrow APB)}\ \mathbf{P(APB \rightarrow STG)}\ \mathbf{cSTG}. \tag{1.5}$$

This equation shows how each of the constituent analyses enters into the calculation of risk, starting from the frequencies of the initiating events and ending with the calculation of consequences. Evaluation of the expression in Eq. 1.5 is performed with the PRAMIS[22] and RISQUE codes.

The description of the complete risk calculation so far has focused on the computation of mean risk (consequences/year) because doing so makes the overall structure of the NUREG-1150 PRAs more easy to comprehend. The mean risk results are derived from the frequency of the initiating events, the conditional probabilities of the many ways that each accident may evolve and the probability of occurrence for each type of weather sequence at the time of an accident. The mean risk, then, is a summary risk measure.

More information is conveyed when distributions for consequence values are displayed. The form typically used for this is the complementary cumulative distribution function (CCDF). CCDFs are defined by pairs of values (c,f), where c is a consequence value and the f is the frequency with which c is exceeded. Figure 1-3 is an example of a CCDF. The construction of CCDFs is described in Volume 1 of this report. Each mean risk result is the outcome from reducing a mean CCDF curve, of the form shown in Figure 1-3, to a single value. While the mean risk results are often useful for summaries or high-level comparisons, the CCDF is the more basic measure of risk because it displays the relationship between the size of the consequence and frequency exceedance. The nature of this relationship, i.e., that high consequence events are much less likely than low consequence events is lost when mean risk results alone are reported. This report utilizes both mean risk and CCDFs to report the risk results.

<u>Propagation of Uncertainty through the Analysis</u>. The integrated NUREG-1150 analyses use Monte Carlo procedures as a basis for both uncertainty and the sensitivity analysis. This approach utilizes a sequence:

$$X_1, X_2, \ldots, X_{nV} \tag{1.6}$$

of potentially important variables, where nV is the number of variables selected for consideration. Most of these variables were considered by a panel of experts representing the NRC and its contractors, the academic world, and the nuclear industry. For each variable treated in this manner, two to six experts considered all the information at their disposal and provided a distribution for the variable. Formal decision analysis techniques[23] (also in Vol. 2 of this report) were used to obtain and record each expert's conclusions and to aggregate the assessments of the individual panel members into a summary distribution for the variable. Thus, a sequence of distributions

$$D_1, D_2, \ldots, D_{nV}, \tag{1.7}$$

is obtained, where D_i is the distribution assigned to variable X_i.

From these distributions, a stratified Monte Carlo technique, Latin hypercube sampling,[24,25] is used to obtain the variable values that will actually be propagated through the integrated analysis. The result of generating a sample from the variables in Eq. 1.6 with the distributions in Eq. 1.7 is a sequence

$$S_i = [X_{i1}, X_{i2}, \ldots, X_{i,nV}],\ i = 1, 2, \ldots, nLHS, \tag{1.8}$$

of sample elements, where X_{ij} is the value for variable X_j in sample element i and nLHS is the number of elements in the sample. The expression in Eq. 1.5 is then determined for each element of the sample. This creates a sequence of results of the form

$$rC_i = fIE_i\ P_i(IE\rightarrow PDS)\ P_i(PDS\rightarrow APB)\ P_i(APB\rightarrow STG)\ cSTG, \tag{1.9}$$

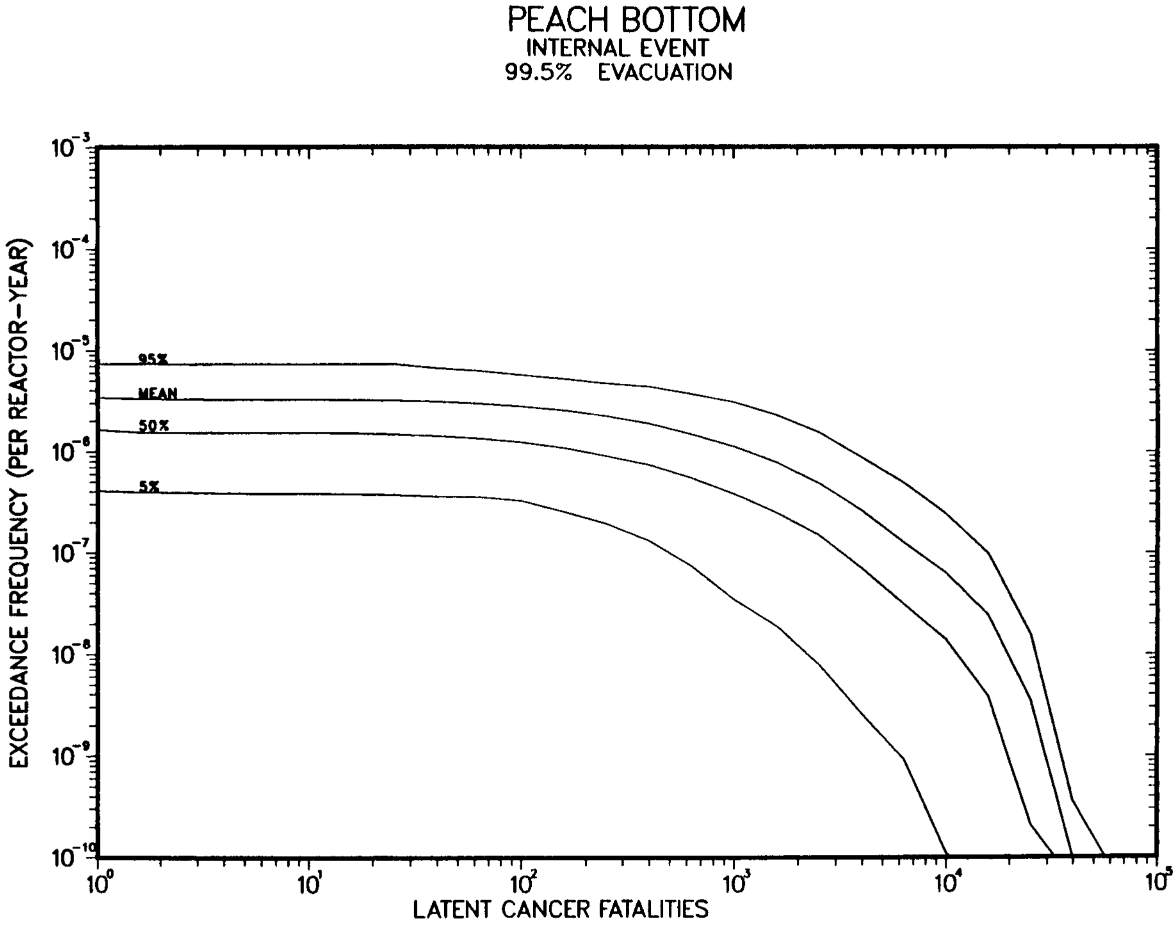

Figure 1-3. Example Risk CCDF.

where the subscript i is used to denote the evaluation of the expression in Eq. 1.5 with the i^{th} sample element in Eq. 1.8. The uncertainty and sensitivity analyses in NUREG-1150 are based on the calculations summarized in Eq. 1.9. Since **P(IE→PDS)**, **P(PDS→APB)** and **P(APB→STG)** are based on results obtained with TEMAC, EVNTRE and PBSOR, determination of the expression in Eq. 1.9 requires a separate evaluation of the cut sets, the APET, and the source term model for each element or observation in the sample. The matrix **cSTG** in Eq. 1.9 is not subscripted because the NUREG-1150 analyses do not include consequence modeling uncertainty other than the stochastic variability due to weather conditions.

1.5 Organization of this Report

This report is published in seven volumes as described briefly in the Foreword. The first volume of NUREG/CR-4551 describes the methods used in the accident progression analysis, the source term analysis, and the consequence analysis, in addition to presenting the methods used to assemble the results of these constituent analyses to determine risk and the uncertainty in risk. The second volume describes the results of convening expert panels to determine distributions for the variables thought to be the most important contributors to uncertainty in risk. Panels were formed to consider in-vessel processes, loads to the containment, containment structural response, molten core-containment interactions, and source term issues. In addition to documenting the results of these panels for about 30 important parameters, Volume 2 includes supporting material used by these panels and presents the results of distributions that were determined by other means.

Volumes 3 through 6 present the results of the accident progression analysis, the source term analysis, and the consequence analysis, and the combined risk results for Surry, Peach Bottom, Sequoyah, and Grand Gulf, respectively. These analyses were performed by SNL. Volume 7 presents analogous results for Zion. The Zion analyses were performed by BNL.

This volume of NUREG/CR-4551, Volume 4, presents risk and constituent analysis results for Unit 2 of the Peach Bottom Atomic Power Station, operated by Philadelphia Electric Company (PECO). Part 1 of this volume presents the analysis and the results in some detail; Part 2 consists of appendices which contain further detail. Following a summary and an introduction, Chapter 2 of this volume presents the results of the accident progression analysis for internal initiating events. Chapter 3 presents the result of the source term analysis. Chapter 4 gives the result of the consequence analysis. Chapter 5 summarizes the risk results, including the contributors to uncertainty in risk, for Peach Bottom. Finally, chapter 6 contains the insights and conclusions of the complete analysis.

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2. ANALYSIS OF THE ACCIDENT PROGRESSION

This chapter describes the analysis of the progression of the accidents, starting from when core damage is eminent (i.e., either water is two feet above the bottom of the active fuel or, for core vulnerable sequences, the uncovering of the top of active fuel (UTAF)) and continuing for about 24 hours or until the bulk of the radioactive material that is going to be released has been released. As the last barrier to the release of the fission products to the environment, the response of the containment to the stresses placed upon it by the degradation of the core and failure of the reactor vessel is an important part of this analysis. The main tool for performing the accident progression analysis is a large and complex event tree. The methods used in the accident progression analysis are presented in Volume 1 of this report. The accident progression analysis starts with information received from the accident frequency analysis: frequencies and definitions of the plant damage states (PDSs). The results of the accident progression analysis are passed to the source term analysis and the risk analysis.

Section 2.1 reviews the plant features that are important to the accident progression analysis and the containment response. Section 2.2 summarizes the results of the accident frequency analysis, defines the PDSs, and presents their frequencies. Section 2.3 contains a brief description of the accident progression event tree (APET). A detailed listing of the APET is contained in Appendix A. Section 2.4 describes the way in which the results of the evaluation of the APET are grouped together into bins. This grouping is necessary to reduce the information resulting from the APET evaluation to a manageable amount while still preserving the information required by the source term analysis. Section 2.5 presents the results of the accident progression analysis for internal initiators, fires, and earthquakes.

2.1 Plant Features Important to Accident Progression at Peach Bottom

The entire Peach Bottom plant was briefly described in Section 1.2 of this volume. This section provides more detail on the features that are important to the progression of a core degradation accident and the response of the containment to the stresses placed upon it. These features are:

the primary containment structure;
the reactor pedestal cavity;
the containment heat removal system;
the Automatic Depressurization system;
the primary containment venting system; and
the reactor building design.

2.1.1 The Peach Bottom Primary Containment Structure

Peach Bottom has a Mark I containment. The Mark I containment at Peach Bottom is composed of two connected structures (see Figure 1.1). The first structure, the drywell, is a light-bulb shaped steel pressure vessel containing the reactor vessel, the reactor coolant recirculation systems, and other primary system piping. The drywell is surrounded by reinforced concrete for shielding purposes. It is imbedded in the concrete at the bottom; but, above the drywell foundation, it is separated from the concrete by an air gap of approximately 2 in. At the top, the drywell head can be removed to have access from the refueling floor and during operation it is covered by a removable, segmented, reinforced concrete shield plug.

The second structure, the wetwell or torus, is a toroidal shaped steel pressure vessel placed below and encircling the drywell. The wetwell is not directly enclosed by concrete but is located in a large room below ground level. The wetwell is connected to the drywell via vent lines that feed into a header inside the wetwell and then to downcomers which extend down into the water forming the suppression pool that half fills the wetwell. Steam released from the reactor vessel to the drywell on vessel failure is conducted down these vent lines into the suppression pool and condensed. Steam exiting the reactor vessel via the RPV safety/relief valves (including those associated with ADS operation) is also discharged, through spargers, into the suppression pool. Thus, all of the in-vessel releases are first passed through the pool before being released to the wetwell air space; while, releases directly to the drywell are only partially passed into the suppression pool. Vacuum breakers allow high pressure in the wetwell to be relieved back into the drywell so as to maintain less than 2 psig pressure differential between the two volumes.

The drywell has a free volume of 159,000-175,000 cu. ft. The wetwell has a free volume of 127,700-132,000 cu. ft. and a water volume of 122,900-127,300 cu. ft. The design pressure of the containment is 56 psig; however, with all the design conservatism used in its construction, the expert panel which assessed the failure pressure concluded that the mean failure pressure would be 150 psig. Due to concerns about hydrogen burns, the containment is inerted with nitrogen during plant operation.

2.1.2 The Reactor Pedestal Cavity

The reactor pedestal cavity is located directly below the reactor pressure vessel (see Figure 1.1). The cavity wall is 3.125 ft. thick and the bottom is imbedded into the concrete forming the drywell floor. The pedestal cavity is essentially a right circular cylinder with a diameter of 20.25 ft. and a height of approximately 26.89 ft.

The upper section of the cavity next to the bottom of the reactor vessel contains the control rod drive (CRD) housings. The expert panels evaluating debris ejection modes upon vessel failure considered the effect of this 'rats nest' of metal on the exiting debris and subsequent impact on the cavity floor.

The major pedestal penetrations are the CRD piping penetrations at the top of the pedestal, the CRD removal opening which is a 2.5 ft. by 6.5 ft.

doorway located 9 ft. above the cavity floor, and a 3.4 ft. by 7.2 ft. personnel access door flush with the drywell floor. The cavity with its sump can not contain all the core debris expected to be released at the time of vessel breach and direct attack of the drywell steel wall is possible as the debris spreads out from the cavity through the personnel access door.

The bottom of the vent lines from the drywell to the wetwell are about 34 in. from the drywell floor so that the maximum water depth is limited to this height. This amount of water, while small compared to the amount at a plant like Grand Gulf, can be an important consideration for several phenomena. The water may affect the probability of drywell failure by attack from debris spreading across the floor. In fact, the experts did consider this as a significant factor leading to a decrease in the probability of drywell failure in cases where continuous water sources were present. The presence of water also allows for the possibility of fuel coolant interactions (FCIs). These FCIs can result in steam explosions that can potentially fail the reactor pedestal from impulse loads or overpressure (this can lead to drywell failure from piping penetration failures as a result of the reactor vessel motion) or direct failure of the drywell from quasi-static pressure loads (the water depth is too shallow for impulse loads to be transmitted directly to the drywell wall). Continuous amounts of water of this depth can also affect the evolution of the core-concrete interactions (CCI).

2.1.3 The Containment Heat Removal System

Suppression Pool Cooling (SPC) and the Containment Spray System (CSS) are two modes of the Residual Heat Removal (RHR) System which can be used to remove heat from the containment. The RHR system has two other modes of operation; Shutdown Cooling (SDC), which is used to circulate water to the RPV and remove heat directly from the vessel, and Low Pressure Injection (LPCI), which is used to inject coolant into the primary system but does not remove heat. The SPC system takes water from the suppression pool, passes it through heat exchangers, and discharges it back into the suppression pool. The CSS system takes water from the suppression pool, passes it through heat exchangers, and discharges the water through spray headers in the drywell. In either case, energy is removed from the primary containment and temperature and pressure remain low.

There are two loops with two trains in each loop. Each train has one pump and one heat exchanger. Success is any one of the four trains operating. The discharge lines are varied to get the different modes. Both modes are emergency AC powered and are unavailable in station blackout scenarios.

2.1.4 The Automatic Depressurization System

The Automatic Depressurization System (ADS) is designed to depressurize the reactor vessel to a pressure at which the low pressure injection systems can inject coolant into the reactor vessel. The ADS consists of five relief valves capable of being manually opened in addition to their automatic logic (there are an additional six safety relief valves which are not connected to the ADS logic but could be used to depressurize the RPV manually if the ADS valves fail in a way that leaves the other valves operational). For the system to be automatically initiated a low pressure injection pump must be operating (one LPCI or two LPCS) and either 1) a low-low RPV water level signal with an eight minute delay or 2) a low-low RPV water level and a high drywell pressure signal with a two minute delay must be received. The operator can inhibit ADS operation if a spurious ADS signal is generated or if directed to by procedures (i.e. as in ATWS scenarios).

In station blackout conditions ADS will not automatically initiate since no low pressure injection pumps will be working. The operator must manually depressurize in this case.

The ADS discharges into the suppression pool via piping from the main steam lines to the downcomers. The ADS valves are located in the drywell and containment pressures of approximately 100 psia will prevent opening of the valves or result in their reclosure. The assessed mean containment failure pressure is 150 psig; so closing of the valves must be considered in long-term sequences with failure of containment heat removal. Also, the ADS system requires DC power and, therefore, the RPV can not be or remain depressurized in sequences with initial DC failure or battery depletion.

2.1.5 The Primary Containment Venting System

If primary containment heat removal fails, the containment pressure will increase up to the failure pressure due to the energy being added to the containment from the decay heat of the fuel or from core concrete interactions after RPV failure. In order to prevent structural failure of the containment, the Primary Containment Venting (PCV) system can be used to obtain a controlled release of pressure and radionuclides from the containment.

Primary containment venting at Peach Bottom currently takes place at 100 psig pressure in the containment and uses the following nine paths in order from one to nine: 1) 2-in pipe from the torus to the Standby Gas Treatment System (SBGTS), 2) 2-in pipe from the drywell to the SBGTS, 3) 6-in Integrated Leak Rate Test (ILRT) pipe from the torus to the environment, 4) 18-in torus vent via ductwork to the SBGTS, 5) 18-in torus supply path, 6) 6-in ILRT pipe from drywell, 7) 18-in drywell vent via ductwork to the SBGTS, 8) 18-in drywell supply path, and 9) two 3-in drywell sump drain pipes.

In accident conditions the two inch lines will not be sufficient to prevent containment pressure from increasing and the 6-in ILRT line will be used. In ATWS scenarios, the energy generation rate will require three or all four of the 18-in lines to relieve pressure, assuming power levels out at approximately 15%.

The effects of venting depend strongly on whether code damage has occurred or not. If core damage has not occurred then, if the 6-inch line is used, steam will be released directly to the environment and no adverse environments will be created in the reactor building. If an 18-in line is used, the ductwork will certainly fail and the reactor building will be flooded with high temperature steam. Safety equipment in the reactor building may fail in the severe environments. For use in this PRA, the probability of system failures for venting or containment failure were evaluated as part of the Level I analysis by an expert panel. For cases with no core damage, venting through the 6-inch line instead of going to an 18-inch line is, therefore, preferable since core damage may continue to be prevented if emergency systems are not affected by severe environments. If core damage has occurred then a specific evaluation would need to be made to determine if a controlled, slow release directly to the environment through a 6-in pipe would be better than an 18-in release to the reactor building with its additional decontamination factor.

2.1.6 The Reactor Building Design

The reactor building at Peach Bottom completely encloses the primary containment (see Figure 1.1). The building has several floors which are isolated from each other except for a large open hatch that runs up to the refueling floor in the southeast corner and two stairwells in the southwest and northeast corners of the building. Steam released into the building will mostly go up the open hatch to the refueling floor and then out the blowout panels to the environment. A path exists from the reactor building to the turbine building via a wire door and hatch into the steam tunnel and then through the blowout panels at the end of the steam tunnel. Any venting by 18-in lines or containment failure in the reactor building (weather by leak or rupture) will likely create pressures in excess of 2 psig and will open all of these paths. However, not much steam will get to the turbine building since the path is much smaller than the path to the refueling floor.

While much equipment is qualified for harsh environments of various kinds, for a PRA we must worry about the reliability of the equipment. An expert panel was asked to evaluate the reliability of several kinds of equipment in a range of environments that were calculated to exist in various locations in the Peach Bottom reactor building after containment failure or venting. Mini-system models including only the equipment subject to the severe environments were constructed and quantified using the experts numbers. The probabilities of system failures generated in this manner were used in the Level I analysis to resolve core vulnerable sequences and in the Level II analysis to quantify various questions in the APET pertaining to continued mitigating system operation and resolve the ATWS sequences.

2.2 Interface with the Core Damage Frequency Analysis

2.2.1 Definition of Plant Damage States

Information about the many different accidents that lead to core damage is passed from the core damage frequency analysis to the accident progression analysis by means of plant damage states (PDSs). Because most of the accident sequences identified in the core damage frequency analysis will have accident progressions similar to other sequences, these sequences have been grouped together into plant damage states. All the sequences in one PDS should behave similarly in the period after core damage has begun. For Peach Bottom, the PDS is denoted by a sixteen-number indicator that defines sixteen characteristics that largely determine the initial and boundary conditions of the accident progression. More information about the accident sequences may be found in NUREG/CR-4550, Volume 4.[1] The methods used in the accident frequency analysis are presented in NUREG/CR-4550, Volume 1.[2]

Table 2.2-1 lists the sixteen characteristics used to define the PDSs for Peach Bottom. Under each characteristic are given the possible values for that characteristic. For example, the first characteristic denotes the initiating event. Table 2.2-1 shows that there are six possibilities for this characteristic:

A = Large break in the PCS pressure boundary,
S_1 = Intermediate break in the PCS pressure boundary,
S_2/S_3 = Small or Small-small break in the PCS pressure boundary,
T = Transient resulting in reactor trip, no LOCA,
TC = Transient followed by failure to scram (ATWS), and
IORV = Inadvertent stuck-open relief valve.

The first characteristic denotes the initiating event and is split into groups which have different effects upon reactor power and RPV pressure: LOCAs of various sizes, transients, ATWS, and IORVs.

The second characteristic describes the state of offsite power and whether or not it is recoverable. For fire and seismic sequences, where LOSP occurs, recovery of offsite power is usually not taken credit for due to the assumed severity of the damage.

The third characteristic denotes whether or not onsite AC has also been lost. If a station blackout occurs, all AC powered systems are unavailable.

The fourth characteristic denotes the status of DC power at the start of the accident and when it is likely to fail by depletion if AC charging is not available.

The fifth characteristic addresses the possibility of getting a transient induced LOCA due to a stuck open SRV. This would be similar to

Table 2.2-1
Peach Bottom Plant Damage State Characteristics

1. What is the Initiating Event?
1 = A = Large break in the PCS pressure boundary
2 = S_1 = Intermediate break in the PCS pressure boundary
3 = S_2/S_3 = Small or Small-small break in the PCS pressure boundary
4 = T = Transient resulting in reactor trip, no LOCA
5 = TC = Transient followed by failure to scram (ATWS)
6 = IORV = Inadvertent stuck-open relief valve

2. Does a Loss of Offsite Power (LOSP) occur?
1 = Seismic or Fire induced LOSP
2 = LOSP
3 = No LOSP

3. Does a Station Blackout (SB) occur?
1 = All on site AC power is lost, SB occurs
2 = Either LOSP has not occurred or at least one DG is operating

4. What is the Status of DC Power?
1 = DC power has failed
2 = DC power is available
3 = DC power lost by battery depletion around three hours
4 = DC power lost by battery depletion around five hours
5 = DC power lost by battery depletion around seven hours
6 = DC power lost by battery depletion around nine hours
7 = DC power lost after twelve hours

5. Does an SRV stick open?
1 = Yes
2 = No

6. What is the status of high pressure injection (RCIC or HPCI)?
1 = Both systems have failed
2 = At least one is working

7. What is the status of the CRD system?
1 = CRD is failed
2 = CRD is recoverable if AC power is restored
3 = CRD is operating

8. What is the RPV pressure?
1 = The RPV is at high pressure and can not be depressurized
2 = The RPV is at high pressure but can be manually depressurized
3 = The RPV is at low pressure

Table 2.2-1 (Continued)
Peach Bottom Plant Damage State Characteristics

9\. What is the status of low pressure injection (LPCS/LPCI)
1 = Both systems have failed
2 = At least one is recoverable if AC power is restored
3 = At least one is available if reactor pressure is lowered
4 = At least one is working

10\. What is the status of containment heat removal?
1 = Residual Heat Removal (RHR) has failed
2 = RHR is recoverable if AC power is restored
3 = RHR is working

11\. What is the status of the condensate system (CDS)?
1 = The system is failed
2 = The system is recoverable if AC power is restored
3 = The system is available if RPV pressure is lowered
4 = The system is working

12\. What is the status of High Pressure Service Water (HPSW)?
1 = The system is failed
2 = The system is recoverable if AC power is restored
3 = The system is available for manual actuation if RPV pressure is lowered
4 = The system is working

13\. What is the status of containment spray (CSS mode of RHR)?
1 = The system is failed
2 = The system is recoverable if AC power is restored
3 = The system is available for manual actuation
4 = The system is working

14\. What is the status of containment venting?
1 = The containment has not been vented
2 = The containment has been vented in the drywell (no ATWS)
3 = The containment has been vented in the drywell (ATWS)
4 = The containment has been vented in the wetwell (ATWS)
5 = The containment has been vented in the wetwell (no ATWS)

15\. What is the level of pre-existing leakage or isolation failure?
1 = Nominal leakage only
2 = Pre-existing leak
3 = Pre-existing rupture
4 = Isolation failure - leak
5 = Isolation failure - rupture

Table 2.2-1 (Concluded)
Peach Bottom Plant Damage State Characteristics

16. What is the location of pre-existing leakage or isolation failure?
1 = No leak, Containment Intact
2 = Drywell failure
3 = Drywell Head failure
4 = Wetwell failure

characteristic 1 choice 6, IORV, but occurring later in the transient. This is different from an ordinary LOCA since the discharge is to the suppression pool.

The sixth characteristic denotes the status of the steam-driven, high flow, high pressure injection systems, HPCI and RCIC. These are either working or failed, since they are DC/Steam systems and system pressure and AC power status does not directly affect them.

The seventh characteristic denotes the status of the CRD system. CRD is either working, failed, or unavailable due to loss of AC power. Since it is a high pressure system it can always inject if working.

The eighth characteristic denotes the reactor vessel pressure at the time of core damage. The reactor pressure can be either high or low and, if high, it may or may not be able to be manually depressurized.

The ninth characteristic denotes the status of the low pressure ECCS systems, LPCS and LPCI. Either both systems have failed, at least one train of one system is working, AC power is not available but at least one train would work if AC was recovered, or the RPV is currently at high pressure but at least one train would work if RPV pressure decreased.

The tenth characteristic denotes the status of the containment heat removal system in any of its modes (SPC, or CSS). Either it has failed, it is working, or it is available if AC power is recovered.

The eleventh characteristic denotes the status of the condensate system, an intermediate pressure injection system. It is either failed , recoverable upon AC recovery, available on RPV depressurization, or working.

The twelfth characteristic denotes the status of the high pressure service water system which is not really high pressure in the sense of HPCI or RCIC but is equivalent to a low pressure ECCS system that must be manually aligned. It can be failed, recoverable upon AC recovery, available on RPV depressurization, or working.

The thirteenth characteristic denotes the status of the containment spray mode of operation of the containment heat removal system. This is important for fission product scrubbing in the drywell. It is either failed, recoverable if AC is restored, available but not manually actuated, or working.

The fourteenth characteristic denotes the status of containment venting. This is important for determining the containment response and reactor building and suppression pool conditions and their effects upon various injection systems, etc. Either no venting has occurred or venting from the wetwell or drywell is possible. The result of venting will be different for different sequences as described in section 2.1.5.

The fifteenth characteristic denotes the level of containment leakage at the start of the accident. Either no leakage (technical specification level only), leak, or rupture is possible.

The sixteenth characteristic denotes the location of the initial leakage. This is import for determining the overall decontamination factor for releases. The locations are the drywell head, the drywell, or the wetwell.

2.2.2 Plant Damage State Frequencies

In this subsection the nine internal, four fire, and seven seismic PDSs are described and their core damage or core vulnerable frequencies are presented. These 20 PDSs are all those that survived the Level I analysis and they account for 100% of the internal, 100% of the fire, and >99% of the seismic total mean core damage frequency (TMCDF), reported in the Level I analyses. The accident frequencies for the Level I analyses were performed with more observations per sample than were the accident progression analyses and subsequent analyses. Since the samples used different random seeds, a different number of variables, and a different number of observations; the core damage frequencies used in the Level II and III analyses differ slightly from those in the Level I analyses. The PDSs used in the Peach Bottom accident progression, source term, consequence, and risk integration analyses are presented in Tables 2.2-2a,b,c,d. The mean core damage frequencies presented in these tables are based on a sample size of 200.

The accident frequency analyses report the PDS frequencies based on a sample size of 1001 (see Section 5 of NUREG/CR-4550, Vol. 4, Part 1 and Part 3[1]). When considered as a separate entity, a great many variables could be sampled in the accident frequency analyses, and so a sample size of 1001 was used. A sample of this size was not feasible for use in the integrated risk analysis. Based on the results from the 1001-observation sample, those variables which were not found to be important contributors to the uncertainty in the core damage frequencies were eliminated from the sampling, and the cut sets were re-evaluated using 200 observations for the integrated risk analysis. As some variation from sample to sample is observed even when the sample size and the variables sampled remain the same, there are variations between the 1001-observation sample utilized in the stand-alone accident frequency analyses and the 200-observation sample used in the integrated risk analysis. These differences are summarized in Tables 2.2-3a-f.

For each PDS, the first line of Tables 2.2-3a-f contains the 5th percentile, median, mean, and 95th percentile core damage frequencies for the 1001-observation sample used in the stand-alone Level I analyses. Samples containing 200 observations are used for the integrated risk analysis at Peach Bottom. The 5th percentile, median, mean, and 95th percentile core damage frequencies for this sample are shown on the second line for each PDS.

Table 2.2-2a

Plant Damage States for Peach Bottom - Internal Events

PDS Number	PDS Name	Mean CD Freq. (1/yr)	PDS % TMCD Freq.	Plant Damage State Descriptor
1	LOCA, RHR	2.6E-07	5.8	1-322-2-13-3-13113-111
2	Fast transient SORV, RHR	2.2E-07	4.9	4-W22-1-13-3-13113-111*
3	Fast transient SORV, No RHR	6.1E-09	0.1	4-W22-1-13-3-11131-111*
4	Fast Blackout	2.1E-07	4.7	4-211-X-12-1-22222-111*
5	Slow Blackout	1.9E-06	42.0	4-212-X-22-3-22222-111*
6	Fast ATWS, SLC	3.0E-07	6.7	5-322-X-23-2-33333-111*
7	ATWS, SORV	1.1E-07	2.4	5-322-1-23-Y-33333-Z11*
8	ATWS	1.5E-06	33.0	5-322-2-23-Y-33333-Z11*
9	ATWS, LOSP	4.4E-08	1.0	5-222-2-23-Y-33233-Z11*

* W, X, Y, and Z are split fractions

Table 2.2-2b
Plant Damage States for Peach Bottom - Fire

PDS Number	PDS Name	Mean CD Freq. (1/yr)	PDS % TMCD Freq.	Plant Damage State Descriptor
1	Fast Transient	6.8E-06	34.0	4-322-2-12-2-22332-111
2	Slow Blackout	5.9E-06	30.0	4-11X-2-21-3-11221-111*
3	Slow Blackout	5.7E-06	29.0	4-117-2-22-3-22222-111
4	Long Transient	1.1E-06	5.5	4-122-2-21-2-41211-111

* X is a split fraction

Table 2.2-2c
Plant Damage States for Peach Bottom - Seismic, LLNL

PDS Number	PDS Name	Mean CD Freq. (1/yr)	PDS % TMCD Freq.	Plant Damage State Descriptor
1	LOSP with RPV Failure	8.9E-06	11.8	1-122-2-11-3-12112-1Z2*
2	Fast Blackout Large LOCA	1.7E-05	22.6	1-11X-2-11-3-11111-1Z2*
3	Fast Blackout Large LOCA	3.0E-06	4.0	1-111-2-11-3-11111-1Z2*
4	Slow Blackout	3.7E-05	49.1	4-11X-2-21-3-11111-111*
5	Fast Blackout	3.2E-06	4.2	4-111-Y-11-1-11111-111*
6	Fast Blackout Inter LOCA	4.7E-06	6.2	2-11X-2-11-3-11111-111*
7	Fast Blackout	1.6E-06	2.1	W-111-2-11-3-11111-111*
TOTAL		7.5E-05		

* W, X, Y, and Z are split fractions

Table 2.2-2d
Plant Damage States for Peach Bottom - Seismic, EPRI

PDS Number	PDS Name	Mean CD Freq. (1/yr)	PDS % TMCD Freq.	Plant Damage State Descriptor
1	LOSP with RPV Failure	3.3E-07	10.4	1-122-2-11-3-12112-1Z2*
2	Fast Blackout Large LOCA	6.3E-07	20.0	1-11X-2-11-3-11111-1Z2*
3	Fast Blackout Large LOCA	1.4E-07	4.3	1-111-2-11-3-11111-1Z2*
4	Slow Blackout	1.6E-06	51.0	4-11X-2-21-3-11111-111*
5	Fast Blackout	1.9E-07	6.1	4-111-Y-11-1-11111-111*
6	Fast Blackout Inter LOCA	1.9E-07	5.9	2-11X-2-11-3-11111-111*
7	Fast Blackout	7.2E-08	2.3	W-111-2-11-3-11111-111*
TOTAL		3.2E-06		

* W, X, Y, and Z are split fractions

Table 2.2-3a
Plant Damage State Comparison - Internal Events

Plant Damage State	LHS Sample Size(1)	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.(2)
PDS1	1000	2.5E-09	4.4E-08	2.6E-07	7.8E-07	5.8
LOCA	200	2.4E-09	4.3E-08	1.5E-07	6.9E-07	
PDS2	1000	1.1E-09	3.0E-08	2.2E-07	8.1E-07	4.9
Fast Trans	200	1.2E-09	3.3E-08	1.8E-07	8.7E-07	
PDS3	1000	5.9E-11	1.2E-09	6.1E-09	2.7E-08	0.1
Fast Trans	200	3.5E-11	5.3E-10	2.6E-09	7.4E-09	
PDS4	1000	3.5E-09	5.0E-08	2.1E-07	7.1E-07	4.7
Fast SBO	200	2.0E-09	5.3E-08	2.0E-07	7.0E-07	
PDS5	1000	3.5E-08	4.0E-07	1.9E-06	4.8E-06	42.0
Slow SBO	200	1.1E-07	5.9E-07	1.9E-06	3.9E-06	
PDS6	1000	3.2E-09	5.9E-08	3.0E-07	1.1E-06	6.7
Fast ATWS	200	3.6E-09	6.5E-08	3.5E-07	1.2E-06	
PDS7	1000	1.2E-09	2.3E-08	1.1E-07	3.8E-07	2.4
ATWS CV	200	2.6E-09	3.0E-08	9.9E-08	4.4E-07	
PDS8	1000	1.8E-08	2.9E-07	1.5E-06	5.6E-06	33.0
ATWS CV	200	3.8E-08	4.6E-07	1.4E-06	5.2E-06	
PDS9	1000	4.3E-10	1.0E-08	4.4E-08	1.6E-07	1.0
ATWS CV	200	9.7E-10	1.5E-08	4.7E-08	2.3E-07	
Total	1000	3.5E-07	1.9E-06	4.5E-06	1.3E-05	100.0
	200	5.3E-07	2.3E-06	4.3E-06	9.6E-06	100.0

Notes:

(1) The Accident Frequency Analysis used a LHS sample size of 1000
The Accident Progression Analysis used a LHS sample size of 200

(2) Percentages based on the LHS sample size of 1000. FCMCD, fractional contribution to mean core damage frequency.

Table 2.2-3b
Plant Damage State Comparison - Fire

Plant Damage State	LHS Sample Size[1]	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.[2]
PDS1	1000	8.3E-08	2.0E-06	6.8E-06	2.4E-05	34.0
Fast Trans	200	5.1E-08	2.3E-06	5.9E-06	2.3E-05	
PDS2	1000	6.8E-09	3.3E-06	5.9E-06	2.1E-05	30.0
Slow SBO	200	2.9E-09	3.2E-06	6.0E-06	2.1E-05	
PDS3	1000	2.1E-09	8.5E-07	5.7E-06	2.3E-05	29.0
Slow SBO	200	9.3E-10	7.9E-07	6.9E-06	2.6E-05	
PDS4	1000	9.5E-10	3.9E-07	1.1E-06	4.2E-06	5.5
Trans CV	200	7.6E-10	3.3E-07	9.4E-07	4.3E-06	
Total	1000	1.1E-06	1.2E-05	2.0E-05	6.4E-05	100.0
	200	7.7E-07	1.1E-05	2.0E-05	6.0E-05	

Notes:
(1) The Accident Frequency Analysis used a LHS sample size of 1000
The Accident Progression Analysis used a LHS sample size of 200
(2) Percentages based on the LHS sample size of 1000. FCMCD, fractional contribution to mean core damage frequency.

Table 2.2-3c
Plant Damage State Comparison - Seismic HIG, LLNL

Plant Damage State	LHS Sample Size[1]	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.[2]
PDS1	1001	5.9E-11	1.3E-07	7.3E-06	2.2E-05	
FSB RPV	200	4.7E-10	1.1E-07	7.2E-06	1.4E-05	9.6
PDS2	1001	6.2E-10	3.8E-07	1.3E-05	5.1E-05	
FSB LLOCA	200	6.9E-10	4.8E-07	1.4E-05	6.1E-05	18.6
PDS3	1001	3.6E-12	3.9E-08	2.5E-06	8.6E-06	
FSB LLOCA	200	1.9E-11	7.7E-08	2.8E-06	2.0E-05	3.7
PDS4	1001	3.2E-09	5.6E-07	1.3E-05	5.0E-05	
Slow SBO	200	4.1E-09	6.6E-07	1.7E-05	4.0E-05	22.6
PDS5	1001	1.6E-11	3.2E-08	1.4E-06	4.4E-06	
Fast SBO	200	7.7E-11	4.2E-08	1.8E-06	5.3E-06	2.4
PDS6	1001	1.6E-10	1.1E-07	3.8E-06	1.3E-05	
FSB ILOCA	200	1.9E-10	1.6E-07	3.9E-06	2.1E-05	5.2
PDS7 FSB	1001	2.5E-11	4.3E-08	1.3E-06	4.4E-06	
I/SLOCA	200	1.6E-10	5.2E-08	1.4E-06	6.1E-05	1.9
Total	1001	3.8E-08	2.6E-06	4.2E-05	1.6E-04	
HIG	200	3.3E-08	2.8E-06	4.8E-05	2.8E-04	64.0

Notes:

(1) The Accident Frequency Analysis used a LHS sample size of 1001
The Accident Progression Analysis used a LHS sample size of 200

(2) Percentages based on the LHS sample size of 200. FCMCD, fractional contribution to mean core damage frequency.

Table 2.2-3d

Plant Damage State Comparison - Seismic LOWG, LLNL

Plant Damage State	LHS Sample Size(1)	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.(2)
PDS1	1001	1.2E-12	4.7E-09	1.4E-06	3.4E-06	
FSB RPV	200	1.0E-10	2.4E-08	1.6E-06	3.1E-06	2.1
PDS2	1001	1.2E-11	2.7E-08	3.5E-06	1.1E-05	
FSB LLOCA	200	1.4E-10	9.8E-08	2.9E-06	1.2E-05	3.9
PDS3	1001	5.9E-16	1.0E-10	3.6E-07	6.7E-07	
FSB LLOCA	200	1.7E-12	6.7E-09	2.4E-07	1.7E-06	0.3
PDS4	1001	5.8E-09	8.0E-07	2.3E-05	7.2E-05	
Slow SBO	200	5.0E-09	8.0E-07	2.0E-05	4.9E-05	26.6
PDS5	1001	2.7E-13	3.0E-09	1.6E-06	3.0E-06	
Fast SBO	200	6.3E-11	3.4E-08	1.4E-06	4.3E-06	1.8
PDS6	1001	2.5E-11	1.1E-08	8.2E-07	2.1E-06	
FSB ILOCA	200	3.6E-11	3.1E-08	7.5E-07	4.0E-06	1.0
PDS7 FSB	1001	3.9E-14	5.6E-10	2.8E-07	4.2E-07	
I/SLOCA	200	2.2E-11	7.1E-09	1.9E-07	8.3E-07	0.3
Total	1001	9.8E-09	1.3E-06	3.1E-05	9.9E-05	
LOWG	200	1.4E-08	1.5E-06	2.7E-05	1.0E-04	36.0

Notes:

(1) The Accident Frequency Analysis used a LHS sample size of 1001
The Accident Progression Analysis used a LHS sample size of 200

(2) Percentages based on the LHS sample size of 200. FCMCD, fractional contribution to mean core damage frequency.

Table 2.2-3e
Plant Damage State Comparison - Seismic HIG EPRI

Plant Damage State	LHS Sample Size[(1)]	Core Damage Frequency (1/yr) 5%	Median	Mean	95%	% TCD Freq.[(2)]
PDS1	1001	*	1.9E-08	2.5E-07	1.0E-06	
FSB RPV	200	7.2E-11	1.7E-08	2.5E-07	1.0E-06	7.9
PDS2	1001	*	5.1E-08	4.6E-07	2.0E-06	
FSB LLOCA	200	1.5E-10	6.2E-08	5.0E-07	2.0E-06	15.9
PDS3	1001	*	5.4E-09	1.0E-07	4.6E-07	
FSB LLOCA	200	3.0E-12	1.3E-08	1.2E-07	6.2E-07	3.8
PDS4	1001	*	9.3E-08	4.7E-07	2.1E-06	
Slow SBO	200	2.4E-09	9.6E-08	6.3E-07	1.8E-06	20.0
PDS5	1001	*	4.6E-09	6.3E-08	2.6E-07	
Fast SBO	200	1.4E-11	4.6E-09	9.1E-08	3.4E-07	2.9
PDS6	1001	*	1.7E-08	1.4E-07	6.1E-07	
FSB ILOCA	200	6.2E-11	1.7E-08	1.5E-07	6.2E-07	4.8
PDS7 FSB	1001	*	5.7E-09	5.3E-08	2.3E-07	
I/SLOCA	200	2.6E-11	6.7E-09	6.1E-08	2.0E-07	1.9
Total	1001	*	3.6E-07	1.5E-06	6.4E-06	
HIG	200	1.1E-08	3.6E-07	1.8E-06	8.6E-06	57.2

Notes:
(1) The Accident Frequency Analysis used a LHS sample size of 1001
The Accident Progression Analysis used a LHS sample size of 200
(2) Percentages based on the LHS sample size of 200. FCMCD, fractional contribution to mean core damage frequency.
* Less than 1.0E-15.

Table 2.2-3f
Plant Damage State Comparison - Seismic LOWG, EPRI

Plant Damage State	LHS Sample Size(1)	Core Damage Frequency (1/yr)				% TCD Freq.(2)
		5%	Median	Mean	95%	
PDS1	1001	3.5E-13	8.6E-10	6.7E-08	2.5E-07	
FSB RPV	200	2.3E-11	5.3E-09	7.9E-08	3.2E-07	2.5
PDS2	1001	4.4E-12	5.0E-09	1.6E-07	7.1E-07	
FSB LLOCA	200	4.1E-11	1.6E-08	1.3E-07	5.3E-07	4.1
PDS3	1001	2.2E-16	1.8E-11	2.8E-08	6.8E-08	
FSB LLOCA	200	3.7E-13	1.6E-09	1.5E-08	7.7E-08	0.5
PDS4	1001	2.9E-09	1.3E-07	1.0E-06	3.7E-06	
Slow SBO	200	3.8E-09	1.5E-07	9.8E-07	2.8E-06	31.0
PDS5	1001	7.4E-14	5.6E-10	1.1E-07	2.5E-07	
Fast SBO	200	1.5E-11	5.1E-09	1.0E-07	3.8E-07	3.2
PDS6	1001	8.9E-12	1.9E-09	4.0E-08	1.2E-07	
FSB ILOCA	200	1.5E-11	4.2E-09	3.7E-08	1.6E-07	1.1
PDS7 FSB	1001	8.3E-15	9.9E-11	1.7E-08	3.8E-08	
I/SLOCA	200	4.5E-12	1.2E-09	1.1E-08	3.6E-08	0.4
Total	1001	5.7E-09	2.4E-07	1.5E-06	5.5E-06	
LOWG	200	6.9E-09	2.7E-07	1.4E-06	5.0E-06	42.8

Notes:

(1) The Accident Frequency Analysis used a LHS sample size of 1001
The Accident Progression Analysis used a LHS sample size of 200

(2) Percentages based on the LHS sample size of 200. FCMCD, fractional contribution to mean core damage frequency.

The remaining portion of this subsection describes the essential characteristics of each of the twenty PDSs.

2.2.2.1 Internal Plant Damage States

Table 2.2-2a lists the nine PDSs defined in the Peach Bottom Level I Internal Events Analysis.

Plant Damage State PDS-1 (1-322-2-13-3-13113-111)

This PDS is composed of two accident sequences: the first is a large LOCA followed by immediate failure of all injection; the second is a medium LOCA with initial HPCI success but almost immediate failure as the vessel depressurizes below HPCI working pressure, all other injection has failed. Early core damage results. CRD and containment heat removal are working. Venting is available. The variables most important to the absolute value of the PDS frequency are: the A and S1 initiator frequencies and miscalibration of pressure permissive sensors for low pressure injection. This PDS contributes 5.8% of the mean internal core damage frequency.

Plant Damage State PDS-2 (4-W22-1-13-3-13113-111)

This PDS is composed of four sequences consisting of a transient initiator followed by two stuck open SRVs (the equivalent of an intermediate LOCA). HPCI works initially but fails when the vessel depressurizes below HPCI working pressure; all other injection has failed and early core damage results. CRD and containment heat removal are working as in PDS-1 but steam is directed through the SRVs to the suppression pool not to the drywell as in PDS-1. Venting is available. The variables most important to the absolute value of the PDS frequency are: the frequency of two SRVs sticking open, the miscalibration of pressure permissive sensors for low pressure injection, and the initiating event frequencies (T1, T3B, T2, and T3A). This PDS contributes 4.9% of the mean internal core damage frequency.

Plant Damage State PDS-3 (4-W22-1-13-3-11131-111)

This PDS is similar to PDS-2 except that containment heat removal is not working and CRD may not be working for some subgroups (however, CRD is assumed to be working since the cut sets where it is not are negligible contributors). The variables most important to the absolute value of the PDS frequency are: the T1 initiator frequency, the failure of the operator to initiate HPSW, the probability of two SRVs sticking open, and failure of valves in the emergency service water system. This PDS contributes 0.1% of the mean internal core damage frequency.

Plant Damage State PDS-4 (4-211-X-12-1-22222-111)

This PDS is a short-term station blackout with DC power failed. It consists of two sequences: one with a stuck open SRV and one without a stuck open SRV. Early core damage results from the immediate loss of all injection. Venting is possible if AC power is restored (manual venting is possible if AC is not restored but considered unlikely). The variables most important to the absolute value of the PDS frequency are: the T1 initiator frequency, the battery beta factor, and the battery random failure probability. This PDS contributes 4.7% of the mean internal core damage frequency.

Plant Damage State PDS-5 (4-212-X-22-3-22222-111)

This PDS is a long-term station blackout. It is composed of three sequences, one of which has a stuck open SRV. High pressure injection is initially working. AC power is not recovered and either: 1) the batteries deplete, resulting in injection failure, reclosure of the ADS valves, and repressurization of the RPV (in those cases where an SRV is not stuck open), followed by boiloff of the primary coolant and core damage or 2) HPCI and RCIC fail on high suppression pool temperature or high containment pressure, respectively, followed by boiloff and core damage at low RPV pressure (since if DC has not failed, ADS would still be possible, or an SRV is stuck open). The containment is at high pressure but less than or equal to the saturation pressure corresponding to the temperature at which HPCI will fail (i.e., about 40 psig at the start of core damage). The variables most important to the absolute value of the PDS frequency are: the T1 initiator frequency, the failure to recover AC power, the probability of battery depletion before AC recovery, the DG failure to run or DG cooling failure, and failure of high pressure injection due to high suppression pool temperature. This PDS contributes 42.0% of the mean internal core damage frequency.

Plant Damage State PDS-6 (5-322-X-23-2-33333-111)

This PDS is an ATWS with SLC working. HPCI works and the vessel is not manually depressurized. Injection fails on high suppression pool temperature and early core damage ensues. Venting is available. The variables most important to the absolute value of the PDS frequency are: the T3A initiator frequency, the failure to scram, the operator failure to depressurize, and the HPCI pump mechanical failure on high temperature. This PDS contributes 6.7% of the mean internal core damage frequency.

Plant Damage State PDS-7 (5-322-1-23-Y-33333-Z11)

This PDS is an ATWS with failure of SLC, the initiator is a stuck open SRV. Otherwise, it is the same as PDS-8. The variables most important to the absolute value of the PDS frequency are: the T3C initiator frequency, the failure to scram, and the operator failure to restore SLC after testing or failure to initiate SLC. This PDS contributes 2.4% of the mean internal core damage frequency.

Plant Damage State PDS-8 (5-322-2-23-Y-33333-Z11)

This PDS is an ATWS sequence with loss of an AC bus or PCS followed by failure to scram. High pressure injection fails on high suppression pool temperature and the reactor is either: 1) not manually depressurized or 2) the operator depressurizes and uses low pressure injection systems until the injection valves fail due to excessive cycling or the containment fails or is vented and the injection systems fail due to harsh environments in the reactor building or loss of NPSH (condensate can not supply enough water since the CST can only supply about 800 gpm to the condenser, condensate can only last a few minutes). Early core damage ensues in case 1 and late core damage in case 2. Venting will not take place before core damage if the operator does not depressurize; but, it may, if he goes to low pressure systems. RHR and CSS are working and the containment pressure will begin to drop in case 1 or will level off at the venting or SRV reclosure pressure in case 2. The variables most important to the absolute value of the PDS frequency are: the T3A initiator frequency, the failure to scram, and the operator failure to restore SLC after testing or failure to initiate SLC. This PDS contributes 33.0% of the mean internal core damage frequency.

Plant Damage State PDS-9 (5-222-2-23-Y-33233-Z11)

This PDS is an ATWS with failure of SLC, the initiator is T1 (LOSP); however, other AC is available. Otherwise, this PDS is the same as PDS-8. The variables most important to the absolute value of the PDS frequency are: the T1 initiator frequency, the failure to scram, and the operator failure to restore SLC after testing or failure to start SLC. This PDS contributes 1% of the mean internal core damage frequency.

2.2.2.2 Fire Plant Damage States

Table 2.2-2b lists the four PDSs defined in the Peach Bottom Level I Fire Analysis.

Plant Damage State PDS-1 (4-322-2-12-2-22332-111)

This PDS is composed of three fire scenarios, two in the control room and one in the cable spreading room. Power is available but remote control of the systems has been lost and auto actuation has failed due to the fire. No injection is available and early core damage ensues. The variables most important to the absolute value of the PDS frequency are: the initiating event frequencies, the failure to properly use the remote shutdown panel, and the probability that smoke will force evacuation of the control room. This PDS contributes 34.0% of the mean fire core damage frequency.

Plant Damage State PDS-2 (4-11X-2-21-3-11221-111)

This PDS is composed of eight fire scenarios in different emergency switchgear rooms (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D). All lead to a fire induced LOSP followed by a random loss of emergency service water due to valve failure resulting in an early loss of all AC power and station blackout. HPCI will work until it fails on battery depletion or high suppression pool temperature and late core damage will ensue. The variables most important to the absolute value of the PDS frequency are: the initiating event frequencies, the percentage of fires that exit the top of a cabinet, the ratio of 4160 V cabinet area to total cabinet area, the percentage of fires suppressed manually, and the failure of emergency service water. This PDS contributes 30.0% of the mean fire core damage frequency.

Plant Damage State PDS-3 (4-117-2-22-3-22222-111)

This PDS is composed of eight fire scenarios in different switchgear rooms (2A, 2B, 2C, 2D, 3A,3B, 3C, and 3D). All lead to a fire induced LOSP followed by a random loss of emergency service water from DG failure to run resulting in a delayed station blackout. HPCI will work until failure on high suppression pool temperature and late core damage will ensue. The variables most important to the absolute value of the PDS frequency are: the initiating event frequencies, the percentage of fires that exit the top of a cabinet, the ratio of 4160 V cabinet area to total cabinet area, the percentage of fires suppressed manually, and the failure of the emergency diesel generators. This PDS contributes 29.0% of the mean fire core damage frequency.

Plant Damage State PDS-4 (4-122-2-21-2-41211-111)

This PDS is composed of two fire scenarios in emergency switchgear room 2C. The fires result in LOSP with failure of PCS, venting, and failure of most RHR trains. Random failures complete the failure of containment heat removal. The HPCI and LPCI systems succeed but core damage results when HPCI fails on high suppression pool temperature and LPCI fails when the SRVs reclose on high containment pressure. The variables most important to the absolute value of the PDS frequency are: the initiating event frequencies, the percentage of fires that exit the top of a cabinet, the ratio of 4160 V cabinet area to total cabinet area, the percentage of fires suppressed manually, and the random failure of the alternate cooling system. This PDS contributes 5.0% of the mean fire core damage frequency.

2.2.2.3 Seismic Plant Damage States

Tables 2.2-2c-2f list the seven PDSs defined in the Peach Bottom Level I Seismic Analysis. Tables 2.2-2c and d show the results for the LLNL Hi and Low G cases and Tables 2.2-2e and f show the results for the EPRI Hi and Low G cases. The PDS descriptions given below are independent of the hazard curve or the G level.

Plant Damage State PDS-1 (1-122-2-11-3-12112-1Z2)

This PDS is composed of one sequence with a seismically induced LOSP followed by RPV vessel rupture. All injection is lost as a result of the initiator and early core damage ensues. The core damage estimate does not depend on any other consideration; but, for the Level II/III analysis, the status of the containment systems needs to be determined. Onsite AC could be available but the failure probability of a DG is also high in this scenario, we assessed that enough onsite AC would be available to vent the containment; but, not enough to operate the containment heat removal systems. Early containment failure occurs as a result of the seismic event. This PDS contributes 11.8% of the mean seismic core damage frequency.

Plant Damage State PDS-2 (1-11X-2-11-3-11111-1Z2)

This PDS is composed of one sequence with a seismically induced LOSP followed by a loss of all onsite AC leading to a station blackout. A large LOCA is also induced by the seismic event resulting in high pressure injection failure (only steam-driven systems are available and these fail on low pressure in the RPV) and early core damage results. Early containment failure occurs as a result of the seismic event. The variables most important to the absolute value of the PDS frequency are: the initiating event frequency, the probability of ceramic insulator failure leading to a LOSP, the failure of the DG cooling water system leading to station blackout, and the induced failure of primary system piping resulting in a large LOCA. This PDS contributes 22.6% of the mean seismic core damage frequency.

Plant Damage State PDS-3 (1-111-2-11-3-11111-1Z2)

This PDS is the same as PDS-2 except that DC power has also failed. This has no effect on accident progression since all systems have failed anyway. This PDS contributes 4.0% of the mean seismic core damage frequency.

Plant Damage State PDS-4 (4-11X-2-21-3-11111-111)

This PDS is composed of one sequence with a seismically induced LOSP followed by loss of all AC leading to station blackout. HPCI succeeds until battery depletion or high suppression pool temperature results in HPCI failure and late core damage. The variables most important to the absolute value of the PDS frequency are: the initiating event frequency, the probability of ceramic insulator failure leading to a LOSP, and the failure of the DG cooling water system leading to station blackout. This PDS contributes 49.1% of the mean seismic core damage frequency.

Plant Damage State PDS-5 (4-111-Y-11-1-11111-111)

This PDS is composed of two sequences, one with a stuck open SRV and one without. Both sequences have a seismically induced LOSP followed by a loss of all AC resulting in station blackout. High pressure injection fails initially upon Radwaste/Turbine building failure and early core damage ensues. The variables most important to the absolute value of the PDS frequency are: the initiating event frequency, the probability of ceramic insulator failure leading to a LOSP, and the failure of the Radwaste/Turbine building resulting in loss of all AC and failure of high pressure DC systems actuation and control. This PDS contributes 4.2% of the mean seismic core damage frequency.

Plant Damage State PDS-6 (2-11X-2-11-3-11111-111)

This PDS is composed of one sequence with a seismically induced LOSP, failure of onsite AC due to cooling water failure, and a seismically induced intermediate LOCA. HPCI works until primary pressure drops below working pressure and early core damage ensues. The variables most important to the absolute value of the PDS frequency are: the initiating event frequency, the probability of ceramic insulator failure leading to a LOSP, the failure of the DG cooling water system leading to station blackout, and the probability of a seismically induced intermediate LOCA. This PDS contributes 6.2% of the mean seismic core damage frequency.

Plant Damage State PDS-7 (W-111-2-11-3-11111-111)

This PDS is composed of two sequences both with a seismically induced LOSP followed by loss of onsite AC resulting in station blackout. A seismically induced intermediate or small LOCA occurs and high pressure injection fails when RPV pressure drops below the systems working pressures resulting in early core damage. The variables most important to the absolute value of the PDS frequency are: the initiating event frequency, the probability of ceramic insulator failure leading to a LOSP, the failure of the DG cooling water system leading to station blackout, and the probability of a seismically induced intermediate or small LOCA. This PDS contributes 2.1% of the mean seismic core damage frequency.

2.2.3 High-Level Grouping of Plant Damage States

The nine internal event plant damage states described above have been further condensed into the following four groups:

1. Loss of Offsite Power (Station Blackout)
2. LOCAs
3. Transients
4. ATWS

These four groups are denoted collapsed PDS Groups. The mapping from the 9 groups described in section 2.2.2.1 into the four collapsed groups used in the presentation of many of the results is given in Table 2.2-4. In combining two groups to form one collapsed group, frequency weighting by

Table 2.2-4
Relationship Between PDSs and Collapsed PDS Groups for Internal Events

Super-Group	% TMCDF	PDS Groups	% TMCDF*
1. LOSP	46.6	4. Fast Blackout	42.0
		5. Slow Blackout	4.6
2. LOCAs	5.7	1. LOCAs	5.7
3. Transients	5.0	2. Fast Transients	4.9
		3. Fast Transients	0.1
4. ATWS	42.7	6. Fast ATWS	6.7
		7. ATWS CV	2.5
		8. ATWS CV	32.5
		9. ATWS CV	1.0

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* FCMCD, fractional contribution to mean core damage frequency.

observation is employed. The percentages of the total mean core damage frequency given above provide only approximate weightings.

2.2.4 Variables Sampled in the Accident Frequency Analysis

In the stand-alone accident frequency analysis, a large number of variables were sampled. (A list of these variables may be found in NUREG/CR-4550, Vol. 4 Part 1 and Part 3[1]). Only those variables that were found to be important to the sequence uncertainties were selected for sampling in the integrated risk analysis. These variables are listed and defined in the first column of Tables 2.2-5a and 2.2-5b.

The second column in Tables 2.2-5a and b gives the LHS variable number for each Level I variable class used, the third column gives the range of the distribution for the variable and the fourth column indicates the type of distribution used and its mean value. The entry "Internal" for the distribution indicates that the distribution came from an elicitation of SNL experts, "LOSP" indicates that the distribution was calculated from LOSP initiating event data, and "FIRE-IE" that the distribution was calculated from fire initiating event data. The fifth and sixth columns show whether the variable is correlated with any other variable and the seventh column describes the variable. More complete descriptions and discussion of these variables and their distributions may be found in the Peach Bottom accident frequency analysis reports (NUREG/CR-4550, Vol. 4 Part 1 and Part 3[1]).

2.3 Description of the Accident Progression Event Tree

2.3.1 Overview of the Accident Progression Event Tree

The Accident Progression Event Tree (APET) for Peach Bottom considers the progression of the accident from the time core damage is imminent (i.e., water two feet above the bottom of the active fuel or, for core vulnerable accidents, from the time of uncovery of the top of the active fuel) through the core-concrete interaction (CCI). Although the CCI may progress at ever slower rates for days, the end of this analysis has been arbitrarily set at 24 hours. Except in very unusual accidents, almost all of the fission products that are going to be released from the containment will have been released by 24 hours after the initiator.

The accident progression event tree is based on the Peach Bottom containment arrangement, systems, and procedures. In addition, emphasis was placed on modeling the accident progressions for the dominant plant damage states presented in the accident frequency analysis [NUREG/CR-4550, Vol 4[1]].

The Peach Bottom APET is broken into 5 time periods. The mnemonic branch abbreviations for most branches start with a character or characters which indicate the time period of the question. The time periods and their abbreviations are:

Table 2.2-5a
Variables Sampled in the Internal Accident Frequency Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
DGN-FR-8H	1	7.9E-05 0.45	Lognormal M=1.6E-02	NONE	-	ACP-DGN-FR-EDGC, B, D. Probability of emergency diesel generator failure to run.
SENSOR-FAIL	2	5.0E-06 2.8E-02	Lognormal M=9.7E-04	NONE	-	ESF-ASP-PL52A, B, C, D. Probability of failure of LPCS and LPCI low Rx pressure sensor.
ESF-XHE-MC-PRESS	3	2.6E-06 1.5E-02	Lognormal M=5.2E-04	NONE	-	Probability of operators miscalibrating all Rx level sensors.
IE-A	4	5.0E-07 2.8E-03	Lognormal M=9.7E-05	NONE	-	Initiating event freq., Large LOCA.
IE-S1	5	1.5E-06 8.5E-03	Lognormal M=3.0E-04	NONE	-	Initiating event freq., Intermediate LOCA.
IE-T3C	6	1.9E-02 1.2	Lognormal M=1.9E-01	NONE	-	Initiating event freq., Inadvertent opening of a relief valve (IORV).
P2	7	9.9E-06 5.7E-02	Lognormal M=2.0E-03	NONE	-	Probability of two relief valves failing to reclose.
ESF-XHE-FO-HSWIN	8	2.0E-02 1.0	Max Entropy M=0.1	NONE	-	Probability of operator failing to realign HPSW for injection.
DCP-BAT-LP-CCF	9	4.5E-06 2.6E-02	Lognormal M=9.2E-04	NONE	-	Probability of failure of one battery for use with common cause beta.

Table 2.2-5a (Continued)
Variables Sampled in the Internal Accident Frequency Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
BETA-5BAT	10	2.5E-04 1.6E-02	Lognormal M=2.5E-03	NONE	-	Beta factor for common cause failure of all five batteries.
ESF-XHE-FO-DATWS	11	4.0E-02 1.0	Max Entropy M=0.2	NONE	-	Probability of operator failure to depressurize during ATWS events.
RPSM	12	5.0E-08 2.8E-04	Lognormal M=1.0E-05	NONE	-	Probability of mechanical failure to scram after some initiating event.
IE-T3A	13	0.25 1.6E+01	Lognormal M=2.5	NONE	-	Initiating event freq. for Transient with PCS initially available.
IE-T2	14	5.1E-03 0.32	Lognormal M=5.0E-02	NONE	-	Initiating event freq. for Transient without PCS initially available.
IE-T3B	15	6.1E-03 0.38	Lognormal M=6.0E-02	NONE	-	Initiating event freq. for Loss of Feedwater transient.
IE-S2	16	1.5E-05 8.5E-02	Lognormal M=3.0E-03	NONE	-	Initiating event freq. for Small LOCA.
IE-S3	17	1.5E-04 0.85	Lognormal M=3.0E-02	NONE	-	Initiating event freq. for Small-small LOCA.
IE-T1	18	1.0E-03 0.25	LOSP M=8.0E-02	NONE	-	Initiating event freq. for LOSP.

Table 2.2-5a (Concluded)
Variables Sampled in the Internal Accident Frequency Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
CKV-HW	54	1.0E-05 6.3E-04	Lognormal M=9.9E-05	NONE	-	ESW-CKV-HW-CV513, HCI-CKV-HW-CV65,32, SLC-CKV-HW-CV16, 17, HIC-TCV-HW-TCV18. Probability of check valve failure to open for mechanical reasons.

* For lognormal distributions use .001 and .999, for expert distributions and LOSP related distributions use min and max from sample.

Table 2.2-5b
Variables Sampled in the External Accident Frequency Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
IE-LCSR	19	3.1E-04 0.15	FIRE-IE M=8.0E-03	NONE	-	Frequency of Cable Spreading Room fires.
IE-LCR	20	2.3E-08 4.1E-02	FIRE-IE M=2.6E-03	NONE	-	Frequency of Control Room fires.
IE-LSWGR	21	2.4E-08 1.6E-02	FIRE-IE 2.7E-03	NONE	-	Frequency of Switchgear Room fires.
QTG1	22	0.6 1.0	Max Entropy M=8.7E-01	NONE	-	% fires in cable spreading room not manually suppressed.
ROP1	23	6.4E-03 0.64	Max Entropy M=6.4E-02	NONE	-	Probability that the operators will fail to recover using remote shutdown panel.
QAUTO	24	2.0E-03 0.12	Max Entropy M=4.0E-02	NONE	-	Probability of failure of automatic CO_2 system in cable spreading room.
FA2	25	1.4E-02 6.8E-02	Max Entropy M=2.7E-02	NONE	-	Area ratio for small fires in cable spreading room.
FS2	26	0.33 0.81	Max Entropy M=7.0E-01	NONE	-	Percentage of fires that are in the small category.
FA1	27	3.1E-02 0.15	Max Entropy M=6.2E-02	NONE	-	Area ratio for large fires in cable spreading room.

Table 2.2-5b (Continued)
Variables Sampled in the External Accident Frequency Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
FS1	28	0.19 0.67	Max Entropy M=3.0E-01	NONE	-	Percentage of fires that are in the large category.
FA3	29	1.0E-02 2.8E-02	Max Entropy M=2.0E-02	NONE	-	Area ratio of RCIC cabinet to total cabinet area in control room.
FA4	30	0.49 1.0	Max Entropy M=9.8E-01	NONE	-	Area ratio of all cabinets but RCIC to total cabinet area in control room.
QRCIC	31	5.0E-03 0.5	Max Entropy M=5.0E-02	NONE	-	Probability of random failure of RCIC system.
FA5	32	0.1 1.0	Max Entropy M=9.0E-01	NONE	-	FA8, FA7, FA5A, FA5B, FA6, FA5C, FA5D. Area ratio of a switchgear cabinet to the total cabinet area in the switchgear room.
FS5	33	0.9 1.0	Max Entropy M=9.9E-01	NONE	-	FS7, FS8, FS6. Percentage of cabinet fires that are large.
Q5TG	34	0.52 1.0	Max Entropy M=7.7E-01	NONE	-	Q8TG, Q7TG, Q6TG. Percentage of fires that are not manually suppressed in switchgear rooms.
RBC-XHE-FO-SWCH	35	6.0E-03 6.0E-01	Max Entropy M=6.1E-02	NONE	-	Probability of failure of the operator to switch to RBCWS following LOSP.

Table 2.2-5b (Continued)
Variables Sampled in the External Accident Frequency Analysis

Variable Name	LHS #	Range*	Distri- bution	Corre- lation	Correl. with	Description
DGHWNR30HR	36	4.0E-02 1.0	Max Entropy M=4.0E-01	NONE	-	Probability of failing to recover DG hardware failures within 30 hr.
DGMANR30HR	37	1.0E-02 1.0	Max Entropy M=1.0E-01	NONE	-	Probability of failing to recover DG maintenance unavailability within 30 hr.
DGACTNR30HR	38	1.0E-04 1.0E-02	Max Entropy M=1.0E-03	NONE	-	Probability of failing to recover DG actuation failure within 30 hr.
DGN-FR-16HR	39	3.2E-03 3.3E-01	Max Entropy M=3.2E-02	NONE	-	ACP-DGN-FR-EDGD, C, B. Probability of DG failing to run for 16 hr.
DGN-LP	40	3.0E-04 1.9E-02	Lognormal M=3.0E-03	NONE	-	ACP-DGN-LP-EDGD. Probability of DG "D" failing to start.
DGN-MA	41	3.0E-05 0.17	Lognormal M=6.1E-03	NONE	-	ACP-DGN-MA-EDGD. Probability of DG "D" being out for maintenance.
DGN-TE	42	2.3E-04 1.5E-02	Lognormal M=2.3E-03	NONE	-	ACP-DGN-TE-EDGD. Probability of DG "D" being unavailable due to testing.
DGACT	43	4.9E-05 2.1E-02	Lognormal M=1.6E-03	NONE	-	DGACTD. Probability of DG "D" actuation circuit failure.
LOG-HW-RHR	44	4.9E-05 2.1E-02	Lognormal M=1.6E-03	NONE	-	ESF-LOG-HW-RHRB. Probability of failure of RHR train B control logic.

Table 2.2-5b (Continued)
Variables Sampled in the External Accident Frequency Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
CCF-LF-ESW	45	5.6E-06 3.5E-04	Lognormal M=5.5E-05	NONE	-	ESW-CCF-LF-AOVS. Probability of common cause loss of air to all air operated valves.
CKV-CB-515	46	3.0E-04 1.9E-02	Lognormal M=3.0E-03	NONE	-	ESW-CKV-CB-C515A,B. Probability of emergency service water check valve failure to open.
CKV-CB-514	47	1.5E-03 9.5E-02	Lognormal M=1.5E-02	NONE	-	ESW-CKV-CB-CV514. Probability of emergency service water check valve failure to open.
PTF-RE-LOOP	48	1.6E-05 9.1E-02	Lognormal M=3.0E-03	NONE	-	LCI-PTF-RE-LOOPB. Probability of failure to restore loop B LPCI valves after maintenance.
DGHWNR16HR	49	5.0E-02 1.0	Max Entropy M=5.0E-01	NONE	-	Probability of failing to recover DG hardware failure within 16 hr.
RAXV503NC	50	3.0E-04 1.3E-01	Lognormal M=1.0E-02	NONE	-	Probability of failing to close manual bypass from normal to emergency service water.
FR1	51	5.0E-02 1.0	Max Entropy M=5.0E-01	NONE	-	Probability that smoke forces abandonment of the control room. This distribution is in error should have been .01, .1, .25 as in Level I. Did not make a difference in fire PDS 1 frequency distribution (neglect).

Table 2.2-5b (Concluded)
Variables Sampled in the External Accident Frequency Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
FR2	52	5.0E-02 1.0	Max Entropy M=5.0E-01	NONE	-	Percentage of large fires that exit the top of a switchgear cubicle.
ESW-XHE-FO-EHS	53	5.0E-02 1.0	Max Entropy M=9.0E-01	NONE	-	Probability of failure of operator to initiate emergency heat sink.
SEISMIC-HAZ	55 56	0 199	Uniform M=100	NONE	-	The frequencies of the seismic PDSs were generated separately and this uniform distribution was generated to allow the seismic distributions to be reordered and inserted for the seismic analysis. The variables used were the seven PDS frequencies and two split fractions: 1) for HI and LOW G and 2) conditional probability of initial containment failure. This was done for both the LLNL and the EPRI analyses.
DUMMY	57- 60	0 199	Uniform M=100	NONE	-	These are dummy uniform distributions so that if any additional variables need to be used they can be inserted without redoing the LHS.

* For lognormal distributions use .001 and .999, for expert distributions and LOSP related distributions use min and max from sample.

E1	Initial	Questions 1 through 22 determine the conditions at the beginning of the accident (i.e., before core damage).
E2,3	Core Vulnerable	Questions 23 through 46 address the progression of the accident during the period the operators are attempting to avert core damage.
E4	Core Damage	Questions 47 through 69 determine the progression of the accident from the beginning of core damage to just before vessel breach.
E5	Vessel Breach	Questions 70 through 109 determine the progression of the accident from immediately before vessel breach to the time of significant core -concrete interaction (CCI). The potential for core damage arrest (i.e., no vessel breach) is addressed in this time period. The majority of the questions address the loads accompanying vessel breach and the containments structural response to these loads.
L	Late	Questions 110 through 145 determine the progression during the core-concrete interaction.

The clock time for each period will vary depending upon the type of accident being modeled.

The APET contains questions to resolve core-vulnerable sequences,i.e., those PDSs which have failure of containment heat removal (either mechanically or because it is ineffectual) but successful core cooling. The continual deposition of energy (either decay heat or low power from ATWS events) by operation of the ECCS and transfer of steam through the SRV discharge lines to the suppression pool is predicted to lead to eventual containment failure (either from structural failure or by venting) in about one hour or a few days depending upon the specific scenario. Containment failure, in turn, may lead to ECCS failure due to harsh environments produced in the reactor building or from loss of NPSH for pumps drawing from the suppression pool.

In several places in the evaluation of the APET, a User Function is called from the main program. This user function allows computations to be carried out which are too complex to be treated directly in the event tree. The user function itself is listed in Appendix A.2. The manipulations performed by the user function are described below. The user function is called upon to:

Determine containment failure pressure and mode of failure
- Questions 29, 62, 102, and 131;

Determine the pressure rise during core damage and after vessel breach
- Question 57 and 122;

Determine the level of reactor building bypass with and without hydrogen burns
    -Questions 76, 80, 140, and 144;
Determine the base containment pressure before vessel breach
    -Question 82;
Determine the amount of hydrogen released at vessel breach
    -Question 93;
Determine the amount of gases produced during CCI
    -Question 120.

2.3.2 Overview of the Accident Progression Event Tree Quantification

This section presents a list of the questions in the Peach Bottom APET and discusses the types of questions and their quantification briefly. A listing of the APET showing the detailed structure of each question may be found in Appendix A.1.

Table 2.3.1 lists the 145 questions in the Peach Bottom APET. In addition to the number and name of the question, Table 2.3-1 indicates if the question was sampled, and how the question was evaluated or quantified. In the sampling column, an entry of P indicates that a parameter is sampled from a distribution, ZO indicates that the question was sampled zero-one, and SF means the question was sampled with split fractions. The difference may be illustrated by a simple example. Consider a question that has two branches, and a uniform distribution from 0.0 to 1.0 for the probability for the first branch. If the sampling is zero-one, in half the observations the probability for the first branch will be 1.0, and in the other half of the observations it will be 0.0. If the sampling is done using split fractions, the probability for the first branch for each observation is a random fractional value between 0.0 and 1.0. The average over all the fractions in the sample is 0.50. The implications of ZO or SF sampling are discussed in the methodology volume (Volume 1[1]) of this report.

If the sampling column is blank, the branching ratios for that question, and the parameter values defined in that question, if any, are fixed. The branching ratios of the PDS questions change to indicate which PDS is being considered. Some of the branching ratios depend on the relative frequency of the PDSs which make up the PDS group being considered. These branching ratios change for every sample observation, but may do so for some PDS groups and not for others. If the branching ratios change from observation to observation for any one of the seven PDS groups, SF is placed in the sampling column for the PDS questions.

The number of questions associated with each type of quantification are summarized in Table 2.3-2.

In some cases, a question may have been quantified using more than one source. If this is the case, the entry under Quantification in Table

Table 2.3-1
Questions in the Peach Bottom APET

Question Number	Question	Sampling	Quantification
1.	What is the Initiating Event?		PDS
2.	Is there a Loss of Offsite Power?		PDS
3.	Is there a Station Blackout (Loss of All AC)?	SF	PDS
4.	Is DC power available?	ZO	PDS
5.	Does an SRV stick open?	SF	PDS
6.	Do the HPCI and RCIC systems fail to inject?		PDS
7.	What is the initial status of the CRD hydraulic system?		PDS
8.	What is the initial status of RPV depressurization?	SF	PDS
9.	What is the initial status of the low-pressure ECC systems?		PDS
10.	What is the initial status of containment heat removal?	SF	PDS
11.	What is the initial status of the condensate system?		PDS
12.	Does HPSW fail in a mode that would preclude injection?		PDS
13.	What is the initial status of containment sprays?		PDS
14.	Level of pre-existing leakage or isolation failure?		AcFrqAn
15.	Location of pre-existing leakage or isolation failure?		AcFrqAn
16.	What is the level of pre-existing suppression pool bypass?		AcFrqAn
17.	Is the containment vented before core degradation?		AcFrqAn
18.	For TC does SLC fail to inject?		PDS
19.	What is the containment pressure when DC power is lost?		Internal
20.	What containment pressure forces reclosure of the SRVs?		Internal
21.	What is the containment pressure when HPCI & RCIC fail?	P	AcFrqAn
22.	What type of sequence is this (summary of plant damage)?		Summary
23.	What is the CF pressure and mode sample value?	P	Struct
24.	Is there a LP system break induced by power cycling?	SF	Internal
25.	Is DC power lost prior to core damage?		Summary

Table 2.3-1 (Continued)
Questions in the Peach Bottom APET

Question Number	Question	Sampling	Quantification
26.	Is RPV depressurization precluded by containment pressure before CD?		Summary
27.	What would be the containment pressure at core damage?		Internal
28.	Does containment fail before core damage?		Summary
29.	What is the CF mode before CD?	ZO	UFUN-Str
30.	Is there leakage in the drywell head?		Summary
31.	Is there leakage in the drywell?		Summary
32.	Is there leakage in the wetwell?		Summary
33.	What is the location of early containment leakage?		Summary
34.	What is the containment leakage level before core degradation?		Summary
35.	Is the suppression pool drained before CD?	SF	Internal
36.	What is the RPV pressure before core damage?	SF	Frontend
37.	Will the SP flash following containment vent or rupture?		Summary
38.	Does the LPC system fail to inject during TC-CV?		Internal
39.	Is the HPSW system used in time in TC-CV?		Internal
40.	What is the status of low-pressure ECC injection before CD?	SF	Frontend
41.	Does the operator start COND if available before CD?		N.A.
42.	What is the status of the condensate system before CD?	SF	Frontend
43.	What is the status of CRD?	SF	Frontend
44.	Does operator start HPSW if available before CD (not ATWS)?		N.A.
45.	What is the status of HPSW?	SF	Frontend
46.	Does the core melt?		Summary
47.	Does (do) any SRV tailpipe vacuum breaker (s) stick open?	SF	Internal
48.	Does AC power remain lost during core degradation?	SF	ROSP
49.	Is the RPV depressurized during core degradation?	SF	Frontend
50.	Is there injection during core degradation?		Internal
51.	What is the status of containment sprays during CD?	SF	Frontend

Table 2.3-1 (Continued)
Questions in the Peach Bottom APET

Question Number	Question		Quantification Sampling
52.	What is the level of flow to the drywell during CD?		Internal
53.	Is the core in a critical configuration following injection recovery?		Internal
54.	Total amount of hydrogen released in-vessel during CD?	P	In-Vessel
55.	What is the level of in-vessel zirconium oxidation?		Summary
56.	Does at least one drywell vacuum breaker stick open?	SF	Internal
57.	What is the pressure rise during CD?		UFUN-Int
58.	Is the vent threshold reached during core degradation?		AcFrqAn
59.	Does containment venting occur during core degradation?		Internal
60.	Is DC lost during CD?		Summary
61.	Does the containment fail by pressure during core degradation?		Summary
62.	What is the CF mode during CD?	ZO	UFUN-Str
63.	Is there a leak in the drywell head prior to VB?		Summary
64.	Is there a leak in the drywell prior to VB?		Summary
65.	Is there leakage in the wetwell prior to VB?		Summary
66.	What is the location of containment leakage prior to vessel breach?		Summary
67.	What is the level of containment leakage before VB?		Summary
68.	Is the suppression pool drained before VB?	SF	Internal
69.	Does the RPV repressurize during core degradation?		Summary
70.	What is the status of low-pressure ECC prior to vessel breach?	SF	Frontend
71.	What is the status of condensate prior to vessel breach?	SF	Frontend
72.	What is the status of CRD prior to vessel breach?	SF	Frontend
73.	What is the status of HPSW prior to vessel breach?	SF	Frontend
74.	Is there auto injection during vessel breach?		Summary
75.	What is the reactor building pressure after CF before VB?	P	Struct
76.	What is the level of reactor building (RB) breach/bypass before VB without burn?	ZO	UFUN-Str

Table 2.3-1 (Continued)
Questions in the Peach Bottom APET

Question Number	Question	Sampling	Quantification
77.	Are the fire sprays actuated before VB?		Internal
78.	Does SGTS fail before VB?		Internal
79.	Does hydrogen burn in RB before VB?	ZO	Loads
80.	What is the level of RB breach/bypass by H_2 burn before VB?	ZO	UFUN-Str
81.	What is the level of RB bypass before VB?		Summary
82.	What is the base containment pressure before VB?		UFUN-Int
83.	Does an Alpha mode event fail both the vessel and containment?	SF	Note 1
84.	What fraction of the core participates in core slump?	ZO	Internal
85.	Is there a large in-vessel steam explosion?		Internal
86.	Does a large in-vessel steam explosion fail the vessel?	ZO	Internal
87.	What fraction of the core debris would be mobile at vessel breach?	ZO	Internal
88.	Is there water in the reactor cavity?		Summary
89.	What is the mode of vessel breach?	ZO	Internal
90.	Is there high-pressure melt ejection?	ZO	Internal
91.	Does a large ex-vessel steam explosion occur?		Internal
92.	What is the amount of H_2 released at VB?	P	In-Vessel
93.	How much hydrogen is released at vessel breach?		UFUN-Int
94.	What is the pressure rise from VB?	P	Loads
95.	What is the peak pedestal pressure at vessel breach?	P	Loads
96.	Does the RPV pedestal fail due to impulse loading at vessel breach?		Internal
97.	Does the RPV pedestal fail due to pressurization at vessel breach?		Internal
98.	Does the drywell fail on pedestal failure?		Internal
99.	What is the structural capacity of DW to impulse loads?		Internal
100.	Is the impulse loading to the drywell at VB sufficient to cause failure?		Summary
101.	Does pressurization fail containment at VB?		Summary
102.	What is the CF mode at VB from overpressure?	ZO	UFUN-Str

Table 2.3-1 (Continued)
Questions in the Peach Bottom APET

Question Number	Question	Sampling	Quantification
103.	Does direct melt-structure attack fail containment at VB?	ZO	MCCI
104.	Is there a leak in the drywell head after VB?		Summary
105.	Is there a leak in the drywell after VB?		Summary
106.	Is there leakage in the wetwell after VB?		Summary
107.	What is the location of containment failure after VB?		Summary
108.	What is the containment leakage level after VB?		Summary
109.	Is the suppression pool drained following vessel breach?	SF	Internal
110.	Is AC power not available?	SF	ROSP
111.	What is the status of low-pressure ECC after vessel breach?	SF	Frontend
112.	What is the status of condensate after vessel breach?	SF	Frontend
113.	What is the status of HPSW after vessel breach?	SF	Frontend
114.	Is RHR operating late?	SF	Frontend
115.	Do containment sprays operate following vessel breach?		Summary
116.	Is service water sprayed following vessel breach?		Internal
117.	Is water supplied to the debris late?		Internal
118.	What is the nature of the core-concrete interaction?		Internal
119.	What fraction of core not participating in HPME participates in CCI?	P	Internal
120.	How much H_2 (& equivalent CO) and CO_2 are produced during CCI?		UFUN-Int
121.	What is the level of Zirc oxidation in the pedestal before CCI?		Summary
122.	What is the pressure rise after VB?		UFUN-Int
123.	Is the vent threshold reached after VB?		AcFrqAn
124.	Is the containment vented late, after VB?		Internal
125.	How much concrete must be eroded to cause pedestal failure?	P	Struct
126.	At what time does pedestal failure occur?	P	MCCI
127.	Does the drywell fail from late pedestal failure before overpressure?		Internal
128.	Does the containment fail at low pressure from temperature in the DW?		Struct

Table 2.3-1 (Continued)
Questions in the Peach Bottom APET

Question Number	Question		Quantification Sampling
129.	If the containment fails from temperature where does it fail?		Struct
130.	Does the containment fail late from overpressure?		Summary
131.	What is the CF mode late?	ZO	UFUN-Str
132.	Is there a leak in the drywell head late?		Summary
133.	Is there a leak in the drywell late?		Summary
134.	Is there a leak in the wetwell late?		Summary
135.	What is the location of late containment leakage?		Summary
136.	What is the level of late containment leakage?		Summary
137.	Is the suppression pool drained late?	SF	Internal
138.	What is the level of late suppression pool bypass?		Summary
139.	Do drywell sprays continue?		Internal
140.	What is the level of late RB bypass without a burn?	ZO	UFUN-Str
141.	Are fire systems operating late without a late burn?		Internal
142.	Does standby gas treatment work late without a burn?		Internal
143.	Does H_2burn in the reactor building after vessel breach?	ZO	Loads
144.	What is the level of late RB bypass from H_2 burns?	ZO	UFUN-Str
145.	What is the level of late RB bypass?		Summary

Notes to Table 2.3-1

Note 1. The Alpha mode of vessel and containment failure was previously considered by the Steam Explosion Review Group. The distribution used in this analysis is based on information contained in the report generated by this group.

Table 2.3-1 (Continued)
Questions in the Peach Bottom APET

Key to Abbreviations in Table 2.3-1

AcFrqAn	The quantification was performed by the Accident Frequency Analysis project staff.
Frontend	This question was quantified by sampling from an aggregate distribution provided by the Expert Panel on Front-End Issues.
Internal	The quantification was performed at Sandia National Laboratories by the analysts responsible for this portion of the analysis, as part of the Severe Accident Risk Reduction Program of the U.S. Nuclear Regulatory Commission.
In-Vessel	This question was quantified by sampling from an aggregate distribution provided by the Expert Panel on In-Vessel Issues.
Loads	This question was quantified by sampling from an aggregate distribution provided by the Expert Panel on Containment Loads.
MCCI	This question was quantified by sampling an aggregate distribution provided by the Expert Panel on Molten Core/Containment Interaction Issues.
N.A.	Not Applicable. This question was not used in the analysis.
P	A value, sampled from a distribution, is assigned to a parameter.
PDS	The quantification follows directly from the definition of the Plant Damage State.
ROSP	This question was quantified by sampling a distribution derived from the offsite power recovery data for the plant.
SF	Split Fraction sampling - the branch probabilities are real numbers between zero and one.
Struct	This question was quantified by sampling from an aggregate distribution provided by the Expert Panel on Structural Issues.

Table 2.3-1 (Concluded)
Questions in the Peach Bottom APET

Summary	The quantification for this question follows directly from the branches taken at preceding questions, or the values of parameters defined in preceding questions.
UFUN-Str	This question is quantified by the execution of a module in the User Function subroutine, using distributions from the Structural Expert Panel.
UFUN-Int	This question is quantified by the execution of a module in the User Function subroutine, using models and data generated by the project staff.
ZO	Zero-One sampling - the branch probabilities are either 0.0 or 1.0.

Table 2.3-2
Peach Bottom APET Quantification Summary

Type of Quant.	Number of Questions	Comments
AcFrqAn	7	Determined by the Accident Frequency Analysis.
Frontend	15	Distributions from the Front-End Issues Expert Panel.
Internal	38	Quantified internally in this analysis.
In-Vessel	2	Distributions from the In-Vessel Expert Panel.
Loads	4	Distributions from the Containment Loads Expert Panel.
MCCI	2	Distributions from the Molten Core-Containment Interaction Panel.
N.A.	2	Recovery of these systems not allowed in level II analysis.
Other Expert	1	See Note 1 of Table 2.3-1.
PDS	14	Determined by the Plant Damage State.
ROSP	2	The branch taken at this question follows directly from the branches taken at previous questions.
Struct	5	Distributions from the Structural Expert Panel.
Summary	40	Quantified internally in this analysis.
UFUN-Str	8	The probability of electric power recovery is determined by distributions derived from electric power recovery data for this plant.
UFUN-Int	5	Calculated in the User Function.

2.3.1 represents the major contributor to the quantification. For example, Questions 29, 62, 102, and 131 are listed as being quantified by distributions generated by the Structural Expert Panel. The actual situation is more complicated. In these questions, a portion of the user function is evaluated which determines whether the containment fails using the failure pressure defined in Question 23. If the failure pressure is lower than the load pressure, then the containment fails and the mode of failure is determined using the random number defined in Question 23 and a table of conditional failure mode probabilities contained in the user function. This table was also generated by the Structural Expert Panel. So the quantification entry for questions 29, 62, 102, and 131 could have been either UFUN or Struct.

Two questions have N.A. after them (Questions 41 and 44). These questions were not used since the definition of the PDS determined the status of the systems before core damage in the core vulnerable accident progressions.

2.3.3 Variables Sampled in the Accident Progression Analysis

About 158 variables were sampled for the accident progression analysis. Every time the APET was evaluated by EVNTRE, the original values of the 158 variables were replaced with values selected for the particular observation under consideration. These values were selected by the LHS program from distributions that were defined before the APET was evaluated. Many of these variables represent the probability of occurrence of or the magnitude of phenomena that are not well understood. In a PRA, we are evaluating the probability of occurrence of a set of events occurring not at any particular time and with a given specific set of initial conditions; but, at any time in the life of the plant with a wide range of initial conditions. Even though specific accidents are analyzed for the PRA, they represent classes of accidents with different initial conditions but with certain similar characteristics. For this reason distributions are assigned to the values that the variables can have. Many of these distributions (e.g., hydrogen production in-vessel, drywell shell meltthrough under various conditions, etc.) were determined by groups of experts that were assembled to look at the range of conditions for which the variables were being assessed and, after reviewing all the current experimental data and analysis, performing some simple analyses or experiments of their own, used their engineering judgement to assign distributions for the cases being analyzed. Distributions for other variables (e.g., probability of recovering off-site power, probability of the operator failing to perform some action, etc.) were determined from data, using HRA techniques, or by the engineering judgement of Sandia experts. Table 2.3-3 lists the variables used in the APET which were sampled for the accident progression analysis and generally how their distributions were determined. Some of them are split fractions for determining the relative probability of various branches in the APET; the others are parameter values for use in calculations performed while the APET is being evaluated.

Table 2.3-3
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
HPCFail Q21 C1	61	1.6E-01 3.5E+00	Max Entropy M=2.1E+00	-	-	HPCI and RCIC fail at 250 F in suppression pool, this is equivalent to 2.1 bars of pressure in containment.
CFPress Q23 C1	62	7.4E+00 1.4E+01	Expert M=1.1E+01	Rank 1	62,64	Pressure at which containment will fail (in bars).
Svalue Q23 C1	63	0.0E+00 1.0E+00	Uniform M=5.0E-01	-	-	A random number used to select the containment failure mode in the user function.
LCFPress Q23 C1	64	4.5E+00 1.3E+01	Expert M=9.3E+00	Rank 1	62,64	Late containment failure pressure under high temperature conditions (in bars).
PCyBk Q24 C1	65	8.8E-06 2.1E-02	Lognormal M=1.0E-03	-	-	Probability of a low pressure system pipe break in ATWS scenarios with large power cycles.
E3-SPD Q35 C2	66	1.0E-02 1.0E-01	Uniform M=5.5E-02	-	-	Probability of a catastrophic rupture or a rupture below the water line resulting in a drained suppression pool.
E3-HiP Q36 C1	67 68	1.8E-04 1.0E+00	Experts M=6.3E-01	Rank 1	67-74, 77,78	Probability of failure of the ADS system from severe environments in ATWS scenarios with pressure at SRV reclosure pressure. LHS variables #67 and #68 used in extender code to calculate new #67.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
E3-HiP Q36 C6	69 70	1.3E-02 1.0E+00	Experts M=7.3E-01	Rank 1	67-74, 77,78	Probability of failure of the ADS system from severe environments when the containment pressurizes above SRV reclosure pressure (non ATWS). LHS variables #69 and #70 used to calculate new #70.
E3fLPC Q40 C2	71	3.4E-01 1.0E+00	Expert M=6.8E-01	Rank 1	67-74, 77,78	Probability of failure of the low pressure injection systems from severe environments in reactor building after catastrophic wetwell failure.
E3fLPC Q40 C3	72	2.0E-08 1.0E+00	Expert M=5.2E-01	Rank 1	67-74, 77,78	Probability of failure of the low pressure injection systems from severe environments in reactor building after containment failure.
E3fCOND Q42 C2	73	1.4E-04 1.0E+00	Expert M=5.9E-01	Rank 1	67-74, 77,78	Probability of failure of the condensate system from severe environments in reactor building after containment failure.
E3fHPSW Q45 C2	74	3.4E-01 1.0E+00	Expert M=7.3E-01	Rank 1	67-74, 77,78	Probability of failure of the high pressure service water system from severe environments in reactor building after catastrophic wetwell failure.
oSRVBkr Q47 C2	75	1.1E-02 5.0E-01	Uniform M=2.6E-01	Rank 1	75,76	The failure probability of a SRV tailpipe vacuum breaker (RPV at high pressure).

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
oSRVBkr Q47 C4	76	1.0E-02 1.0E-01	Uniform M=5.5E-02	Rank 1	75,76	The failure probability of a SRV tailpipe vacuum breaker (either ATWS or RPV at low pressure).
E4nDeP Q49 C3	77	2.0E-02 1.0E+00	Experts M=6.5E-01	Rank 1	67-74, 77,78	Probability of failure of ADS from severe environments in containment upon pressurization above SRV reclosure pressure.
E4nDeP Q49 C8	78	4.0E-02 1.0E+00	Experts M=6.7E-01	Rank 1	67-74, 77,78	Probability of failure of ADS from severe environments in containment upon pressurization above SRV reclosure pressure
H2INVES Q54 C2	79	1.3E+01 9.5E+02	Experts M=3.8E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV at high pressure, only CRD working.
H2INVES Q54 C3	80	3.9E+01 9.3E+02	Experts M=3.7E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV at high pressure, no injection.
H2INVES Q54 C4	81	0.0E+00 7.5E+02	Experts M=1.8E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV initially at high pressure, goes to low pressure, CRD and LPI working.
H2INVES Q54 C5	82	0.0E+00 8.4E+02	Experts M=2.7E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV initially at high pressure, only LPI working.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri- bution	Corre- lation	Correl. with	Description
H2INVES Q54 C6	83	0.0E+00 1.2E+03	Experts M=4.0E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV initially at high pressure, only CRD working or no injection.
H2INVES Q54 C8	84	0.0E+00 4.8E+02	Experts M=1.6E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV at low pressure, both CRD and LPI working.
H2INVES Q54 C9	85	0.0E+00 7.0E+02	Experts M=2.3E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV at low pressure, only LPI working.
H2INVES Q54 C10	86	1.8E+01 9.9E+02	Experts M=3.8E+02	Rank 1	79-86	The amount of hydrogen (Kg-moles) produced in-vessel with RPV at low pressure and only CRD working or no injection.
E4-VBo Q56 C2	87	6.5E-05 2.7E-03	Lognormal M=5.0E-04	Rank 1	87,88	Probability that a drywell vacuum breaker will stick open given containment failure in both wetwell and drywell.
E4-VBo Q56 C3	88	1.0E-04 6.3E-03	Lognormal M=1.0E-03	Rank 1	87,88	Probability that a drywell vacuum breaker will stick open given no containment failure or only drywell failure, no bypass of suppression pool.
RBPK Q75 C1 P9	89	2.5E-03 1.0E+00	Uniform M=5.0E-01	-	-	Random variable used to select peak reactor building pressure after containment failure with no hydrogen burn.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
RBFM Q75 C1 P10	90	3.1E-04 1.0E+00	Uniform M=5.0E-01	-	-	Random variable used to select reactor building failure mode for selected pressure.
H2BPK Q75 C1 P11	91	2.8E-03 1.0E+00	Uniform M=5.0E-01	-	-	Random variable used to select reactor building peak pressure with hydrogen burn.
HBbVB Q79 C4	92 93	Zero One	Experts HBbVB=0.83 NHBbVB=0.17	-	-	The probability of hydrogen ignition in the reactor building.
Alpha Q83 C3	94	1.0E-07 1.0E+00	Experts M=1.0E-02	Rank 1	94,95	Probability that an Alpha mode event occurs, given that the RPV is at low pressure.
Alpha Q83 C2	95	1.0E-08 1.0E-01	Experts M=1.0E-03	Rank 1	94,95	Probability that an Alpha mode event occurs, given that the RPV is at high pressure.
Slump Q84 C2	96 97	Zero One	Experts HISL=0.6 MEDSL=0.4 LOWSL=0.0	Rank 1	96-103	Fraction of the core participating in core slump given CRD injection only.
Slump Q84 C3	98 99 100	Zero One	Internal HISL=0.4 MEDSL=0.3 LOWSL=0.3	Rank 1	96-103	Fraction of the core participating in core slump given no injection.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
Slump Q84 C4	101 102 103	Zero One	Internal HISL=0.1 MEDSL=0.2 LOWSL=0.7	Rank 1	96-103	Fraction of the core participating in core slump given RPV is at low pressure and some high flow injection occurs (i.e. not CRD).
SEfV Q86 C2	104 105 106 107	Zero One	Internal SE-Alp=0.0 SE-BtHd=0.2 SE-LgBr=0.2 SE-SmBr=0.3 SE-NFAI=0.3	-	-	The probability that an in-vessel steam explosion will fail the RPV in a certain mode.
LiqVB Q87 C2	108 109	Zero One	Internal HiLiqVB=0.025 LoLiqVB=0.975 nMELT=0.0	Rank 1	108-111	Probability that there is a large amount of molten core debris (HiLiqVB) at VB given that coolant is being injected during core melt (CRD or LPI).
LiqVB Q87 C3	110 111	Zero One	Internal HiLiqVB=0.1 LoLiqVB=0.9 nMELT=0.0	Rank 1	108-111	Probability that there is a large amount of molten core debris (HiLiqVB) at VB given that coolant is not being injected during core melt.
mVB Q89 C6	112 113 114	Zero One	Internal A-FAIL=0.0 BH-FAIL=0.25 LgBch=0.005 SmBrch=0.75 nBreach=0.0	Rank 1	112-122	The probability that the RPV will fail in a certain mode given that the RPV is at high pressure and no injection (or only CRD), or RPV is at low pressure and no injection or goes recritical when LPI is restored.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
mVB Q89 C8	115 116 117 118	Zero One	Internal A-FAIL=0.0 BH-FAIL=0.124 LgBrch=0.005 SmBrch=0.371 nBreach=0.5	Rank 1	112-122	The probability that the RPV will fail in a certain mode given that the RPV is at low pressure, LPI is working, and a large amount of the core is mobile. No recriticality after LPI is restored.
mVB Q89 C9	119 120 121 122	Zero One	Internal A-FAIL=0.0 BH-FAIL=0.062 LgBrch=0.005 SmBrch=0.188 nBreach=0.745	Rank 1	112-122	The probability that the RPV will fail in a certain mode given that the RPV is at low pressure, LPI is working, and a small amount of the core is mobile. No recriticality after LPI is restored.
HPME Q90 C3	123 124	Zero One	Internal HPME=0.8 nHPME=0.2	-	-	The probability of an HPME event given that the RPV fails at high pressure.
H2VB Q92 C2 P17	125	4.6E-01 4.8E+02	Experts M=7.3E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV at high pressure with only CRD injection.
H2VB Q92 C3 P17	126	8.2E-01 5.0E+02	Experts M=1.9E+02	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV at high pressure with no injection.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
H2VB Q92 C4 P17	127	0.0E+00 5.7E+02	Experts M=5.1E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV initially at high pressure but goes to low pressure and CRD and LPI are both working.
H2VB Q92 C5 P17	128	0.0E+00 2.0E+02	Experts M=4.4E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV initially at high pressure but goes to low pressure and LPI only is working.
H2VB Q92 C6 P17	129	0.0E+00 2.1E+02	Experts M=3.9E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV initially at high pressure but goes to low pressure and only CRD is working or no injection.
H2VB Q92 C8 P17	130	0.0E+00 8.2E+01	Experts M=1.5E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV at low pressure during core damage and CRD and LPI are working.
H2VB Q92 C9 P17	131	0.0E+00 1.2E+02	Experts M=2.3E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV at low pressure during core damage and only LPI is working.
H2VB Q92 C10 P17	132	1.4E-01 3.1E+02	Experts M=5.1E+01	Rank 1	125-132	The amount of H_2 (Kg-moles) produced at VB with RPV at low pressure during core damage and only CRD is working or no injection.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
DPVB Q94 C2 P18	133	1.3E-01 1.8E+01	Experts M=4.3E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a wet cavity (Expert Case 1-HC).
DPVB Q94 C3 P18	134	4.1E-02 1.7E+01	Experts M=3.3E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a wet cavity (Expert Case 1-hC).
DPVB Q94 C4 P18	135	3.6E-01 9.3E+00	Experts M=3.9E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a dry cavity (Expert Case 2-HC).
DPVB Q94 C5 P18	136	2.0E-01 5.2E+00	Experts M=2.4E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a dry cavity (Expert Case 2-hC).
DPVB Q94 C6 P18	137	9.9E-02 1.9E+01	Experts M=4.3E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a wet cavity (Expert Case 1-Hc).
DPVB Q94 C7 P18	138	9.1E-03 1.8E+01	Experts M=3.1E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a wet cavity (Expert Case 1-hc).
DPVB Q94 C8 P18	139	3.5E-01 8.8E+00	Experts M=3.4E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a dry cavity (Expert Case 2-Hc).

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
DPVB Q94 C9 P18	140	2.2E-01 5.2E+00	Experts M=2.2E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at high pressure into a dry cavity (Expert Case 2-hc).
DPVB Q94 C10 P18	141	1.3E-01 1.7E+01	Experts M=2.9E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at low pressure into a wet cavity (Expert Case 3-HC).
DPVB Q94 C11 P18	142	6.0E-04 2.0E+01	Experts M=2.4E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at low pressure into a wet cavity (Expert Case 3-hC).
DPVB Q94 C12 P18	143	4.9E-02 1.7E+01	Experts M=2.9E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at low pressure into a wet cavity (Expert Case 3-Hc).
DPVB Q94 C13 P18	144	4.8E-02 1.7E+01	Experts M=2.4E+00	Rank 1	133-158	The containment pressure rise at VB (in bars). RPV fails at low pressure into a wet cavity (Expert Case 3-hc).
PeD-VBP Q95 C2 P19	145	5.8E+00 8.1E+01	Experts M=3.6E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a wet cavity (Expert Case 1-HC).
PeD-VBP Q95 C3 P19	146	4.7E+00 6.9E+01	Experts M=2.8E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a wet cavity (Expert Case 1-hC).

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
PeD-VBP Q95 C4 P19	147	4.1E+00 5.9E+01	Experts M=3.1E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a dry cavity (Expert Case 2-HC).
PeD-VBP Q95 C5 P19	148	1.5E-01 4.8E+01	Experts M=1.7E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a dry cavity (Expert Case 2-hC).
PeD-VBP Q95 C6 P19	149	4.4E+00 6.6E+01	Experts M=3.3E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a wet cavity (Expert Case 1-Hc).
PeD-VBP Q95 C7 P19	150	3.9E+00 5.6E+01	Experts M=2.2E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a wet cavity (Expert Case 1-hc).
PeD-VBP Q95 C8 P19	151	3.1E+00 5.9E+01	Experts M=2.8E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a dry cavity (Expert Case 2-Hc).
PeD-VBP Q95 C9 P19	152	2.6E+00 4.0E+01	Experts M=1.4E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at high pressure into a dry cavity (Expert Case 2-hc).
PeD-VBP Q95 C10 P19	153	2.0E+00 4.0E+01	Experts M=1.1E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at low pressure into a wet cavity (Expert Case 3-OHC and 3-oHC).

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
PeD-VBP Q95 C11 P19	154	1.4E+00 2.3E+01	Experts M=7.4E+00	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at low pressure into a wet cavity (Expert Case 3-OhC).
PeD-VBP Q95 C13 P19	155	7.3E-01 2.4E+01	Experts M=5.6E+00	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at low pressure into a wet cavity (Expert Case 3-ohC).
PeD-VBP Q95 C14 P19	156	1.0E+00 4.1E+01	Experts M=1.0E+01	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at low pressure into a wet cavity (Expert Case 3-OHC).
PeD-VBP Q95 C15 P19	157	1.0E+00 2.1E+01	Experts M=6.1E+00	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at low pressure into a wet cavity (Expert Case 3-Ohc and 3-oHc).
PeD-VBP Q95 C17 P19	158	7.1E-01 1.6E+01	Experts M=4.4E+00	Rank 1	133-158	The peak pedestal cavity pressure (bars) at VB. RPV fails at low pressure into a wet cavity (Expert Case 3-ohc).
IM Q103 C3	159 160	Zero One	Experts IM=0.38 nIM=0.62	Rank 1	159-168	The probability of drywell shell meltthrough with Hi flow melt in a flooded drywell.
IM Q103 C4	161 162	Zero One	Experts IM=0.79 nIM=0.21	Rank 1	159-168	The probability of drywell shell meltthrough with Hi flow melt, RPV at Hi pressure at VB, Hi metals and\or Hi superheat, in a dry or wet drywell.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
IM Q103 C7	163 164	Zero One	Experts IM=0.6 nIM=0.4	Rank 1	159-168	The probability of drywell shell meltthrough with Hi flow melt, RPV at low pressure at VB, low metals and\or low superheat, in a dry or wet drywell.
IM Q103 C10	165 166	Zero One	Experts IM=0.32 nIM=0.68	Rank 1	159-168	The probability of drywell shell meltthrough with low flow melt in a flooded drywell.
IM Q103 C11	167 168	Zero One	Experts IM=0.51 nIM=0.49	Rank 1	159-168	The probability of drywell shell meltthrough with low flow melt in a dry or wet drywell.
FCCI Q119 C2 P22	169	6.0E-01 1.0E+00	Uniform M=8.0E-01	Rank 1	169,170	The fraction of core debris that participates in CCI; given that a large amount of core debris participates in an ex-vessel steam explosion (EVSE).
FCCI Q119 C3 P22	170	9.0E-01 1.0E+00	Uniform M=9.5E-01	Rank 1	169,170	The fraction of core debris that participates in CCI; given that a small amount of core debris participates in an EVSE.
ConErPed Q125 C1	171	1.8E-01 1.3E+00	Experts M=0.65	-	-	The depth (m) of concrete erosion that will fail the reactor pedestal.
PedF@1 Q126 C3	172	8.6E-04 5.3E-01	Experts M=0.19	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 1.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
PedF@1 Q126 C4	173	7.2E-04 5.2E-01	Experts M=0.16	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 2.
PedF@1 Q126 C5	174	1.3E-04 3.9E-01	Experts M=0.14	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 3.
PedF@1 Q126 C6	175	2.3E-02 6.0E-01	Experts M=0.20	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 4.
PedF@1 Q126 C7	176	2.3E-02 6.0E-01	Experts M=0.26	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 5.
PedF@1 Q126 C8	177	2.5E-02 6.0E-01	Experts M=0.26	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 6.
PedF@1 Q126 C9	178	2.4E-02 4.3E-01	Experts M=0.2	Rank 1	172-199	The depth of concrete eroded (m) in 1 hour during CCI--Expert Group 7.
PedF@3 Q126 C3	179	6.0E-04 7.5E-01	Experts M=0.32	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 1.
PedF@3 Q126 C4	180	1.2E-03 7.4E-01	Experts M=0.29	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 2.
PedF@3 Q126 C5	181	1.5E-03 6.9E-01	Experts M=0.26	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 3.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
PedF@3 Q126 C6	182	8.1E-02 8.5E-01	Experts M=0.41	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 4.
PedF@3 Q126 C7	183	8.3E-02 8.5E-01	Experts M=0.47	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 5.
PedF@3 Q126 C8	184	8.1E-02 8.5E-01	Experts M=0.47	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 6.
PedF@3 Q126 C9	185	8.1E-02 8.5E-01	Experts M=0.4	Rank 1	172-199	The depth of concrete eroded (m) in 3 hours during CCI--Expert Group 7.
PedF@6 Q126 C3	186	1.5E-01 1.3E+00	Experts M=0.55	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 1.
PedF@6 Q126 C4	187	1.5E-01 1.3E+00	Experts M=0.52	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 2.
PedF@6 Q126 C5	188	1.5E-01 1.2E+00	Experts M=0.49	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 3.
PedF@6 Q126 C6	189	2.3E-01 1.3E+00	Experts M=0.66	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 4.
PedF@6 Q126 C7	190	2.9E-01 1.3E+00	Experts M=0.73	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 5.
PedF@6 Q126 C8	191	2.8E-01 1.3E+00	Experts M=0.72	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 6.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
PedF@6 Q126 C9	192	2.3E-01 1.3E+00	Experts M=0.62	Rank 1	172-199	The depth of concrete eroded (m) in 6 hours during CCI--Expert Group 7.
PedF@10 Q126 C3	193	3.7E-01 1.4E+00	Experts M=0.83	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 1.
PedF@10 Q126 C4	194	2.7E-01 1.4E+00	Experts M=0.79	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 2.
PedF@10 Q126 C5	195	2.6E-01 1.4E+00	Experts M=0.74	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 3.
PedF@10 Q126 C6	196	2.9E-01 1.5E+00	Experts M=0.83	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 4.
PedF@10 Q126 C7	197	3.8E-01 1.6E+00	Experts M=0.92	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 5.
PedF@10 Q126 C8	198	3.8E-01 1.6E+00	Experts M=0.93	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 6.
PedF@10 Q126 C9	199	3.0E-01 1.4E+00	Experts M=0.82	Rank 1	172-199	The depth of concrete eroded (m) in 10 hours during CCI--Expert Group 7.
LOSPR2.5-5HR APET Q110,C8	213	2.1E-01 7.9E-01	LOSPR M=5.2E-01	RANK 1	213-231	Probability of recovering offsite power between 2.5 and 5 hours.

Table 2.3-3 (Continued)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distri-bution	Corre-lation	Correl. with	Description
LOSPR5-7.5HR APET Q48, C2	214	1.5E-01 7.3E-01	LOSPR M=4.3E-01	RANK 1	213-231	Probability of recovering offsite power between 5 and 7.5 hours.
LOSPR7.5-10HR APET Q110, C2	215	1.1E-01 7.1E-01	LOSPR M=3.9E-01	RANK 1	213-231	Probability of recovering offsite power between 7.5 and 10 hours.
LOSPR7-9.5HR APET Q48, C3	216	1.2E-01 7.1E-01	LOSPR M=4.0E-01	RANK 1	213-231	Probability of recovering offsite power between 7 and 9.5 hours.
LOSPR9.5-12HR APET Q110, C3	217	9.7E-02 6.8E-01	LOSPR M=3.7E-01	RANK 1	213-231	Probability of recovering offsite power between 9.5 and 12 hours.
LOSPR9-11.5HR APET Q48, C4	218	1.0E-01 6.7E-01	LOSPR M=3.8E-01	RANK 1	213-231	Probability of recovering offsite power between 9 and 11.5 hours.
LOSPR11.5-14HR APET Q110, C4	219	3.0E-02 6.7E-01	LOSPR M=3.6E-01	RANK 1	213-231	Probability of recovering offsite power between 11.5 and 14 hours.
LOSPR12-14.5HR APET Q48, C5	220	2.6E-02 6.8E-01	LOSPR M=3.6E-01	RANK 1	213-231	Probability of recovering offsite power between 12 and 14.5 hours.
LOSPR14.5-17HR APET Q110, C5	221	1.3E-02 6.7E-01	LOSPR M=3.5E-01	RANK 1	213-231	Probability of recovering offsite power between 14.5 and 17 hours.
LOSPR13-15.5HR APET Q48, C6	222	2.0E-02 6.7E-01	LOSPR M=3.6E-01	RANK 1	213-231	Probability of recovering offsite power between 13 and 15.5 hours.

Table 2.3-3 (Concluded)
Variables Sampled in the Accident Progression Analysis

Variable Name	LHS #	Range*	Distribution	Correlation	Correl. with	Description
LOSPR15.5-18HR APET Q110, C6	223	1.0E-02 6.2E-01	LOSPR M=3.5E-01	RANK 1	213-231	Probability of recovering offsite power between 15.5 and 18 hours.
LOSPNRO-2.5HR APET Q48, C8	224	2.6E-02 2.7E-01	LOSPR M=9.6E-02	RANK 1	213-231	Probability of not recovering offsite power by 2.5 hours.
LOSPR1.1-3.6HR APET Q48, C7	225	4.0E-01 8.4E-01	LOSPR M=6.5E-01	RANK 1	213-231	Probability of recovering offsite power between 1.1 and 3.6 hours.
LOSPR3.6-6.1HR APET Q110, C7	226	1.8E-01 7.6E-01	LOSPR M=4.7E-01	RANK 1	213-231	Probability of recovering offsite power between 3.6 and 6.1 hours.
INJ-FAILS APET Q4, Br 7	227	0 1	Internal F=5.0E-01	RANK 1	213-231	Given station blackout, probability of battery not depleting within 12 hours.
BAT-DEP-3HR APET Q4, Br 3	228	0 1	Internal F=8.5E-02	RANK 1	213-231	Given station blackout, probability of battery depletion by 3 hours.
BAT-DEP-5HR APET Q4, Br 4	229	0 1	Internal F=8.0E-02	RANK 1	213-231	Given station blackout, probability of battery depletion by 5 hours.
BAT-DEP-7HR APET Q4, Br 5	230	0 1	Internal F=8.5E-02	RANK 1	213-231	Given station blackout, probability of battery depletion by 7 hours.
BAT-DEP-9HR APET Q4, Br 6	231	0 1	Internal F=2.5E-01	RANK 1	213-231	Given station blackout, probability of battery depletion by 9 hours.

* For lognormal distributions use .001 and .999, for expert distributions use min and max from sample, for LOSP related distributions use min and max from sample.

In Table 2.3-3, the first column gives the variable abbreviation or identifier, and the question (and case if appropriate) in which the variable is used. Where several variables are correlated, they are treated as different variables for sampling purposes and evaluation of the APET; but, as one variable for the regression analysis (see Section 5.3).

The second column gives the LHS variable number for the extended LHS sample. That is, this number indicates which position this variable occupies in the extended LHS matrix.

The third column gives the range of values that the variable can take in this analysis. For lognormal distributions the numbers represent the .001 and .999 quantiles of the distribution, for expert distributions the values represent the minimum and maximum from the sample, and for LOSP related distributions the values also represent the minimum and maximum from the sample. An entry of "Zero/One" in this column indicates that the variable was sampled Zero-One, i.e., it took on only the values of 0.0 or 1.0. In any observation one and only one of these values would be assigned.

The fourth column in Table 2.3-3 indicates the type of distribution used and its source. The mean value from the distribution is given. The entry "Experts" for the distribution indicates that the distribution came from an expert panel and the entry "Internal" indicates that the distribution was determined by some method other than the formal expert elicitation process. (None of the distributions obtained by aggregating the conclusions of experts can be described succinctly in words. Plots of the aggregate distributions are contained in volume 2 of this report. A listing of the input to the LHS program that contains many of these distributions in tabular form is given in Appendix E.) For Zero-One variables, an indication of the probability of each state is given in this column.

The fifth and sixth columns in Table 2.3-3 show whether the variable is correlated with any other variable. "Rank 1" indicates a rank correlation of 1.0. The entry in the "Correl. With" column lists the LHS number of all other variables correlated with the variable.

The seventh column in Table 2.3-3 gives a short description of the variable.

2.4 Description of the Accident Progression Bins

As each path through the Accident Progression Event Tree (APET) is evaluated, the result of that evaluation is stored by assigning it to an Accident Progression Bin. This bin describes the evaluation in enough detail that a source term (release of radionuclides) can be calculated for it. The accident progression bins are the means by which information is passed from the accident progression analysis to the source term analysis. A bin is defined by specifying the attribute or value for each of thirteen characteristics or quantities which define certain features of the evaluation of the APET. Section 2.4.1 describes the thirteen characteristics, and the values that each characteristic can assume. The binner itself, which is expressed as a computer input file, is listed in Appendix A.1.2. Section 2.4.2 contains a discussion of rebinning, a process that takes place between evaluating the APET (in which binning takes place) and the source term analysis. The rebinner is listed in Appendix A.1.3. Section 2.4.3 describes the reduced set of binning characteristics used in the rebinning which is used to present the results of the APET evaluation.

2.4.1 Description of the Bin Characteristics

The binning scheme for Peach Bottom utilizes the thirteen characteristics listed below. That is, there are thirteen types of information required to define a path through the APET. A bin is defined by a sequence of thirteen letters where each position represents a different characteristic in the order given below. For a characteristic, different letters are used represent the different possible states of the characteristic and are termed attributes. The meaning of the letters for each characteristic are defined in Table 2.4-1. The Peach Bottom binning characteristics are:

Characteristic	Abbreviation	Description
1	ASEQ	Accident Sequence Type
2	ZROXID	Zirconium Oxidation Level In-Vessel
3	VB	Vessel Condition at Vessel Breach
4	DCH-SE	Fraction of Core Participating in Direct Heating (DCH) and Steam Explosions (SE)
5	CFbCD	Containment Failure Mode before Core Damage
6	CFdCD	Containment Failure Mode during Core Damage
7	CFatVB	Containment Failure Mode at Vessel Breach
8	CFafVB	Containment Failure Mode after Vessel Breach
9	DWS	Drywell Spray Available
10	MCCI	Molten Core-Concrete Interaction Type
11	ESPBY	Suppression Pool Bypass Level
12	LSPBY	Suppression Pool Bypass with Containment Failure
13	RBBY	Reactor Building Bypass Level

Table 2.4-1
Description of Peach Bottom APB Characteristics - Binner

Attribute	Mnemonic	Description
Characteristic 1 - Accident Sequence Type.		
A	LOCA	LOCA sequence with CRD working.
B	FTRANS	Fast Transient, CRD works.
C	FTC	Fast ATWS.
D	TC-CV	Core Vulnerable ATWS.
E	FSB	Fast Station Blackout (no initial injection).
F	SSB	Slow Station Blackout (injection fails at 3 or 5 hrs.).
G	VSSB	Very Slow Station Blackout (injection fails at > 5 hrs.).
Characteristic 2 - Zirconium Oxidation Level In-Vessel		
A	HIZROX	High - Greater than 21 % of the in-vessel Zirconium has been oxidized before vessel breach.
B	LOZROX	Low - Less the 21 % of the in-vessel Zirconium has been oxidized before vessel breach.
Characteristic 3 - Vessel Condition at Vessel Breach		
A	HIP-nLPI	RPV is at high pressure at vessel breach, low pressure injection is not available during or after vessel breach.
B	LOP-nLPI	RPV is at low pressure at vessel breach, low pressure injection is not available during or after vessel breach.
C	HIP-LPI	RPV is at high pressure at vessel breach, low pressure injection is available during or after vessel breach.

Table 2.4-1 (Continued)
Description of Peach Bottom APB Characteristics - Binner

Attribute	Mnemonic	Description
D	LOP-LPI	RPV is at low pressure at vessel breach, low pressure injection is available during or after vessel breach.
E	nVB	No vessel breach, these APBs have core damage arrest due to water injection.
F	nCD	No core damage, in some ATWS sequences no core damage occurs if systems do not fail.
Characteristic 4 - Fraction of Core Participating in Direct Containment Heating (DCH) or Steam Explosion (SE)		
A	HIDCH	High DCH (large amount of debris mobile at vessel breach, 40 % of core participates).
B	LODCH	Low DCH (small amount of debris mobile at vessel breach, 10 % of core participates).
C	HIEXSE	High ex-vessel steam explosion, no DCH (large amount of debris mobile at vessel breach, 40 % of core participates).
D	LOEXSE	Low ex-vessel steam explosion, no DCH (small amount of debris mobile at vessel breach, 10 % of core participates).
E	nDCH-SE	No DCH or ex-vessel steam explosion.
Characteristic 5 - Containment Failure Mode before Core Damage.		
A	DWHLI	Drywell head leak occurs before core damage.
B	DWLI	Drywell leak occurs before core damage.
C	WWLI	Wetwell leak occurs before core damage.
D	DWHRI	Drywell head rupture occurs before core damage.
E	DWRI	Drywell rupture occurs before core damage.

Table 2.4-1 (Continued)
Description of Peach Bottom APB Characteristics - Binner

Attribute	Mnemonic	Description
F	DWVENTI	Drywell venting occurs before core damage.
G	WWRI	Wetwell rupture occurs before core damage.
H	WWVENTI	Wetwell venting occurs before core damage.
I	NOCFI	No containment failure or venting occurs before core damage.
Characteristic 6 - Containment Failure Mode during Core Damage.		
A	DWHLCD	Drywell head leak during core damage.
B	DWLCD	Drywell leak during core damage.
C	WWLCD	Wetwell leak during core damage.
D	DWHRCD	Drywell head rupture during core damage.
E	DWRCD	Drywell rupture during core damage.
F	DWVENTCD	Drywell venting during core damage.
G	WWRCD	Wetwell rupture during core damage.
H	WWVENTCD	Wetwell venting during core damage.
I	NOCFCD	No containment failure during core damage.
Characteristic 7 - Containment Failure Mode at Vessel Breach.		
A	DWHLVB	Drywell head leak at vessel breach.
B	DWLVB	Drywell leak at vessel breach.
C	WWLVB	Wetwell leak at vessel breach.
D	ALPHAVB	Alpha mode failure at vessel breach.
E	DWHRVB	Drywell head rupture at vessel breach.

Table 2.4-1 (Continued)
Description of Peach Bottom APB Characteristics - Binner

Attribute	Mnemonic	Description
F	DWMVB	Drywell melt-through at vessel breach.
G	DWRVB	Drywell rupture at vessel breach.
H	WWRVB	Wetwell rupture at vessel breach.
I	NOCFVB	No containment failure at vessel breach.
Characteristic 8 - Containment Failure Mode after Vessel Breach.		
A	DWHLL	Drywell head leak after vessel breach.
B	DWLL	Drywell leak after vessel breach.
C	WWLL	Wetwell leak after vessel breach.
D	DWHRL	Drywell head rupture after vessel breach.
E	DWRL	Drywell rupture after vessel breach.
F	WWRL	Wetwell rupture after vessel breach.
G	WWVENTL	Wetwell venting after vessel breach.
H	NOCFL	No containment failure after vessel breach.
Characteristic 9 - Drywell Spray Available.		
A	NO-Spr	No drywell sprays at any time.
B	Ear-Spr	Drywell sprays up to vessel breach.
C	Lat-Spr	Drywell sprays after vessel breach but not before.
D	E&L-Spr	Drywell sprays before and after vessel breach.
Characteristic 10 - Molten Core-Concrete Interaction Type.		
A	DRYCCI	Dry CCI (no water or wet cavity initially with no continuous water addition).

Table 2.4-1 (Continued)
Description of Peach Bottom APB Characteristics - Binner

Attribute	Mnemonic	Description
B	FLDCCI	Flooded CCI (water is added continuously but does not prevent CCI).
C	NOCCI	No CCI (no vessel breach or water is added continuously and prevents CCI).
Characteristic 11 - Suppression Pool Bypass Level.		
A	NOBY	No suppression pool bypass before vessel breach.
B	PARTBY	Partial suppression pool bypass before vessel breach.
C	COMPBY	Complete suppression pool bypass before vessel breach.
Characteristic 12 - Suppression Pool Bypass with Containment Failure.		
A	CSPBYbCD	Complete suppression pool bypass before vessel breach.
B	PSPBYbCD	Partial suppression pool bypass before vessel breach.
C	CSPBYVB	Complete suppression pool bypass at vessel breach.
D	PSPBYVB	Partial suppression pool bypass at vessel breach.
E	CSPBYafVB	Complete suppression pool bypass after vessel breach.
F	PSPBYafVB	Partial suppression pool bypass after vessel breach.
G	NSPBY	No suppression pool bypass.
Characteristic 13 - Reactor Building Bypass Level.		
A	RBNBY	Nominal bypass only.

Table 2.4-1 (Concluded)
Description of Peach Bottom APB Characteristics - Binner

Attribute	Mnemonic	Description
B	RBSBY	Small bypass.
C	RBPBY	Partial bypass.
D	RBCBY	Complete bypass.

Most of this information is needed by PBSOR to calculate the fission product source terms. PBSOR does not directly use the level of detail provided by characteristics 5, 6, 7, 8, 12, and 13. This level of detail is used to check that the APET is classifying the accident progression paths correctly.

In Table 2.4-1 is a listing of each attribute for each characteristic followed by a brief description of each characteristic. A more detailed description of each characteristic follows and an example of a typical bin is shown.

Characteristic 1 address the type of accident progression that has occurred. Seven attributes are defined. The attributes are based on the initiating event and the time at which core damage occurs. The initiating events are LOCAs, Transients, Station Blackout, and ATWS. For each initiating event, core damage may occur at various times: fast (1 hr), slow (3-5 hr), and very slow (>5 hr).

Characteristic 2 addresses the fraction of in-vessel zirconium that is oxidized before vessel breach. There are two possible values for this characteristic: low and high. The demarcation point between the two ranges is 21%.

Characteristic 3 addresses the RPV pressure before vessel breach and the availability of low pressure coolant injection at vessel breach. There are six possibilities, including no core damage and no vessel breach. The RPV can either be at high or low pressure before vessel breach. High pressure is SRV relief pressure (i.e., approximately 1150 psig) and low pressure is less than 200 psia. There are two possibilities for coolant injection: coolant is being injected into the RPV at or immediately after vessel breach or coolant is not injected at or immediately after vessel breach.

Characteristic 4 addresses the fraction of core participating in DCH or an ex-vessel steam explosion. There are five attributes associated with this characteristic. There are two levels for DCH: low (10% of the core) and high (40% of the core).

Characteristic 5 addresses the containment failure mode before core damage occurs. There are nine attributes. The only means by which the containment can fail at this time are: pre-existing leakage, isolation failure, venting, and overpressure. For this analysis pre-existing leakage and isolation failure have been determined to be negligible. The attributes describe both size (leak or rupture), location (drywell head, drywell, or wetwell), and type (structural overpressure or vent) of failure.

Characteristic 6 addresses the containment failure mode during core damage but before vessel breach. This characteristic is the same as characteristic 5 except that the time of failure is different.

Characteristic 7 addresses the containment failure mode at or immediately after vessel breach. There are nine attributes. The containment can fail in this time frame due to overpressure (static loads from the blowdown, DCH, or steam explosions), explosive loads (from in-vessel, alpha mode, or ex-vessel steam explosions), or structural failure (pedestal failure induced by reactor cavity overpressure resulting in drywell failure or direct melt attack resulting in drywell meltthrough). Again the attributes describe size, location, and type of failure.

Characteristic 8 addresses the long term containment failure modes after vessel breach. There are eight attributes. The containment can fail in this time frame from overpressure (gas generation from MCCI and concrete degassing), structural (long-term erosion of the reactor pedestal resulting in drywell failure or high temperatures, i.e., 800 to 1200 °F, from the MCCI weakening the structural strength of the drywell), or venting.

Characteristic 9 addresses the availability of drywell sprays. There are four attributes. For this characteristic the accident progression is divided into two time periods: before and after vessel breach. Drywell spray may operate in both, one, or none of the time periods.

Characteristic 10 addresses core-concrete interaction types. There are three attributes including no CCI releases. The first two attributes describe the amount of water in the reactor cavity and drywell floor. The cavity can be dry, wet, or flooded. For PBSOR the difference between dry and wet is not important so these are grouped together. The amount of water at Peach Bottom is limited to about 2.5 feet because of the level of the downcomers. Most of the water in the cavity and on the drywell floor will be displaced to the wetwell by the core debris so that the amount of water covering the debris will be small and boil off fairly quickly. For a flooded CCI, water is added continuously so we always have a water layer over the debris bed.

Characteristic 11 addresses the level of suppression pool bypass before vessel breach. There are three choices: none, partial, and complete. Bypass may occur due to Large and Small LOCAs, stuck open SRV vacuum breakers which result in diversion of SRV from to the drywell, and ATWS induced pipe breaks.

Characteristic 12 addresses the level of suppression pool bypass in conjunction with containment failure. There are seven attributes including no bypass. The characteristic is divided into three time intervals: before vessel breach, at or near vessel breach, and after vessel breach. There are two levels in each interval: partial or complete.

Characteristic 13 addresses the level of reactor building bypass. There are four choices: no bypass, small bypass, partial bypass, and complete bypass. The bypass occurs at the time of containment failure and includes the possibility of hydrogen burns in the reactor building.

A typical bin might be GAABIIFHAAAGB which, using the information presented above, is:

G - VSSB	Very slow station blackout
A - HIZROX	A high fraction of the Zr was oxidized in-vessel
A - HIP-nLPI	RPV at high pressure at vessel breach and no low pressure injection is available
B - LODCH	Low DCH
I - NOCFI	No containment failure before core damage
I - NOCFCD	No containment failure during core damage
F - DWMVB	Containment failure by drywell melt-through at vessel breach
H - NOCFL	No containment failure after vessel breach
A - NO-Spr	No drywell sprays
A - DRYCCI	Dry CCI, no continuous water supplied to drywell
A - NOBY	No suppression pool bypass
G - nSPBY	No suppression pool bypass with containment failure
B - RBSBY	Small reactor building bypass

2.4.2 Rebinning

The binning scheme utilized for the evaluation of the APET does not exactly match the input information required by PBSOR. The additional information in the initial binning is kept because it provides a better record of the outcomes of the APET evaluation. Therefore, there is a step between the evaluation of the APET using the initial binning scheme and the evaluation of PBSOR known as "rebinning". In the rebinning, attributes in some characteristics are combined because there are no significant differences between them for calculating the fission product releases or characteristics are combined and new attributes are defined to better represent the progression characteristics necessary for PBSOR.

In the rebinning for Peach Bottom there are no changes for Characteristics 1, 2, 3, 4, 9, 10, and 11. However, characteristics 5, 6, 7, 8, and 12 are combined into two new characteristics and characteristic 13 is simplified. The characteristics are renumbered as old=>new: 1=>1, 2=>2, 3=>3, 4=>4, 5,6,7,8,12=>5, 5,6,7,8=>6, 9=>7, 10=>8, 11=>9, 13=>10. The rebinning process takes the containment failure modes in bin characteristics 5, 6, 7, and 8 and combines them with the suppression pool bypass level with containment failure in bin characteristic 12 to get a single containment failure mode which is defined in rebin characteristic 5 for use in PBSOR. The rebinner also takes the time of containment failure combined with the type of containment failure and determines a single time of containment failure which is defined in rebin characteristic 6 for use in PBSOR. Finally, the rebinner reduces the number of reactor building bypass levels to two by combining none and small into small and partial and complete into large for rebin characteristic 10.

The Peach Bottom rebinning characteristics are:

Characteristic	Abbreviation	Description
1	ASEQ	Accident Sequence Type
2	ZROXID	Zirconium Oxidation Level In-Vessel
3	VB	Vessel Condition at Vessel Breach
4	DCH-SE	Fraction of Core Participating in Direct Heating (DCH) or Steam Explosion (SE)
5	CFM	Containment Failure Mode
6	CFT	Containment Failure Time
7	DWS	Drywell Spray Available
8	MCCI	Molten Core-Concrete Interaction Type
9	SPBY	Suppression Pool Bypass Level
10	RBBY	Reactor Building Bypass Level

A complete list of the attributes for each characteristic and a short description appears in Table 2.4-2. The descriptions of each characteristic are the same as for the binner except for characteristics 5 and 6 (i.e., BC1 = RBC1, BC2 = RBC2, BC3 = RBC3, BC4 = RBC4, BC9 = RBC7, BC10 = RBC8, BC11 = RBC9, BC13 = RBC10).

Thus, the rebinning process converts the example bin, GAABIIFHAAAGB to GAABFBAAAA:

G - VSSB	Very slow station blackout
A - HIZROX	A high fraction of the Zr was oxidized in-vessel
A - HIP-nLPI	RPV at high pressure at vessel breach and no low pressure injection is available
B - LODCH	Low DCH
F - DWMTH	Containment failed by drywell melt-through
B - ICF	Containment failure occurred at vessel breach
A - NO-Spr	No drywell sprays
A - DRYCCI	Dry CCI, no continuous water supplied to drywell
A - NOBY	No suppression pool bypass
A - RBSMBY	Small or no reactor building bypass

Table 2.4-2
Description of Peach Bottom APB Characteristics - Rebinner

Attribute	Mnemonic	Description
Characteristic 1 - Accident Sequence Type.		
A	LOCA	LOCA sequence with CRD working.
B	FTRANS	Fast Transient, CRD works.
C	FTC	Fast ATWS.
D	TC-CV	Core Vulnerable ATWS.
E	FSB	Fast Station Blackout (no initial injection).
F	SSB	Slow Station Blackout (injection fails at 3 or 5 hrs.).
G	VSSB	Very Slow Station Blackout (injection fails at > 5 hrs.).
Characteristic 2 - Zirconium Oxidation Level In-Vessel		
A	HIZROX	High - Greater than 21 % of the in-vessel Zirconium has been oxidized before vessel breach.
B	LOZROX	Low - Less than 21 % of the in-vessel Zirconium has been oxidized before vessel breach.
Characteristic 3 - Vessel Condition at Vessel Breach		
A	HIP-nLPI	RPV is at high pressure at vessel breach, low pressure injection is not available during or after vessel breach.
B	LOP-nLPI	RPV is at low pressure at vessel breach, low pressure injection is not available during or after vessel breach.
C	HIP-LPI	RPV is at high pressure at vessel breach, low pressure injection is available during or after vessel breach.

Table 2.4-2 (Continued)
Description of Peach Bottom APB Characteristics - Rebinner

Attribute	Mnemonic	Description
D	LOP-LPI	RPV is at low pressure at vessel breach, low pressure injection is available during or after vessel breach.
E	nVB	No vessel breach, these APBs have core damage arrest due to water injection.
F	nCD	No core damage, in some ATWS sequences no core damage occurs if systems do not fail.
Characteristic 4 - Fraction of Core Participating in Direct Containment Heating (DCH) or Steam Explosion (SE)		
A	HIDCH	High DCH (large amount of debris mobile at vessel breach, 40 % of core participates).
B	LODCH	Low DCH (small amount of debris mobile at vessel breach, 10 % of core participates).
C	HIEXSE	High ex-vessel steam explosion, no DCH (large amount of debris mobile at vessel breach, 40 % of core participates).
D	LOEXSE	Low ex-vessel steam explosion, no DCH (small amount of debris mobile at vessel breach, 10 % of core participates).
E	nDCH-SE	No DCH or ex-vessel steam explosion.
Characteristic 5 - Containment Failure Mode.		
A	DWHL	Drywell head leak.
B	DWL	Drywell leak occurs.
C	WWL	Wetwell leak occurs.
D	DWHR	Drywell head rupture.
E	DWR	Drywell rupture.

Table 2.4-2 (Continued)
Description of Peach Bottom APB Characteristics - Rebinner

Attribute	Mnemonic	Description
F	DWMTH	Drywell Melt-through.
G	WWVENT	Wetwell venting.
H	WWR	Wetwell rupture.
I	NOCF	No containment failure or venting.
Characteristic 6 - Containment Failure Time.		
A	ECF	Containment Failure occurs before or during core damage.
B	ICF	Containment Failure occurs at vessel breach.
C	LCF	Containment Failure occurs after vessel breach or not at all.
Characteristic 7 - Drywell Spray Available.		
A - NO-Spr		No drywell sprays at any time.
B - Ear-Spr		Drywell sprays up to vessel breach.
C - Lat-Spr		Drywell sprays after vessel breach but not before.
D - E&L-Spr		Drywell sprays before and after vessel breach.
Characteristic 8 - Molten Core-Concrete Interaction Type.		
A - DRYCCI		Dry CCI (no water or wet cavity initially with no continuous water addition).
B - FLDCCI		Flooded CCI (water is added continuously but does not prevent CCI).
C - NOCCI		No CCI (no vessel breach or water is added continuously and prevents CCI).

Table 2.4-2 (Concluded)
Description of Peach Bottom APB Characteristics - Rebinner

Attribute	Mnemonic	Description
Characteristic 9 - Suppression Pool Bypass Level.		
A	NOBY	No suppression pool bypass before vessel breach.
B	PARTBY	Partial suppression pool bypass before vessel breach.
C	COMPBY	Complete suppression pool bypass before vessel breach.
Characteristic 10 - Reactor Building Bypass Level.		
A	RBSMBY	Nominal or small bypass.
B	RBLGBY	Partial or complete bypass.

2.4.3 Reduced Bins for Presentation

For presentation purposes in NUREG-1150, a set of "reduced" bins has been adopted. Instead of the 10 characteristics and thousands of possible bins that describe the evaluation of the APET in detail, the reduced bins place the outcomes of the evaluation of the APET into a few, very general groups. The ten reduced bins for Peach Bottom are:

1 VB, Early CF, WW Failure, V Pressure >200 psi at VB
2 VB, Early CF, WW Failure, V Pressure <200 psi at VB
3 VB, Early CF, DW Failure, V Pressure >200 psi at VB
4 VB, Early CF, DW Failure, V Pressure <200 psi at VB
5 VB, Late CF, WW Failure
6 VB, Late CF, DW Failure
7 VB, Vent
8 VB, No CF
9 No VB
10 No CD

In the reduced binning scheme there are essentially five characteristics: core damage, vessel breach, containment failure time, containment failure location, and reactor pressure vessel pressure at the time of vessel breach. Each of these characteristics and their associated attributes are defined in Table 2.4-3.

In assigning bins to one of these reduced bins, however, the reduced bins are considered in the reverse order. That is:

10 No CD
9 No VB
8 VB, No CF
7 VB, Vent
6 VB, Late CF, DW Failure
5 VB, Late CF, WW Failure
3 VB, Early CF, DW Failure, V Pressure >200 psi at VB
4 VB, Early CF, DW Failure, V Pressure <200 psi at VB
1 VB, Early CF, WW Failure, V Pressure >200 psi at VB
2 VB, Early CF, WW Failure, V Pressure <200 psi at VB

The ten reduced bins may now be defined as follows (NA means that characteristic is not applicable for that bin):

1: CD, VB, Early CF, WW Failure, V Pressure >200 psi at VB

> Core damage occurs followed by vessel breach. The containment fails early in the wetwell (i.e., either before core damage, during core damage, or at vessel breach) and the RPV pressure is greater than 200 psi at the time of vessel breach (this means DCH is possible).

Table 2.4-3
Description of Reduced APB Characteristics

Attribute	Description
Characteristic 1: Core Damage (CD)	
CD	Core Damage occurs
No CD	Core Damage does not occur
Characteristic 2: Vessel Breach (VB)	
VB	Vessel Breach occurs
No VB	Vessel Breach does not occur
Characteristic 3: Containment Failure Time	
Early CF	Containment Failure at or before VB
Late CF	Containment Failure after VB
No CF	No containment failure
Characteristic 4: Containment Failure Location	
WW Failure	Wetwell failure
DW Failure	Drywell failure
Vent	Containment is vented from the wetwell
Characteristic 5: Reactor Pressure Vessel Pressure	
V Pressure >200 psi at VB	
V Pressure <200 psi at VB	

2: CD, VB, Early CF, WW Failure, V pressure <200 psi at VB

Core damage occurs followed by vessel breach. The containment fails early in the wetwell (i.e., either before core damage, during core damage, or at vessel breach) and the RPV pressure is less than 200 psi at the time of vessel breach (this means DCH is not possible).

3: CD, VB, Early CF, DW Failure, V Pressure >200 psi at VB

Core damage occurs followed by vessel breach. The containment fails early in the drywell (i.e., either before core damage, during core damage, or at vessel breach) and the RPV pressure is greater than 200 psi at the time of vessel breach (this means DCH is possible).

4: CD, VB, Early CF, DW Failure, V Pressure <200 psi at VB

Core damage occurs followed by vessel breach. The containment fails early in the drywell (i.e., either before core damage, during core damage, or at vessel breach) and the RPV pressure is less than 200 psi at the time of vessel breach (this means DCH is not possible).

5: CD, VB, Late CF, WW Failure, NA

Core damage occurs followed by vessel breach. The containment fails late in the wetwell (i.e., after vessel breach during MCCI) and the RPV pressure is not important since, even if DCH occurred, it did not fail containment at the time it occurred.

6: CD, VB, Late CF, DW Failure, NA

Core damage occurs followed by vessel breach. The containment fails late in the drywell (i.e., after vessel breach during MCCI) and the RPV pressure is not important since, even if DCH occurred, it did not fail containment at the time it occurred.

7: CD, VB, No CF, Vent, NA

Core damage occurs followed by vessel breach. The containment never structurally fails but is vented sometime during the accident progression. RPV pressure is not important (characteristic 5 is NA) since, even if it occurred, DCH does not significantly affect the source term as the containment does not fail and the vent limits it's effect.

8: CD, VB, No CF, NA, NA

Core damage occurs followed by vessel breach. The containment never fails structurally (characteristic 4 is NA) and is not vented. RPV pressure is not important (characteristic 5 is NA) since, even if it occurred, DCH did not fail containment. Some nominal leakage from containment exists and is accounted for in the analysis so that while the risk will be small is it not completely negligible.

9: CD, No VB, NA, NA, NA

Core damage occurs but is arrested in time to prevent vessel breach. There are no releases associated with vessel breach or MCCI. It must be remembered, however, that the containment can fail due to overpressure or venting even if vessel breach is averted. Thus, the potential exists for some of the in-vessel releases to be released to the environment.

10: No CD, NA, NA, NA, NA

Core Damage did not occur. No in-vessel or ex-vessel release occurs. The containment may fail on overpressure or be vented. The RPV may be at high or low pressure depending on the progression characteristics. The risk associated with this bin is negligible.

2.5 Results of the Accident Progression Analysis

This section presents the results of evaluating the APET. As evaluating the APET produces the accident progression bins (APBs) which each PDS can evolve into, the discussion is primarily in terms of APBs. Some summary results are presented and sensitivity analyses are discussed.

Section 2.5.1 presents the accident progression results for the internal initiators and Section 2.5.2 discusses the sensitivity analysis. The accident progression analysis results for the fire initiators are presented in Section 2.5.3 and sensitivity analyses for fires are presented in Section 2.5.4. The seismic accident progression results are given in section 2.5.5. The basic results of the APET are the same for either the LLNL hazard curve or the EPRI hazard curve and are only presented once. Section 2.5.6 presents the sensitivity analyses results for the seismic analysis.

The tables in this section present only a very small portion of the output obtained by evaluating the APETs. Complete listings giving average bin conditional probabilities for each PDS group, and listings giving the bin probabilities for each PDS group (for each observation) are available on computer media by request.

2.5.1 Results for Internal Initiators

2.5.1.1 Results for PDS Group 1 - LOCA

This PDS represents two scenarios: 1) a large LOCA followed by immediate failure of all injection, and 2) a medium LOCA with initial HPCI success but almost immediate failure as the vessel depressurizes below HPCI working pressure, all other injection has failed. Early core damage results with the vessel at low pressure. CRD and containment heat removal are working. Venting is available.

Tables 2.5-1 through 2.5-9 will list, for each PDS; the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). If the five most probable bins also all have VB, then the table will list the ten most probable bins. If the five most probable bins all have VB and CF, then the table will list the fifteen most probable bins. The "Order" column gives the order of the bin, out of all bins, when ranked by conditional probability. The "Prob." column lists mean APB probabilities conditional on the occurrence of the PDS. That is, these tables show the results averaged over the 200 observations from the sample. If bin X occurred with a probability of 0.004 for each observation, its mean probability would be 0.004 in the Table. If bin Y occurred with a probability of 0.8 for one observation and did not occur in the remaining 199 observations, its mean probability would also be 0.004. The remaining nine columns explain nine of the ten characteristics in the APB descriptor for the rebinned results. The first characteristic, the accident sequence descriptor (ASEQ), has been omitted since this is defined by the PDS. The abbreviations for each APB characteristic are explained in Section 2.4.

The first part of Table 2.5-1 shows the ten most probable bins since they all have VB. The second part lists the five most probable bins with early containment failure. Evaluation of the APET produced 97 source term bins for this PDS. In order to represent 95% of the probability, 38 bins are required. The ten most probable bins represent 75% of the probability.

All of the bins in this PDS have VB since all injection had to fail in order to get core damage and, for this PDS, it can not be recovered. All bins occur with low RPV pressure and with suppression pool bypass before VB as a result of the LOCA. The top ten bins all have a small reactor building bypass. For eight of the top ten bins, water continues to be deposited on the core debris in the drywell by the CSS system. For nine of the ten, only a small ex-vessel steam explosion occurs, for the other no steam explosion occurs. For five of the ten, no containment failure ever occurs and, in one other, late drywell failure on overpressure occurs. For the other four, drywell meltthrough occurs at the time of VB.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.39 of which 0.32 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell meltthrough).

2.5.1.2 Results for PDS Group 2 - Fast Transient

This PDS represents four scenarios involving four different transient initiators followed by two stuck open SRVs (the equivalent of an intermediate LOCA). HPCI works initially but fails when the vessel

Table 2.5-1
Results of the Accident Progression Analysis for Peach Bottom
Internal Initiators - PDS 1 - LOCA

Ten Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AADDICDBCA	2.3884E-01	HIZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
2	ABDDICDBCA	1.2507E-01	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
3	AABDFBBACA	8.5696E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	COMPBY	RBSMBY
4	AADDICDCCA	5.2973E-02	HIZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	NOCCI	COMPBY	RBSMBY
5	AADDFBDBCA	5.2468E-02	HIZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
6	ABBDFBBACA	4.9514E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	COMPBY	RBSMBY
7	AADEICDBCA	4.0440E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
8	ABDDFBDBCA	3.8534E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
9	AADDECDBCA	3.8000E-02	HIZROX	LOP-LPI	LOEXSE	DWR	LCF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
10	ABDDICDCCA	2.8516E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	NOCCI	COMPBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
3	AABDFBBACA	8.5696E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	COMPBY	RBSMBY
5	AADDFBDBCA	5.2468E-02	HIZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
6	ABBDFBBACA	4.9514E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	COMPBY	RBSMBY
8	ABDDFBDBCA	3.8534E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	COMPBY	RBSMBY
13	AABEFBBACA	1.3950E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	Ear-Spr	DRYCCI	COMPBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

depressurizes below HPCI working pressure; all other injection has failed and early core damage results with the vessel at low pressure. CRD and containment heat removal are working as in PDS-1 but steam is directed through the SRVs to the suppression pool not to the drywell as in PDS-1. Venting is available.

Table 2.5-2 lists the ten most probable bins since the top five all have VB. As can be seen from the table, the bins produced by this PDS are identical to those of PDS 1 except that no suppression pool bypass occurs. This is because the only difference is the fact that the steam is released via the SRVs to the suppression pool not to the drywell as in PDS 1.

2.5.1.3 Results for PDS Group 3 - Fast Transient

This PDS is similar to PDS-2 except that containment heat removal is not working and CRD may not be working for some subgroups (CRD is assumed to be working since the cut sets where it is not are negligible contributors). HPSW failed due to operator failure and can be recovered during core degradation.

Table 2.5-3 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). The evaluation of the APET produced 122 source term bins for this PDS. In order to represent 95% of the probability, 43 bins are required. The five most probable bins represent 49% of the probability.

Two of the top five bins have core damage arrest. For this PDS, it is possible for the operator to initiate the HPSW system during the core degradation and possibly arrest the core damage; thereby, preventing vessel breach. For these no VB bins, all of the in-vessel release passes through the suppression pool and escapes from the containment via nominal leakage paths so the releases are very small. For the other three bins, two have late containment venting and one fails by drywell meltthrough. There are no containment sprays; however, HPSW is working in all the dominant bins and the drywell is flooded. The suppression pool is not bypassed before VB. None of the top bins with VB have ex-vessel steam explosions.

For the top bins with VB, two have small ex-vessel steam explosions and the others have none. In three, containment failure is by late containment venting and in the other two at VB by drywell meltthrough. The drywell is flooded by use of the HPSW system in all the bins.

For the top five bins with both VB and early CF, all have containment failure by drywell meltthrough. Two have small ex-vessel steam explosions; the others have none. One does not have HPSW working so the drywell is dry.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.27 of which 0.26 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell

Table 2.5-2
Results of the Accident Progression Analysis for Peach Bottom Internal Initiators - PDS 2 - Fast Transient

Ten Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	BADDICDBAA	2.3884E-01	HIZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
2	BBDDICDBAA	1.2507E-01	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
3	BABDFBBAAA	8.5696E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	NOBY	RBSMBY
4	BADDICDCAA	5.2973E-02	HIZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
5	BADDFBDBAA	5.2468E-02	HIZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
6	BBBDFBBAAA	4.9514E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	NOBY	RBSMBY
7	BADEICDBAA	4.0440E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
8	BBDDFBDBAA	3.8534E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
9	BADDECDBAA	3.7999E-02	HIZROX	LOP-LPI	LOEXSE	DWR	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
10	BBDDICDCAA	2.8516E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
3	BABDFBBAAA	8.5696E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	NOBY	RBSMBY
5	BADDFBDBAA	5.2468E-02	HIZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
6	BBBDFBBAAA	4.9514E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	Ear-Spr	DRYCCI	NOBY	RBSMBY
8	BBDDFBDBAA	3.8534E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
13	BABEFBBAAA	1.3950E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	Ear-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-3
Results of the Accident Progression Analysis for Peach Bottom Internal Initiators - PDS 3 - Fast Transient

Five Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	BBEEICACAA	1.7522E-01	LOZROX	nVB	nDCH-SE	NOCF	LCF	NO-Spr	NOCCI	NOBY	RBSMBY
2	BBDEGCABAB	9.3295E-02	LOZROX	LOP-LPI	nDCH-SE	WWVENT	LCF	NO-Spr	FLDCCI	NOBY	RBLGBY
3	BAEEICACAA	7.5962E-02	HIZROX	nVB	nDCH-SE	NOCF	LCF	NO-Spr	NOCCI	NOBY	RBSMBY
4	BBDEFBABAA	7.5577E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY
5	BADEGCABAB	7.4091E-02	HIZROX	LOP-LPI	nDCH-SE	WWVENT	LCF	NO-Spr	FLDCCI	NOBY	RBLGBY

Five Most Probable Bins that have VB*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
2	BBDEGCABAB	9.3295E-02	LOZROX	LOP-LPI	nDCH-SE	WWVENT	LCF	NO-Spr	FLDCCI	NOBY	RBLGBY
4	BBDEFBABAA	7.5577E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY
5	BADEGCABAB	7.4091E-02	HIZROX	LOP-LPI	nDCH-SE	WWVENT	LCF	NO-Spr	FLDCCI	NOBY	RBLGBY
6	BBDDGCABAB	5.5524E-02	LOZROX	LOP-LPI	LOEXSE	WWVENT	LCF	NO-Spr	FLDCCI	NOBY	RBLGBY
7	BBDDFBABAA	3.8442E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
4	BBDEFBABAA	7.5577E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY
7	BBDDFBABAA	3.8442E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY
8	BADEFBABAA	3.0337E-02	HIZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY
12	BABEFBAAAA	1.9272E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
13	BADDFBABAA	1.6002E-02	HIZROX	LOP-LPI	LOEXSE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

meltthrough). The probability of recovering injection is 0.9. The probability of recovering HPSW and averting VB is 0.25.

2.5.1.4 Results for PDS Group 4 - Fast SBO

This PDS is a short-term station blackout with DC power failed. It consists of two scenarios: one with a stuck open SRV (8.8%) and one without (91.2%). Early core damage results from the immediate loss of all injection. The vessel may or may not be at low pressure depending on the stuck open SRV split. Venting is possible if AC power is restored (manual venting is possible if AC is not restored but considered unlikely).

Table 2.5-4 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). The evaluation of the APET produced 1294 source term bins for this PDS. In order to represent 95% of the probability, 179 bins are required. The five most probable bins represent 40% of the probability.

Two of the top five bins have core damage arrest. For this PDS, AC power was not recovered prior to the start of core damage but can be recovered during the core degradation (this occurs in 91% of the cases) and possibly arrest the core damage preventing vessel breach (this occurs in 25% of the cases). For these no VB bins, all of the in-vessel release passes through the suppression pool and escapes from the containment via nominal leakage paths so the releases are very small. For the other three bins, AC power is recovered before VB but does not arrest core damage. However, containment sprays are recovered and the containment never fails. One of the bins with VB has a small ex-vessel steam explosion. All of the no VB bins have a stuck open SRV or are depressurized using ADS after AC power is restored so VB occurs at low RPV pressure.

For the top bins with VB, two have small ex-vessel steam explosions and the others have none. In one, containment failure is at VB by drywell meltthrough. In the others, the containment never fails. The drywell is flooded by use of the CSS system in all the bins.

For the top five bins with both VB and early CF, all have containment failure by drywell meltthrough. One has a small ex-vessel steam explosion and one has a small DCH event (for this one, the RPV was at high pressure because AC power was not recovered before VB and the drywell is dry), the others have neither.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.33 of which 0.28 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.9. The probability of recovering AC and averting VB is 0.25 (this is about the same as in PDS 3 since the probability of using HPSW in PDS 3 and the probability of recovering AC power in PDS 4 is about 0.9 in both cases).

Table 2.5-4
Results of the Accident Progression Analysis for Peach Bottom
Internal Initiators - PDS 4 - Fast SBO

Five Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	EBEEICDCAA	1.2951E-01	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
2	EADEICDBAA	7.6978E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
3	EBDEICDBAA	7.4510E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
4	EAEEICDCAA	7.3659E-02	HIZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
5	EBDDICDBAA	4.2450E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
2	EADEICDBAA	7.6978E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
3	EBDEICDBAA	7.4510E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
5	EBDDICDBAA	4.2450E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
6	EBDEFBBBAA	3.7183E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
7	EADDICDBAA	2.7179E-02	HIZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
6	EBDEFBBBAA	3.7183E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
8	EBDEFBDBAA	2.0648E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
11	EBDDFBBBAA	1.6809E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
12	EAABFBAAAA	1.6179E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
13	EADEFBDBAA	1.5788E-02	HIZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

2.5.1.5 Results for PDS Group 5 - Slow SBO

This PDS is a long-term station blackout. It is composed of two scenarios. High pressure injection is initially working. AC power is not recovered and either: 1) the batteries deplete, resulting in injection failure, reclosure of the ADS valves, and repressurization of the RPV (in those cases where an SRV is not stuck open), followed by boiloff of the primary coolant and core damage at high or low RPV pressure depending on whether an SRV is stuck open or not, or 2) HPCI and RCIC fail on high suppression pool temperature or high containment pressure, respectively, followed by boiloff and core damage at low RPV pressure (since if DC has not failed, ADS would still be possible, or an SRV is stuck open). The containment is at high pressure but less than or equal to the saturation pressure corresponding to the temperature at which HPCI will fail (i.e., about 40 psig at the start of core damage).

Table 2.5-5 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 3426 source term bins for this PDS. In order to represent 95% of the probability, 537 bins are required. The fifteen most probable bins represent 0.39% of the probability.

Three of the top fifteen bins have core damage arrest. For this PDS, AC power was not recovered prior to the start of core damage but can be recovered during the core degradation (this occurs in 37% of the cases) and possibly arrest the core damage preventing vessel breach (this occurs in 8.5% of the cases). For these no VB bins, all of the in-vessel release passes through the suppression pool and, in one bin, escapes from the containment via nominal leakage paths so the releases are very small. In the other two bins, the containment is vented from the wetwell via the 6" line before VB. For these two bins, even though AC power is recovered before VB and containment heat removal becomes available, venting occurred. If the containment pressure is above 100 psig, the operators may vent the containment before starting the sprays on recovery of AC power or, for very high in-vessel hydrogen releases, pressure may still increase above the venting limit. In nine of the top bins, AC is not recovered and VB occurs at high pressure with a large DCH occurring in one, a low DCH in seven, and a small ex-vessel steam explosion in the other. Seven of the nine have CF by drywell meltthrough, the other two by drywell rupture on overpressure. In the other three top bins, AC is recovered but does not prevent core damage. The RPV is depressurized at VB and no ex-vessel steam explosions occur. In one bin, drywell meltthrough occurs. In another, wetwell venting occurred before VB and, in the last, no CF occurs.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.75 of which 0.55 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.37. The probability of recovering AC and averting VB is 0.085.

Table 2.5-5
Results of the Accident Progression Analysis for Peach Bottom
Internal Initiators - PDS 5 - Slow SBO

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	GAABFBAAAA	9.2671E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	GBABFBAAAA	6.0458E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	GAABEBAAAA	3.1029E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
4	GBDEFBBBAA	2.1838E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
5	GAABFBAAAB	2.1551E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
6	GADEGBBBAB	2.1414E-02	HIZROX	LOP-LPI	nDCH-SE	WWVENT	ICF	Ear-Spr	FLDCCI	NOBY	RBLGBY
7	GBEEICDCAA	2.0189E-02	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
8	FAABFBAAAA	1.9884E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
9	GBEEGCDCAB	1.7095E-02	LOZROX	nVB	nDCH-SE	WWVENT	LCF	E&L-Spr	NOCCI	NOBY	RBLGBY
10	GAADFBAAAA	1.6915E-02	HIZROX	HIP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
11	GAEEGBBCAB	1.6349E-02	HIZROX	nVB	nDCH-SE	WWVENT	ICF	Ear-Spr	NOCCI	NOBY	RBLGBY
12	GBDEICDBAA	1.5344E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
13	GBABEBAAAA	1.3717E-02	LOZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
14	GBAAFBAAAA	1.1888E-02	LOZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
15	FBABFBAAAA	1.0709E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

2.5.1.6 Results for PDS Group 6 - Fast ATWS

This PDS is an ATWS with SLC working. HPCI works and the vessel is not manually depressurized. Injection fails on high suppression pool temperature and early core damage ensues. Venting is available.

Table 2.5-6 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). The evaluation of the APET produced 720 source term bins for this PDS. In order to represent 95% of the probability, 101 bins are required. The five most probable bins represent 42% of the probability.

Two of the top five bins have core damage arrest. For this PDS, the high pressure injection systems fail due to high suppression pool temperature and the operator fails to depressurize and use low pressure systems. However, during the core degradation, the operator has another chance to depressurize the RPV (0.8) or an SRV may be stuck open (0.02) (one or the other of these occurs in 82% of the cases) and, in either of these cases, core damage may possibly be arrested using low pressure injection thus preventing vessel breach (this occurs in 20% of the cases). For these no VB bins, all of the in-vessel release passes through the suppression pool and escapes from the containment via nominal leakage paths so the releases are very small. For the other three bins, injection is recovered before VB but does not arrest core damage. However, containment sprays are recovered and the containment never fails. One of the bins with VB has a small ex-vessel steam explosion. All of the no VB bins have a stuck open SRV or are depressurized using ADS after core degradation begins so VB occurs at low RPV pressure.

For the top bins with VB, two have small ex-vessel steam explosions and the others have none. In one, containment failure is at VB by drywell meltthrough. In the others the containment never fails. The drywell is flooded by use of the CSS system in all the bins.

For the top five bins with both VB and early CF, all occur with low RPV pressure at VB, injection and/or sprays are operating, and have containment failure by drywell meltthrough. Two have small ex-vessel steam explosions

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.32 of which 0.26 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell meltthrough). The probability that low pressure injection is recovered before VB is 0.82. The probability of recovering injection and averting VB is 0.20.

2.5.1.7 Results for PDS Group 7 - ATWS CV

This PDS is an ATWS with failure of SLC, the initiator is a stuck open SRV. High pressure injection fails on high suppression pool temperature and the reactor is either: 1) not manually depressurized or 2) the operator

Table 2.5-6
Results of the Accident Progression Analysis for Peach Bottom
Internal Initiators - PDS 6 - Fast ATWS

Five Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	CBEEICDCAA	1.2454E-01	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
2	CADEICDBAA	9.0476E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
3	CBDEICDBAA	8.0462E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
4	CAEEICDCAA	7.3155E-02	HIZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
5	CBDDICDBAA	5.2299E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
2	CADEICDBAA	9.0476E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
3	CBDEICDBAA	8.0462E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
5	CBDDICDBAA	5.2299E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
6	CADDICDBAA	3.8239E-02	HIZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
7	CBDEFBBBAA	3.5729E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
7	CBDEFBBBAA	3.5729E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
9	CBDEFBDBAA	2.3388E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
12	CADEFBDBAA	1.6997E-02	HIZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
13	CBDDFBBBAA	1.6091E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
15	CBDDFBDBAA	1.4235E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

depressurizes and uses low pressure injection systems until the injection valves fail due to excessive cycling or the containment fails (or is vented) and the injection systems fail due to harsh environments in the reactor building or loss of NPSH. The condensate system will fail within a few minutes since the CST can only supply about 800 gpm to the condenser and the condenser will be depleted within a few minutes after the failure of the PCS system. Other low pressure injection system will need to be used. Early core damage ensues in case 1 and late core damage in case 2. Venting will not take place before core damage if the operator does not depressurize; but, it may, if he goes to low pressure systems. RHR and CSS are working and the containment pressure will begin to drop in case 1 or will level off at the venting or SRV reclosure pressure in case 2.

Table 2.5-7 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 865 source term bins for this PDS. In order to represent 95% of the probability, 106 bins are required. The fifteen most probable bins represent 0.59% of the probability.

Two of the top fifteen bins have core damage arrest. For this PDS, high pressure injection failed prior to core damage but the operator can depressurize and use low pressure injection during the core degradation (this occurs in 40% of the cases) and possibly arrest the core damage preventing vessel breach (this occurs in 10% of the cases). For these no VB bins, all of the in-vessel release passes through the suppression pool and, in one bin, escapes from the containment via nominal leakage paths so the releases are very small. Also, containment sprays work for this bin. In the other bin, the containment is vented from the wetwell via the 18" line before VB and containment sprays are not operable. In seven of the top bins, injection is recovered but does not prevent VB. VB occurs at low pressure with no ex-vessel steam explosions. Two of the seven have sprays all the time and containment never fails. The other five either have late sprays or no sprays and three fail by wetwell venting before vessel breach while the other two fail by drywell meltthrough. For the remaining six top bins injection is never recovered, although the RPV is depressurized. Containment sprays have failed from lack of NPSH due to the saturated suppression pool. The RPV is depressurized at VB and no ex-vessel steam explosions occur. In two bins, drywell meltthrough occurs. In two others, wetwell venting occurs before VB and, in the last two, drywell rupture occurs before VB.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.85 of which 0.40 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell meltthrough). The probability that injection is recovered before VB is 0.40. The probability of recovering AC and averting VB is 0.1.

2.5.1.8 Results for PDS Group 8 - ATWS CV

This PDS is an ATWS sequence with loss of an AC bus or PCS followed by a failure to scram. Otherwise, it is the same as PDS 7. Since an SRV is not

Table 2.5-7
Results of the Accident Progression Analysis for Peach Bottom
Internal Initiators - PDS 7 - ATWS CV

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	DABEFBAAAA	1.3759E-01	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	DABEGAAAAA	7.9595E-02	HIZROX	LOP-nLPI	nDCH-SE	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	DBBEFBAAAA	7.3098E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
4	DBBEGAAAAA	5.9194E-02	LOZROX	LOP-nLPI	nDCH-SE	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
5	DADEGACBAA	2.7640E-02	HIZROX	LOP-LPI	nDCH-SE	WWVENT	ECF	Lat-Spr	FLDCCI	NOBY	RBSMBY
6	DBDEGAABAA	2.6597E-02	LOZROX	LOP-LPI	nDCH-SE	WWVENT	ECF	NO-Spr	FLDCCI	NOBY	RBSMBY
7	DABEEAAAAA	2.6558E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	CBEEICDCAA	2.4908E-02	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
9	DADEFBCBAA	2.4376E-02	HIZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Lat-Spr	FLDCCI	NOBY	RBSMBY
10	DBEEGAACAA	1.9204E-02	LOZROX	nVB	nDCH-SE	WWVENT	ECF	NO-Spr	NOCCI	NOBY	RBSMBY
11	DBBEEAAAAA	1.9144E-02	LOZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
12	DADEGAABAA	1.9142E-02	HIZROX	LOP-LPI	nDCH-SE	WWVENT	ECF	NO-Spr	FLDCCI	NOBY	RBSMBY
13	CADEICDBAA	1.8513E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
14	DBDEFBABAA	1.7455E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	NO-Spr	FLDCCI	NOBY	RBSMBY
15	CBDEICDBAA	1.6707E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

stuck open, bins with VB with the RPV at high pressure are probable in this PDS.

Table 2.5-8 lists the fifteen most probable APBs since four of the top five bins all have VB and early CF. The evaluation of the APET produced 1392 source term bins for this PDS. In order to represent 95% of the probability, 203 bins are required. The fifteen most probable bins represent 0.42% of the probability.

Two of the top fifteen bins have core damage arrest. For this PDS, high pressure injection failed prior to core damage but the operator can depressurize and use low pressure injection during the core degradation (this occurs in 33% of the cases) and possibly arrest the core damage preventing vessel breach (this occurs in 10% of the cases). For these no VB bins, all of the in-vessel release passes through the suppression pool and, in one bin, escapes from the containment via nominal leakage paths so the releases are very small. Also, containment sprays work for this bin. In the other bin, the containment is vented from the wetwell via the 18" line before VB and containment sprays are not operable. In four of the top bins, injection is recovered but does not prevent VB. VB occurs at low pressure and a small ex-vessel steam explosion occurs for one bin. Two of the four have sprays all the time and the containment never fails. The other two have no sprays and fail by wetwell venting before vessel breach. For the remaining nine top bins injection is never recovered, although in three the RPV is depressurized anyway. Containment sprays have failed from lack of NPSH due to the saturated suppression pool. For three of the bins, the RPV is depressurized at VB and no ex-vessel steam explosions occur; for the other six, the RPV is at high pressure and, in five, a low DCH occurs. In five bins, drywell meltthrough occurs. In three others, wetwell venting occurs before VB and, in the last, drywell rupture occurs before VB.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.85 of which 0.49 is from drywell meltthrough (see Section 2.5.2.1 for a discussion of the impact of no drywell meltthrough). The probability that injection is recovered before VB is 0.33. The probability of recovering AC and averting VB is 0.1.

2.5.1.9 Results for PDS Group 9 - ATWS CV

This PDS is an ATWS with failure of SLC, the initiator is T1 (LOSP); however, other AC is available. Otherwise, this PDS is the same as PDS-8. Table 2.5-9 lists the fifteen most probable APBs since four of the top five bins all have VB and early CF. As can be seen from the table, the APBs are identical to those of PDS 8. The LOSP does not effect the results since onsite AC power is available.

2.5.1.10 Core Damage Arrest, Avoidance of VB.

Once core damage has begun, the only way vessel failure can be prevented is if coolant injection is restored to the RPV. Restoration of coolant

Table 2.5-8
Results of the Accident Progression Analysis for Peach Bottom
Internal Initiators - PDS 8 - ATWS CV

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	DAABFBAAAA	1.1508E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	DBABFBAAAA	5.4873E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	CBEEICDCAA	2.4908E-02	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
4	DBDEGAABAA	2.4810E-02	LOZROX	LOP-LPI	nDCH-SE	WWVENT	ECF	NO-Spr	FLDCCI	NOBY	RBSMBY
5	DABEFBAAAA	2.1679E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
6	DAAEFBAAAA	2.1217E-02	HIZROX	HIP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
7	DABEGAAAAA	1.9482E-02	HIZROX	LOP-nLPI	nDCH-SE	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	DBEEGAACAA	1.9204E-02	LOZROX	nVB	nDCH-SE	WWVENT	ECF	NO-Spr	NOCCI	NOBY	RBSMBY
9	DAABGAAAAA	1.7965E-02	HIZROX	HIP-nLPI	LODCH	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
10	DBABGAAAAA	1.7594E-02	LOZROX	HIP-nLPI	LODCH	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
11	DAABEBAAAA	1.7257E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
12	DBDDGAABAA	1.6627E-02	LOZROX	LOP-LPI	LOEXSE	WWVENT	ECF	NO-Spr	FLDCCI	NOBY	RBSMBY
13	CADEICDBAA	1.6211E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
14	CBDEICDBAA	1.6027E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
15	DBBEFBAAAA	1.5495E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-9
Results of the Accident Progression Analysis for Peach Bottom Internal Initiators - PDS 9 - ATWS CV

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	DAABFBAAAA	1.1508E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	DBABFBAAAA	5.4873E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	CBEEICDCAA	2.4908E-02	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
4	DBDEGAABAA	2.4810E-02	LOZROX	LOP-LPI	nDCH-SE	WWVENT	ECF	NO-Spr	FLDCCI	NOBY	RBSMBY
5	DABEFBAAAA	2.1679E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
6	DAAEFBAAAA	2.1217E-02	HIZROX	HIP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
7	DABEGAAAAA	1.9482E-02	HIZROX	LOP-nLPI	nDCH-SE	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	DBEEGAACAA	1.9204E-02	LOZROX	nVB	nDCH-SE	WWVENT	ECF	NO-Spr	NOCCI	NOBY	RBSMBY
9	DAABGAAAAA	1.7965E-02	HIZROX	HIP-nLPI	LODCH	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
10	DBABGAAAAA	1.7594E-02	LOZROX	HIP-nLPI	LODCH	WWVENT	ECF	NO-Spr	DRYCCI	NOBY	RBSMBY
11	DAABEBAAAA	1.7257E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
12	DBDDGAABAA	1.6627E-02	LOZROX	LOP-LPI	LOEXSE	WWVENT	ECF	NO-Spr	FLDCCI	NOBY	RBSMBY
13	CADEICDBAA	1.6211E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
14	CBDEICDBAA	1.6027E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
15	DBBEFBAAAA	1.5495E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

injection to the RPV, however, does not necessarily preclude vessel breach. If injection is not recovered until late in the core damage process, it is unlikely that the addition of water will prevent VB. In addition, there is the possibility that the core debris that slumps into the bottom head of the vessel will trigger a steam explosion. Although steam explosions do not guarantee vessel failure, they do pose a significant challenge to the integrity of the RPV and in some cases result in vessel failure.

Figure 2.5-1 shows the probability distribution for core damage arrest before the lower head of the vessel fails for each of the nine PDSs. Figure 2.5-2 shows the same information for the collapsed PDS groups. These distributions are conditional upon the occurrence of the PDS. It is important to note that the possibility of core damage arrest at Peach Bottom and Grand Gulf only appears less likely than in the PWRs. In the PWRs, core damage can occur often with only high pressure injection failed. Low pressure injection is available but cannot be used because the vessel can not be depressurized before core damage begins. After core uncovery, various mechanisms allow the possibility that the vessel will depressurize and, at that time, low pressure injection becomes possible. Therefore, the core damage frequencies are higher; but, the probability of core damage arrest can also be large depending upon the probability of the depressurization mechanisms. In the BWRs, since almost all systems can supply water directly to the core and depressurization of the vessel is common, core damage can not occur unless many systems fail. The result is that the BWR core damage frequency is lower than that for the PWRs; but, the possibility of core damage arrest, after core damage begins, is less likely because more failures had to occur in the first place. In BWRs, core damage arrest is possible, in non ATWS cases, when the initial failures are a result of loss of AC power or other common support systems that are recoverable during the time that core damage is occurring or, in ATWS cases, when RPV pressure becomes low enough to use the low pressure injection systems.

For the LOSP collapsed PDS group, the probability of core damage arrest is driven directly by the conditional probability of recovering AC power between the time core damage starts and when VB would occur if injection was not restored. Because of the many available injection systems, injection into the RPV is possible in most cases immediately after AC is restored. While the probability of recovering AC power is high (0.9) in PDS 4, the probability of recovery in PDS 5 is only 0.37 (for long-term station blackout, the probability of recovering AC power within the time window of core damage is about 1/3 that of the short-term case) and it is the dominant PDS. Since the probability of core damage arrest is about 25% given injection is restored, the average for this collapsed PDS group is only 0.112. Many factors must be considered in determining if core damage arrest is possible even if injection is restored. In particular, six major factors were considered in the APET. First, the timing of the injection recovery with respect to the time between the start of core damage and vessel breach. Second, the fraction of core participating in core slump. Third, the probability of in-vessel steam explosions. Fourth, the amount

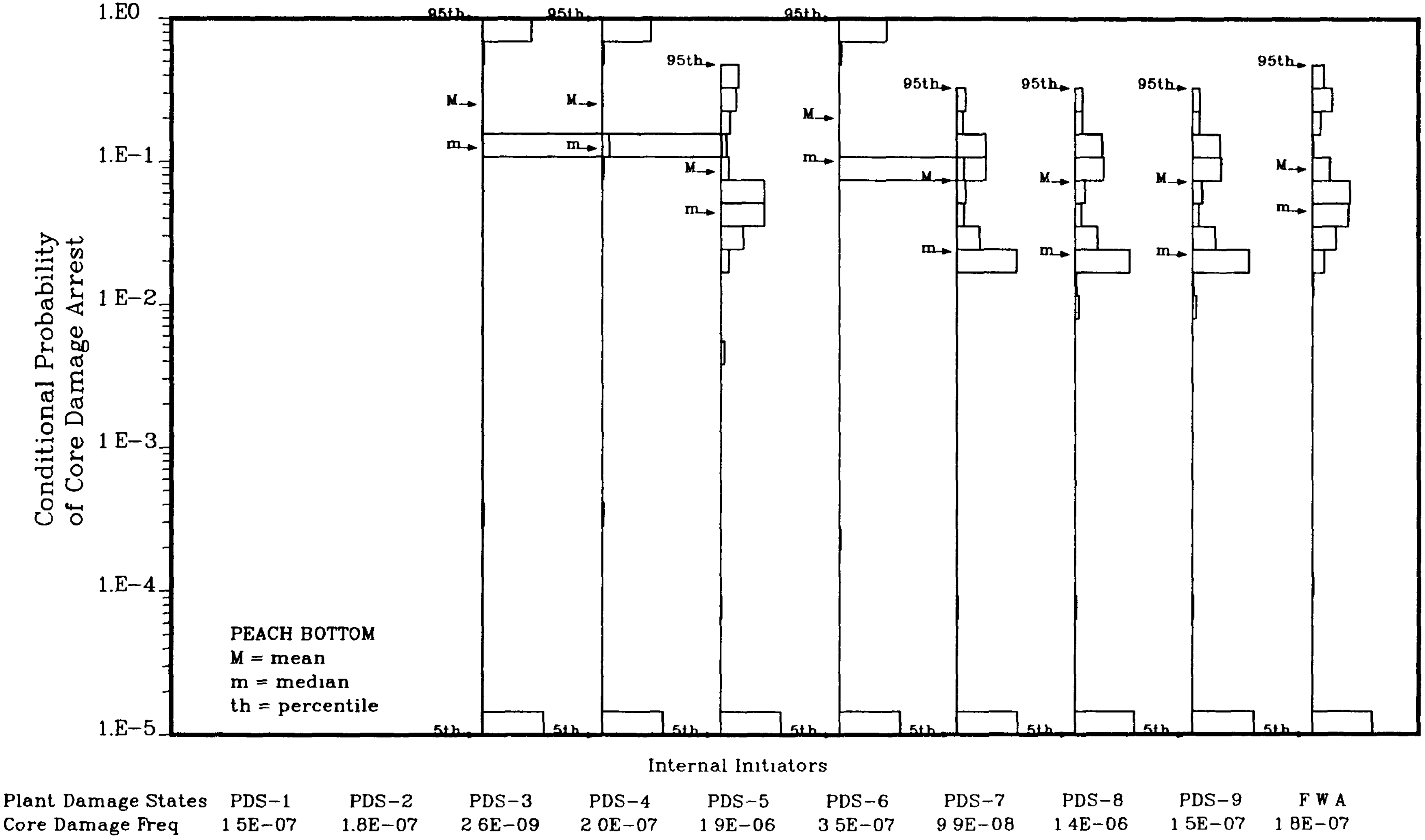


Figure 2.5-1
Conditional Probability of Core Damage Arrest for Internal PDSs

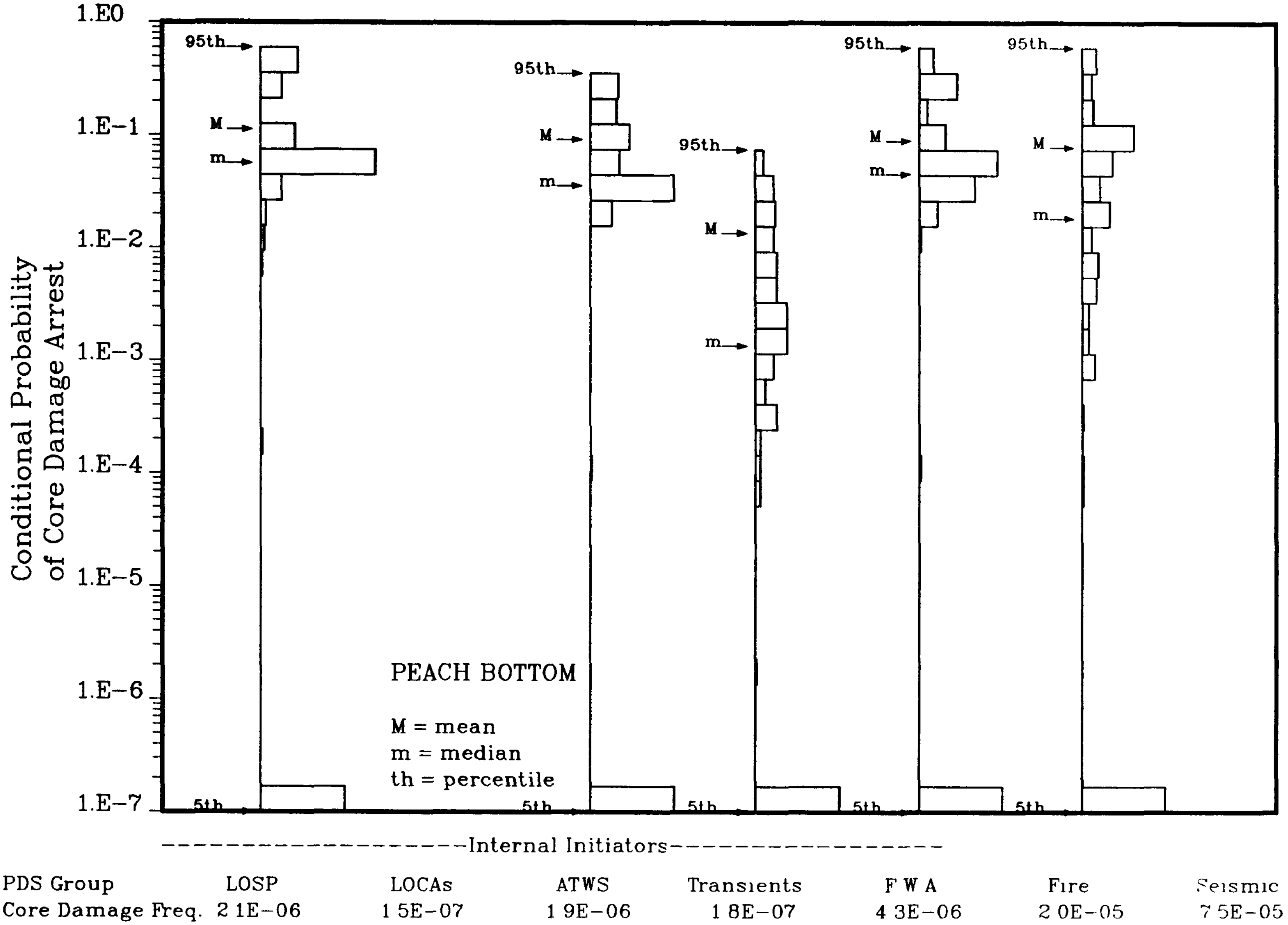


Figure 2.5-2
Conditional Probability of Core Damage Arrest for Collapsed PDS Groups

of core debris which is mobile in the lower plenum. Fifth, depending upon the accident scenario, the RPV pressure may also be a factor and, sixth, the probability of the core going recritical during reflood. All of these contribute to our estimate of the fraction of time injection recovery can result in core damage arrest.

For the LOCA collapsed PDS group, injection is not recoverable in the dominant PDSs. If injection was recoverable core damage would in most cases not even have occurred. The possibility of core damage arrest is, therefore, zero.

In the ATWS collapsed PDS group, injection recovery depends upon the conditions allowing the operator to be able to depressurize and then that he does it. PDS 8 dominates this PDS group. In PDS 8, injection is recovered with a probability of 0.33 and core damage arrest is 0.1. In the other PDSs the probability of core damage arrest is the same or lower, so that the overall probability for this collapsed PDS group is 0.09.

In the transient collapsed PDS group, injection is recoverable in one of the PDSs but the other is like the LOCA PDS and injection can not be recovered. The frequency of the PDS where injection is not recovered dominates and the probability of core damage arrest for transients is only 0.014. Operator error dominates the recovery probability.

It must be remembered that core damage arrest does not necessarily mean that there will be no radionuclide releases during the accident. Both hydrogen and radionuclides are released to the containment during the core damage process through the SRVs to the suppression pool. In the majority of the cases, the release is small because, when injection is restored, containment heat removal is also restored and, if the mass of hydrogen released is small, containment pressure remains low. This implies radionuclides get released only through the nominal containment leakage paths. However, in some cases, either a large amount of non-condensibles are generated and containment venting is required or containment heat removal is not restored and venting or containment failure occurs.

2.5.1.11 Early Containment Failure.

The early fatality risk depends strongly on the probability of early containment failure (CF). Early containment failure includes both failures that occur before vessel breach and those that occur at or shortly after vessel breach. The Peach Bottom containment is a relatively strong containment with the suppression pool being able to absorb large amounts of energy if not released to quickly. The design pressure is 56 psig; but, after evaluation by the experts, an assessed mean failure pressure of 150 psig was determined. Because of its high failure pressure combined with its energy absorbing capabilities in the suppression pool, the containment is unlikely to fail early from overpressure in most accidents. The containment has a significant probability of early overpressure failure only in those sequences where containment heat removal and venting are failed or inadequate (ATWS) and the suppression pool becomes saturated. This can result in a significant base pressure before core damage begins. The pressure increase from hydrogen generation during core damage or events at vessel breach can result in peak containment pressures in the failure range.

Early containment failure is most likely in non-ATWS sequences to occur from drywell meltthrough and in ATWS sequences to occur from wetwell venting before core damage (drywell meltthrough is the second most likely).

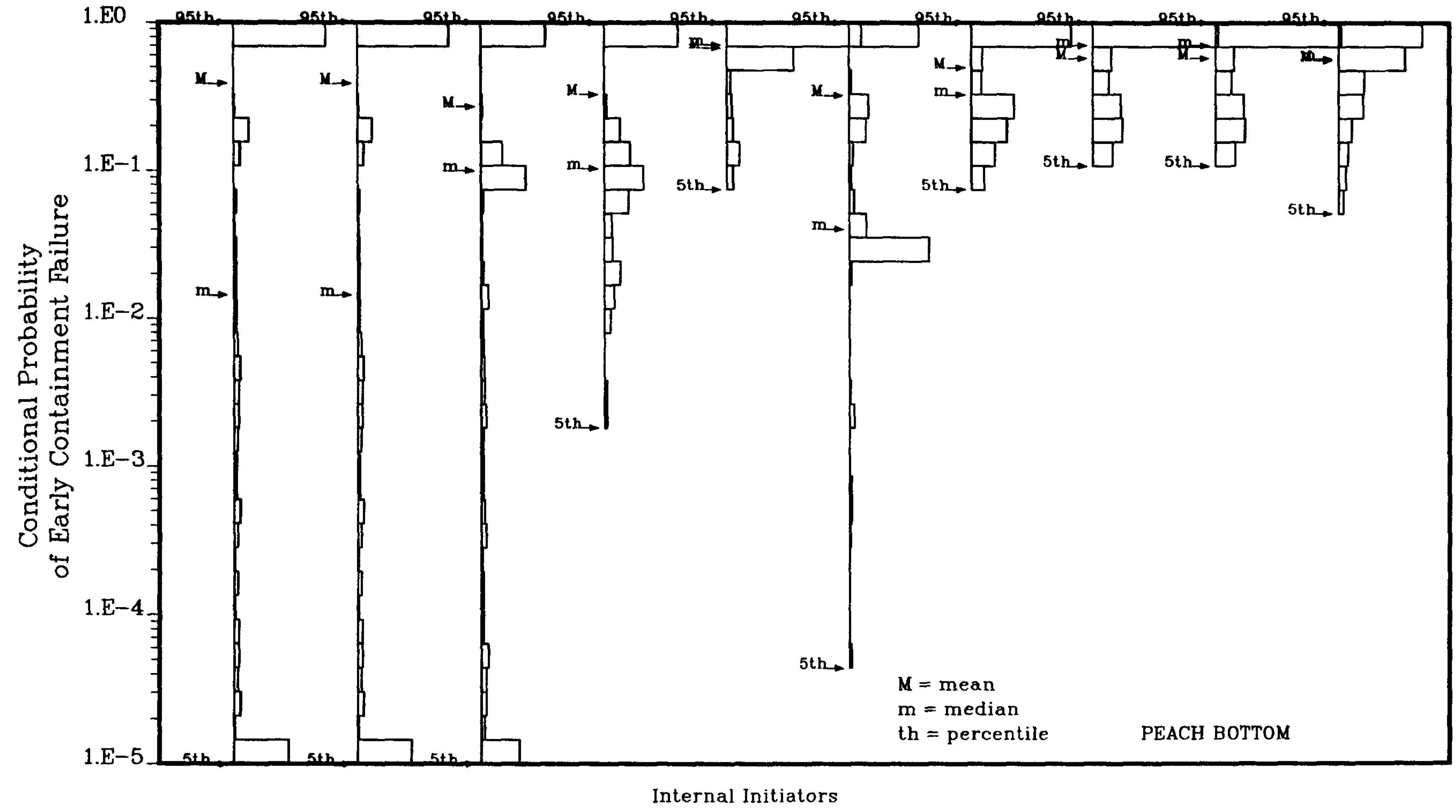
Figure 2.5-3 shows the probability distribution for early containment failure at Peach Bottom for each of the nine PDSs. Figure 2.5-4 shows the same information for the collapsed PDS groups. The probability distributions shown in these figures are conditional upon occurrence of the PDS, core damage, and vessel breach.

2.5.1.12 Summary.

Figure 2.5-5 shows the mean conditional probability of the internal plant damage states for each of the collapsed accident progression bins. Figure 2.5-6 shows the mean conditional probability of the collapsed PDS groups for each of the collapsed APBs. The collapsed APBs are composed of five characteristics: occurrence of core damage, occurrence of vessel breach, RPV pressure at vessel breach, timing of containment failure, and mode of containment failure. A detailed description of these summary bins is presented in section 2.4.3.

Because the Level I analysis did not resolve some of the ATWS sequences all the way to core damage, the ATWS group has a probability of 2.4% of no core damage. These involve sequences were low pressure injection is being used to cool the core and injection does not fail from severe environments or injection valve cycling. In the Level I analysis, these were conservatively assumed to go to core damage.

The LOSP group is composed of two PDSs representing a short-term station blackout with no DC power (PDS 4) and a long-term station blackout (PDS 5). These two PDSs are 46.7% of the core damage frequency and PDS 5 is 90% of the group frequency so that its characteristics dominate. There is a 0.112 probability of recovering AC power during core degradation and arresting core damage. The high probability of early drywell failure (0.569) is mostly from drywell shell meltthrough. The dominant APBs for this group have no recovery of AC power and the vessel breach occurs at high RPV pressure. The next highest APBs have AC recovery but no core damage arrest and vessel breach occurs at low RPV pressure. In either case, drywell failure by meltthrough is the dominant containment failure mechanism (although the relative probability is lower in the AC recovered cases because the drywell can be flooded by containment sprays). If drywell meltthrough does not occur there is still some probability of failure by overpressure, venting, or pedestal failure. In 12.1% of the cases, AC



Plant Damage States	PDS−1	PDS−2	PDS−3	PDS−4	PDS−5	PDS−6	PDS−7	PDS−8	PDS−9	F.W.A.
Core Damage Freq.	1.5E−07	1.8E−07	2.6E−09	2.0E−07	1.9E−06	3.5E−07	9.9E−08	1.4E−06	1.5E−07	1.8E−07

Figure 2.5-3
Conditional Probability of Early Containment Failure for Internal PDSs

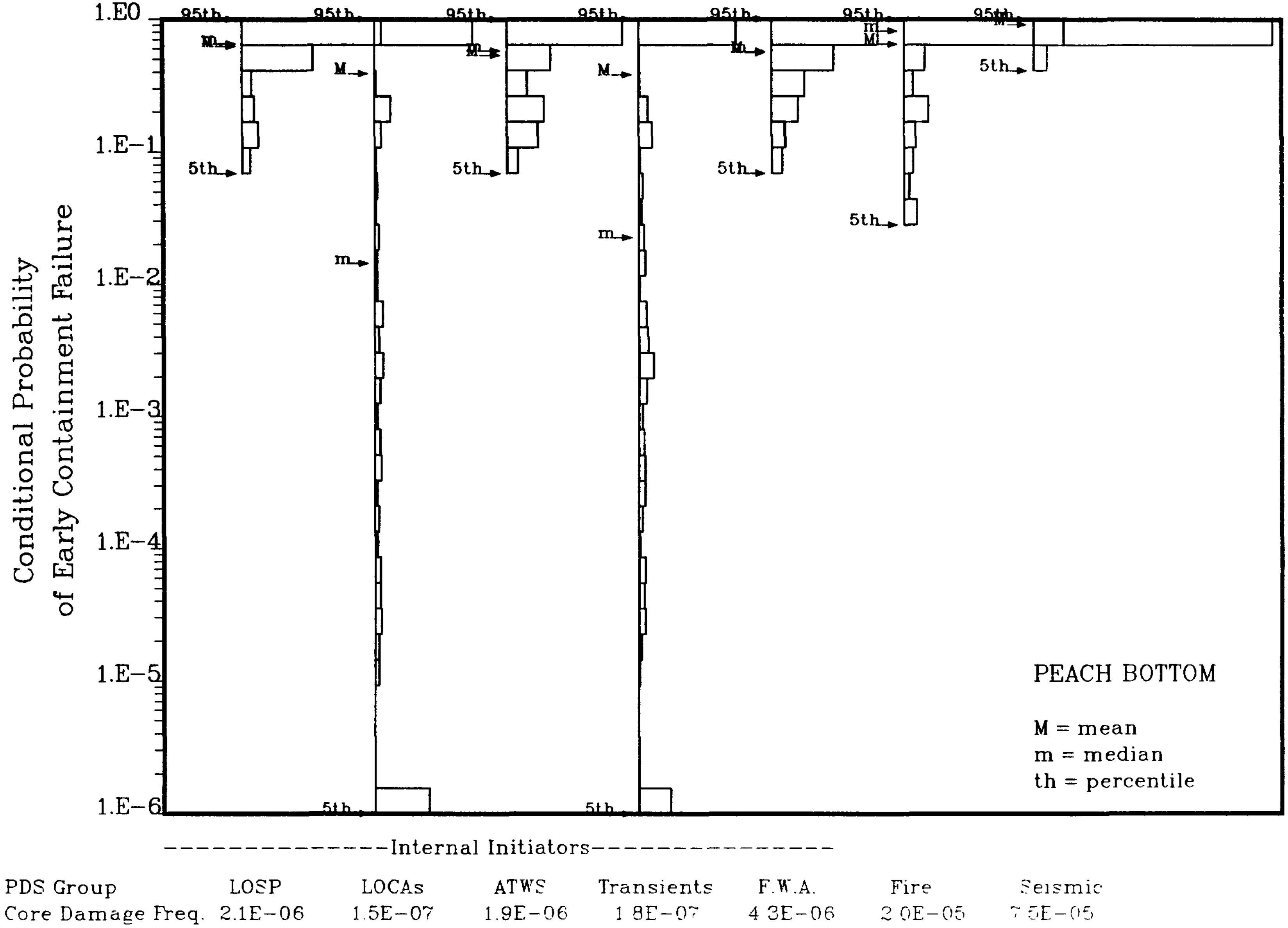


Figure 2.5-4
Conditional Probability of Early Containment Failure for Collapsed PDS Groups

PLANT DAMAGE STATES
(Mean Core Damage Frequency)

SUMMARY ACCIDENT PROGRESSION BIN GROUP	PDS 1 (1 50E-07)	PDS 2 (1 79E-07)	PDS 3 (2 65E-09)	PDS 4 (1 98E-07)	PDS 5 (1 89E-06)	PDS 6 (3 51E-07)	PDS 7 (9 92E-08)	PDS 8 (4 72E-08)	PDS 9 (4 34E-06)	Frequency Weighted Average (0 00E+00)
VB > 200psi, early WWF					0 053	0 005		0 008	0 008	0 022
VB < 200 psi, early WWF	0 028	0 028		0 024	0 010	0 017	0 011	0 004	0 004	0 011
VB > 200 psi, early DWF				0 066	0 503	0 084		0 400	0 400	0 341
VB < 200 psi, early DWF	0 360	0 360	0 270	0 237	0 110	0 218	0 485	0 163	0 163	0 183
VB, late WWF			0 046	0 005	0 007					0 003
VB, late DWF	0 074	0 074	0 084	0 063	0 061	0 049	0 012	0 009	0 009	0 047
VB, CV	0 003	0 003	0 271	0 024	0 084		0 308	0 236	0 236	0 110
No CF	0 536	0 536	0 078	0 328	0 088	0 424	0 082	0 080	0 080	0 184
No VB			0 251	0 253	0 085	0 203	0 074	0 073	0 073	0 089
No Core Damage							0 028	0 028	0 028	0 010

VB = Vessel Breach
WWF = Wetwell Failure
DWF = Drywell Failure
CV = Containment Venting
CF = Containment Failure

Peach Bottom

Figure 2.5-5
Conditional Probability of Collapsed APBs for Internal PDSs

SUMMARY ACCIDENT PROGRESSION BIN GROUP	SUMMARY PDS GROUP (Mean Core Damage Frequency)						
	Internal Initiators						
	LOSP (2.08E-06)	LOCAs (1.50E-07)	ATWS (1.93E-06)	Transients (1.81E-07)	All (4.34E-06)	Fire (1.98E-05)	Seismic (7.52E-05)
VB > 200psi, early WWF	0.045		0.006		0.022	0.045	0.028
VB < 200 psi, early WWF	0.012	0.028	0.006	0.026	0.011	0.004	0.027
VB > 200 psi, early DWF	0.436		0.330		0.341	0.529	0.369
VB < 200 psi, early DWF	0.133	0.360	0.194	0.356	0.183	0.070	0.489
VB, late WWF	0.007			0.002	0.003	0.009	0.006
VB, late DWF	0.061	0.074	0.015	0.074	0.047	0.086	0.074
VB, CV	0.074	0.003	0.207	0.016	0.110	0.020	0.007
No CF	0.121	0.536	0.127	0.512	0.184	0.159	
No VB	0.112		0.091	0.014	0.089	0.078	
No Core Damage			0.024		0.010		

VB = Vessel Breach
WWF = Wetwell Failure
DWF = Drywell Failure
CV = Containment Venting
CF = Containment Failure

Peach Bottom

Figure 2.5-6
Conditional Probability of Collapsed APBs for Collapsed PDS Groups

power is recovered, vessel breach occurs, and the sprays provide sufficient heat removal and reduced CCI to prevent containment failure altogether.

The LOCA group is composed only of PDS 1 representing 5.8% of the core damage frequency. In order to get core damage all injection had to fail and there is no possibility of recovering injection; therefore, core damage arrest is not possible. There are no high RPV vessel breach scenarios because of the LOCA depressurizing the vessel. Since the drywell is flooded by water from the vessel, drywell meltthrough is less likely in this case (only 0.36). There is some probability of overpressure failure or venting; but, the availability of containment heat removal in this sequence results in a high probability of no containment failure at all (0.536).

THe ATWS group is composed of four PDSs (PDSs 6, 7, 8, 9). This group is 43.1% of the core damage frequency. PDS 8 is 77% of the group frequency, PDS 6 is 16%, PDS 7 is 6%, and PDS 9 is 2%. Since PDSs 7, 8, and 9 are almost the same, 85% of this group is represented by PDS 8. PDSs 7, 8, and 9 were not resolved all the way to core damage in the Level I analysis and there is a group average of 2.4% for no core damage. All the PDSs have some chance of recovery of injection during core damage and arresting vessel breach. The group average is 9.1%. If vessel breach is not avoided, most accident progression bins (about 75%) will have containment venting before core damage (PDS 7, 8, and 9). Drywell meltthrough can still occur, mainly in cases were the RPV is at high pressure at vessel breach (about 50% of the time usually concurrent with wetwell venting).

The Transient group is composed of two PDSs (PDS 2 and 3). This group is 5% of the core damage frequency and PDS 2 is 98% of the group frequency. PDS 2 is very similar to the LOCA group with containment heat removal working but no injection recovery. PDS 3 does not have containment heat removal but does have some possibility of recovering injection. It can be seen that there is a small possibility of core damage arrest (1.4%) for the group. The rest is identical to the LOCA group for the same reasons.

The frequency weighted average results are about equally weighted between the LOSP and ATWS groups which are dominated by PDS 5 and 8, respectively. For accidents which proceed to core damage and vessel breach, there is still a significant probability that the core debris will be cooled by an overlying pool of water and either no CCI will occur or the CCI releases will be scrubbed through the water. In the following table, we can see the mean conditional probabilities of: No CCI (which includes no VB and no CD), Dry CCI, Wet CCI (no continuous water on debris), Flooded CCI (continuous water on debris but CCI continues), and Delayed CCI (no continuous water but CCI cooled down and restarts later).

PDS	No CCI	Dry CCI	Wet CCI	Flooded CCI	Delayed CCI
1	0.127	0.000	0.173	0.667	0.033
2	0.127	0.000	0.173	0.667	0.033
3	0.364	0.043	0.000	0.593	0.000
4	0.379	0.062	0.008	0.550	0.002
5	0.224	0.039	0.152	0.241	0.344
6	0.400	0.000	0.022	0.546	0.032
7	0.172	0.431	0.026	0.367	0.005
8	0.263	0.430	0.012	0.269	0.026
9	0.263	0.440	0.012	0.269	0.026

2.5.2 Sensitivity Analyses for Internal Initiators

2.5.2.1 No Drywell Shell Meltthrough

In this section, we will discuss the implications of a sensitivity calculation run through the APET which investigated the effect of removing completely the possibility of drywell shell meltthrough. This sensitivity analysis was done only on the APET; the results were not propagated through to risk. The internal events PDSs were run through the APET with the question pertaining to drywell meltthrough set so that meltthrough never occurred. The results can be summarized in Tables 2.5-10 and 2.5-11 which list, for each PDS, the mean conditional probabilities of each mode of containment failure for the no drywell meltthrough and drywell meltthrough cases. Both early and late failures are listed so that, by comparing the drywell meltthrough and no drywell meltthrough cases, we can see how the failure modes shift around.

By comparing the two tables, one can clearly see two important points. First, that multiple containment failure modes can and do occur. This means that the algebraic sum of the conditional probabilities for the individual modes add up to more than the final realized probability for containment failure as a whole. The implication of this is that removing a particular mode of failure does not buy as much reduction as one might think; it depends upon the amount of overlap of that particular mode with the other modes (PDS 8 is an example of this; containment has failed by venting in almost all cases and drywell shell meltthrough occurs in addition so that removing meltthrough hardly changes the early containment failure probability). Second, that removing drywell shell meltthrough from the possible early failure modes does not affect the probabilities of the other early modes but can increase substantially, in some cases, the probability of some late containment failure modes. This means that if one is concerned with containment failure only, not just early containment failure, that removing drywell shell meltthrough may not buy much reduction (PDS 3 is an example of this; removing drywell shell meltthrough results in late failures increasing so much that the final total containment failure probability hardly changes, 0.67 vs 0.63).

Table 2.5-10
PEACH BOTTOM INTERNAL PDS - CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY)
SENSITIVITY CASE: NO DRYWELL MELTTHROUGH

APET QUES	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	7.2000E-01	7.2000E-01	7.2000E-01
28op	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1.1990E-02	1.1990E-02	1.1990E-02
59v	0.0000E+00	0.0000E+00	0.0000E+00	3.0340E-04	1.1550E-01	0.0000E+00	5.3130E-02	5.3130E-02	5.3130E-02
61op	0.0000E+00	0.0000E+00	0.0000E+00	2.6920E-04	1.6420E-02	0.0000E+00	9.6840E-03	9.6840E-03	9.6840E-03
83a	9.9610E-03	9.9610E-03	9.9610E-03	9.3140E-03	3.4910E-03	8.2930E-03	9.5870E-03	5.5990E-03	5.5990E-03
98ped	2.9400E-02	2.9400E-02	0.0000E+00	2.7950E-02	1.0440E-01	4.4250E-02	5.8920E-03	6.9840E-02	6.9840E-02
101op	5.2690E-02	5.2690E-02	0.0000E+00	4.4500E-02	1.9160E-01	4.0200E-02	1.7340E-02	1.8740E-02	1.8740E-02
103dwmth	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
ECF-SUM	9.2051E-02	9.2051E-02	9.9610E-03	8.2337E-02	4.3141E-01	9.2743E-02	8.2762E-01	8.8898E-01	8.8898E-01
ECF-EVNTRE	9.2100E-02	9.2000E-02	9.9610E-03	8.2140E-02	4.1299E-01	9.2740E-02	8.0190E-01	8.0780E-01	8.0790E-01
124v	3.3600E-03	3.3600E-03	4.9680E-01	4.2910E-02	1.0670E-01	4.7200E-04	1.7730E-02	1.8440E-02	1.8440E-02
127pedop	1.1200E-01	1.1200E-01	9.8000E-02	7.7500E-02	4.1700E-02	7.1000E-02	1.2480E-01	6.6800E-02	6.6800E-02
128optemp	0.0000E+00	0.0000E+00	0.0000E+00	8.9190E-03	7.9340E-02	0.0000E+00	7.0140E-02	7.0100E-02	7.0100E-02
130op	0.0000E+00	0.0000E+00	1.1440E-01	4.6160E-02	2.4280E-01	3.0670E-04	3.5380E-03	3.4920E-03	3.4920E-03
TCF-SUM	2.0746E-01	2.0736E-01	7.1916E-01	2.5763E-01	8.8353E-01	1.6452E-01	1.0181E+00	9.6663E-01	9.6673E-01
TCF-EVNTRE	2.0680E-01	2.0680E-01	6.2940E-01	2.4020E-01	7.7810E-01	1.6440E-01	8.3750E-01	8.3980E-01	8.3980E-01

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability.

Table 2.5-11
PEACH BOTTOM INTERNAL PDS - CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY)
BASE CASE: DRYWELL MELTTHROUGH ALLOWED

APET QUES	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	7.2000E-01	7.2000E-01	7.2000E-01
28op	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1.1990E-02	1.1990E-02	1.1990E-02
59v	0.0000E+00	0.0000E+00	0.0000E+00	3.0340E-04	1.1550E-01	0.0000E+00	5.3130E-02	5.3130E-02	5.3130E-02
61op	0.0000E+00	0.0000E+00	0.0000E+00	2.6920E-04	1.6420E-02	0.0000E+00	9.6840E-03	9.6840E-03	9.6840E-03
83a	9.9610E-03	9.9610E-03	9.9610E-03	9.3140E-03	3.4910E-03	8.2930E-03	9.5870E-03	5.5990E-03	5.5990E-03
98ped	2.9400E-02	2.9400E-02	0.0000E+00	2.7950E-02	1.0440E-01	4.4250E-02	5.8920E-03	6.9840E-02	6.9840E-02
101op	5.2690E-02	5.2690E-02	0.0000E+00	4.4500E-02	1.9160E-01	4.0200E-02	1.7340E-02	1.8740E-02	1.8740E-02
103dwmth	3.2410E-01	3.2410E-01	2.6010E-01	2.7530E-01	5.5280E-01	2.6360E-01	3.9660E-01	4.9350E-01	4.9350E-01
ECF-SUM	4.1615E-01	4.1615E-01	2.7006E-01	3.5764E-01	9.8421E-01	3.5634E-01	1.2242E+00	1.3825E+00	1.3825E+00
ECF-EVNTRE	3.8780E-01	3.8780E-01	2.7010E-01	3.2720E-01	7.5420E-01	3.2340E-01	8.4800E-01	8.5320E-01	8.5320E-01
ECFWODWMTH	6.3700E-02	6.3700E-02	1.0000E-02	5.1900E-02	2.0140E-01	5.9800E-02	4.5140E-01	3.5970E-01	3.5970E-01
124v	3.3600E-03	3.3600E-03	3.2190E-01	2.7630E-02	5.2090E-02	4.7200E-04	1.7250E-02	1.7410E-02	1.7410E-02
127pedop	7.3700E-02	7.3700E-02	6.3600E-02	5.1300E-02	2.4200E-02	4.8500E-02	6.6800E-02	3.3900E-02	3.3900E-02
128optemp	0.0000E+00	0.0000E+00	0.0000E+00	2.6220E-03	2.1450E-02	0.0000E+00	3.1600E-02	1.9510E-02	1.9510E-02
130op	0.0000E+00	0.0000E+00	7.4110E-02	1.6950E-02	5.7800E-02	3.0670E-04	3.5190E-03	3.4190E-03	3.4190E-03
TCF-SUM	4.9321E-01	4.9321E-01	7.2967E-01	4.5614E-01	1.1398E+00	4.0562E-01	1.3434E+00	1.4567E+00	1.4567E+00
TCF-EVNTRE	4.6430E-01	4.6430E-01	6.7100E-01	4.1810E-01	8.7290E-01	3.7260E-01	8.7740E-01	8.7990E-01	8.7990E-01
TCFWODWMTH	1.4020E-01	1.4020E-01	4.1090E-01	1.4280E-01	3.2010E-01	1.0900E-01	4.8080E-01	3.8640E-01	3.8640E-01

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF, ECFWODWMTH = the probability of ECF subtracting out DWMTH.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability, TCFWODWMTH = the probability of TCF subtracting out DWMTH.

The conclusion that can be drawn by looking at the two dominant plant damage states (PDS 5 and 8) is that removing drywell shell meltthrough would not change the early containment failure probability as much as expected (PDS 5, 0.75 to 0.43; PDS 8, 0.85 to 0.81).

2.5.3 Results for Fire Initiators

2.5.3.1 Results for PDS Group 1 -Fast Transient

This PDS is composed of three fire scenarios, two in the control room and one in the cable spreading room. Power is available but remote control of the systems has been lost and auto actuation has failed due to the fire. The operator fails to manually control the plant from the remote shutdown panel in time to prevent core damage. No injection is available and early core damage ensues with the RPV at high pressure. This PDS contributes 34.0% of the mean fire core damage frequency.

Table 2.5-12 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). The evaluation of the APET produced 1017 source term bins for this PDS. In order to represent 95% of the probability, 181 bins are required. The five most probable bins represent 35% of the probability.

Two of the top five bins have core damage arrest. For this PDS, it is possible for the operator to recover by depressurizing the vessel and use low pressure injection systems during core degradation possibly arresting core damage; thereby, preventing vessel breach. For these no VB bins, all of the in-vessel release passes through the suppression pool and escapes from the containment via nominal leakage paths so the releases are very small. For the other three bins, the containment also does not fail. There are containment sprays in all three bins and low pressure injection has been recovered but did not prevent vessel breach. The suppression pool is not bypassed before VB. One of the three bins has a small ex-vessel steam explosion.

For the top bins with VB, one has a small ex-vessel steam explosion and one has a low DCH event; the others have neither. In four, the containment never fails and in the remaining one it fails at VB by drywell meltthrough. The drywell is flooded by use of the CSS system in all the bins.

For the top five bins with both VB and early CF, all have containment failure by drywell meltthrough. Two have small ex-vessel steam explosions; the others have none. All have CSS working so the drywell is flooded.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.33 of which 0.26 is from drywell meltthrough (see Section 2.5.4.1 for a discussion of the impact of no drywell meltthrough). The probability of recovering injection is 0.8. The probability of recovering injection and averting VB is 0.22.

Table 2.5-12
Results of the Accident Progression Analysis for Peach Bottom
Fire Initiators - PDS 1 - Fast Transient

Five Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	BBEEICDCAA	1.1181E-01	LOZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
2	BADEICDBAA	6.8711E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
3	BAEEICDCAA	6.5144E-02	HIZROX	nVB	nDCH-SE	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY
4	BBDEICDBAA	6.3746E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
5	BBDDICDBAA	3.6446E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
2	BADEICDBAA	6.8711E-02	HIZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
4	BBDEICDBAA	6.3746E-02	LOZROX	LOP-LPI	nDCH-SE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
5	BBDDICDBAA	3.6446E-02	LOZROX	LOP-LPI	LOEXSE	NOCF	LCF	E&L-Spr	FLDCCI	NOBY	RBSMBY
6	BBDEFBBBAA	3.2697E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
7	BACBICDCAA	3.2027E-02	HIZROX	HIP-LPI	LODCH	NOCF	LCF	E&L-Spr	NOCCI	NOBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
6	BBDEFBBBAA	3.2697E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
9	BBDEFBDBAA	1.8087E-02	LOZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
11	BBDDFBBBAA	1.4643E-02	LOZROX	LOP-LPI	LOEXSE	DWMTH	ICF	Ear-Spr	FLDCCI	NOBY	RBSMBY
14	BADEFBDBAA	1.3613E-02	HIZROX	LOP-LPI	nDCH-SE	DWMTH	ICF	E&L-Spr	FLDCCI	NOBY	RBSMBY
15	BAABFBBAAA	1.2887E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	Ear-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.
** Mean Probability conditional on the occurrence of the PDS.

2.5.3.2 Results for PDS Group 2 -Slow SBO

This PDS is composed of eight fire scenarios in different emergency switchgear rooms (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D). All lead to a fire induced LOSP followed by a random loss of emergency service water due to valve failure resulting in an early loss of all AC power and station blackout. HPCI will work until it fails on battery depletion or high suppression pool temperature and late core damage will ensue. In 64% of the cases, DC power will be lost and the core degradation will proceed at high RPV pressure. This PDS contributes 30.0% of the mean fire core damage frequency.

Table 2.5-13 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 518 source term bins for this PDS. In order to represent 95% of the probability, 178 bins are required. The fifteen most probable bins represent 0.64% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For fire initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons (none of which occurred for this PDS). Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection. Two have a high DCH event, ten have a low DCH event, and three have a small ex-vessel steam explosion. All but two have containment failure at vessel breach; nine from drywell meltthrough, three from drywell rupture, and one from wetwell rupture. In the remaining two, containment fails late by drywell head leakage.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.86 of which 0.73 is from drywell meltthrough (see Section 2.5.4.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.3.3 Results for PDS Group 3 -Slow SBO

This PDS is composed of eight fire scenarios in different switchgear rooms (2A, 2B, 2C, 2D, 3A,3B, 3C, and 3D). All lead to fire induced LOSP followed by a random loss of emergency service water from DG failure to run resulting in a delayed station blackout. HPCI will work until failure on high suppression pool temperature and late core damage will ensue. This PDS contributes 29.0% of the mean fire core damage frequency.

Table 2.5-14 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 237 source term bins for this PDS. In order to represent 95% of the probability, 59

Table 2.5-13
Results of the Accident Progression Analysis for Peach Bottom
Fire Initiators - PDS 2 - Slow SBO

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	GAABFBAAAA	1.7110E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	GBABFBAAAA	1.0417E-01	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	GAABEBAAAA	5.8621E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
4	GAABFBAAAB	4.7930E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
5	FAABFBAAAA	3.6289E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
6	GAADFBAAAA	3.5340E-02	HIZROX	HIP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
7	GBABEBAAAA	3.1794E-02	LOZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	FBABFBAAAA	2.2295E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
9	GBAAFBAAAA	2.2221E-02	LOZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
10	GAAAFBAAAA	2.1561E-02	HIZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
11	GAABACAAAB	2.0506E-02	HIZROX	HIP-nLPI	LODCH	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
12	GBABFBAAAB	1.8604E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
13	GAABHBAAAA	1.6875E-02	HIZROX	HIP-nLPI	LODCH	WWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
14	GBADACAAAB	1.5410E-02	LOZROX	HIP-nLPI	LOEXSE	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
15	GAADEBAAAA	1.3497E-02	HIZROX	HIP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-14
Results of the Accident Progression Analysis for Peach Bottom
Fire Initiators - PDS 3 - Slow SBO

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	GAABFBAAAA	2.0569E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	GBABFBAAAA	1.2520E-01	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	GAABEBAAAA	7.2144E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
4	GAABFBAAAB	6.5026E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
5	GAADFBAAAA	4.2778E-02	HIZROX	HIP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
6	GBABEBAAAA	3.8271E-02	LOZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
7	GBAAFBAAAA	2.7986E-02	LOZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	GAAAFBAAAA	2.5606E-02	HIZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
9	GAABACAAAB	2.4266E-02	HIZROX	HIP-nLPI	LODCH	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
10	GBABFBAAAB	2.3134E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
11	GAABHBAAAA	2.2041E-02	HIZROX	HIP-nLPI	LODCH	WWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
12	GBADACAAAB	1.9008E-02	LOZROX	HIP-nLPI	LOEXSE	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
13	GAADEBAAAA	1.6518E-02	HIZROX	HIP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
14	GAADHBAAAA	1.6146E-02	HIZROX	HIP-nLPI	LOEXSE	WWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
15	GBADFBAAAA	1.4745E-02	LOZROX	HIP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

bins are required. The fifteen most probable bins represent 0.74% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For fire initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons (none of which occurred for this PDS). Credit was given in the Level I analysis for recovering onsite AC power. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection. Two have a high DCH event, eight have a low DCH event, and five have a small ex-vessel steam explosion. All but two have containment failure at vessel breach; eight from drywell meltthrough, three from drywell rupture, and two from wetwell rupture. In the remaining two, containment fails late by drywell head leakage.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.88 of which 0.73 is from drywell meltthrough (see Section 2.5.4.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.3.4 Results for PDS Group 4 -Transient CV

This PDS is composed of two fire scenarios in emergency switchgear room 2C. The fires result in LOSP with failure of PCS, venting, and failure of most RHR trains. Random failures complete the failure of containment heat removal. The HPCI and LPCI systems succeed but core damage results when HPCI fails on high suppression pool temperature and LPCI fails when the SRVs reclose on high containment pressure. This PDS contributes 5.0% of the mean fire core damage frequency.

Table 2.5-15 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 270 source term bins for this PDS. In order to represent 95% of the probability, 53 bins are required. The fifteen most probable bins represent 0.77% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, AC power can not be recovered prior to or during core degradation. For fire initiated loss of AC power, recovery was not allowed except if the power failed for other than fire reasons (none of which occurred for this PDS). All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection. Two have a high DCH event, nine have a low DCH event, and four have a small ex-vessel steam explosion. All have containment failure at vessel breach or during core degradation: eight from drywell meltthrough, three from drywell rupture, and four from wetwell venting during core damage.

Table 2.5-15
Results of the Accident Progression Analysis for Peach Bottom
Fire Initiators - PDS 4 - Transient CV

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	GAABFBAAAB	2.2029E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
2	GBABFBAAAB	1.2628E-01	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
3	GAABEBAAAB	6.5463E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
4	GAABGBAAAB	4.8041E-02	HIZROX	HIP-nLPI	LODCH	WWVENT	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
5	GAADFBAAAB	4.2165E-02	HIZROX	HIP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
6	GBABEBAAAB	3.9291E-02	LOZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
7	GBABGBAAAB	3.5427E-02	LOZROX	HIP-nLPI	LODCH	WWVENT	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
8	GAABFBAAAA	3.4117E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
9	GAAAFBAAAB	2.4491E-02	HIZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
10	GBAAFBAAAB	2.3687E-02	LOZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
11	GBABFBAAAA	2.1424E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
12	GAABFBAABB	2.0016E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBLGBY
13	GBADGBAAAB	1.9457E-02	LOZROX	HIP-nLPI	LOEXSE	WWVENT	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
14	GAADGBAAAB	1.9425E-02	HIZROX	HIP-nLPI	LOEXSE	WWVENT	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
15	GAADEBAAAB	1.6067E-02	HIZROX	HIP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY

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* A listing of all bins, and a listing by observation are available on computer media.
** Mean Probability conditional on the occurrence of the PDS.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.997 of which 0.73 is from drywell meltthrough (see Section 2.5.4.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.3.5 Core Damage Arrest, Avoidance of VB.

For the dominant PDSs in the fire analysis, only PDS 1 has a possibility of recovering injection after core damage has begun. For PDS 2 to 4, the failure of injection in a non-recoverable manner was necessary to get core damage in the first place. Figure 2.5-7 shows the probability distribution for core damage arrest before lower head failure for each of the four PDSs (note that only PDS 1 is less than 1.0). These distributions are conditional on the occurrence of the PDS. The average conditional probability for core damage arrest for all the fire PDSs together is therefore .078, since PDS 1 is 34% of the total. Figure 2.5-2 shows the probability of fire core damage arrest in relation to the probability of core damage arrest for the other initiators (i.e., internal and seismic).

2.5.3.6 Early Containment Failure.

For fire initiated events, the probability of early containment failure is high. This is driven by the nature of the dominant PDSs, most of which do not have AC power or injection. This leads to a high probability of drywell meltthrough since the drywell will, at most, only have water in the reactor cavity sump and this is the most favorable condition for drywell meltthrough. Figure 2.5-8 shows the fire early containment failure probability for each of the four fire PDSs. Figure 2.5-4 shows the fire early containment failure probability in relation to the probability for the other initiators (i.e., internal and seismic).

2.5.3.7 Summary.

Figure 2.5-9 shows the mean conditional probability of the fire plant damage states for each of the collapsed accident progression bins. Figure 2.5-6 shows the mean conditional probabilities for fire events in relation to the probabilities of the other initiators (internal and seismic).

The fire PDSs are dominated by scenarios (66%) that do not allow for the recovery of injection or containment heat removal (CHR) and they look much like short or long-term station blackout sequences. The impossibility of recovering injection or CHR, however, means that the containment failure probability will be very high from overpressure related events since the base pressure in containment can not be reduced before vessel breach and long term containment failure from overpressure can not be mitigated.

For the fire initiated PDSs, only in PDS 1 is there a significant probability of being able to cool the core debris by adding water and thereby preventing CCI.

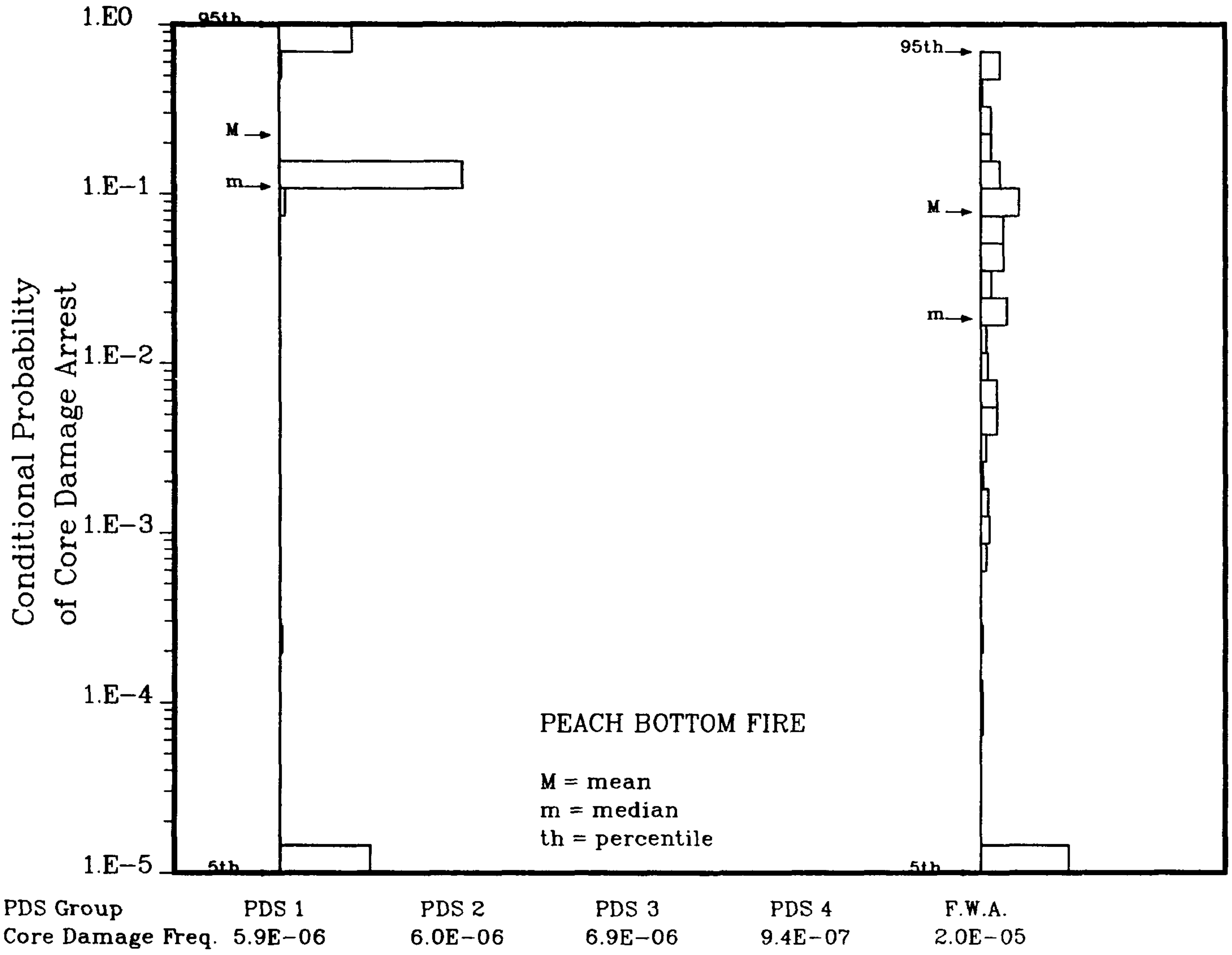


Figure 2.5-7
Conditional Probability of Core Damage Arrest for Fire PDSs

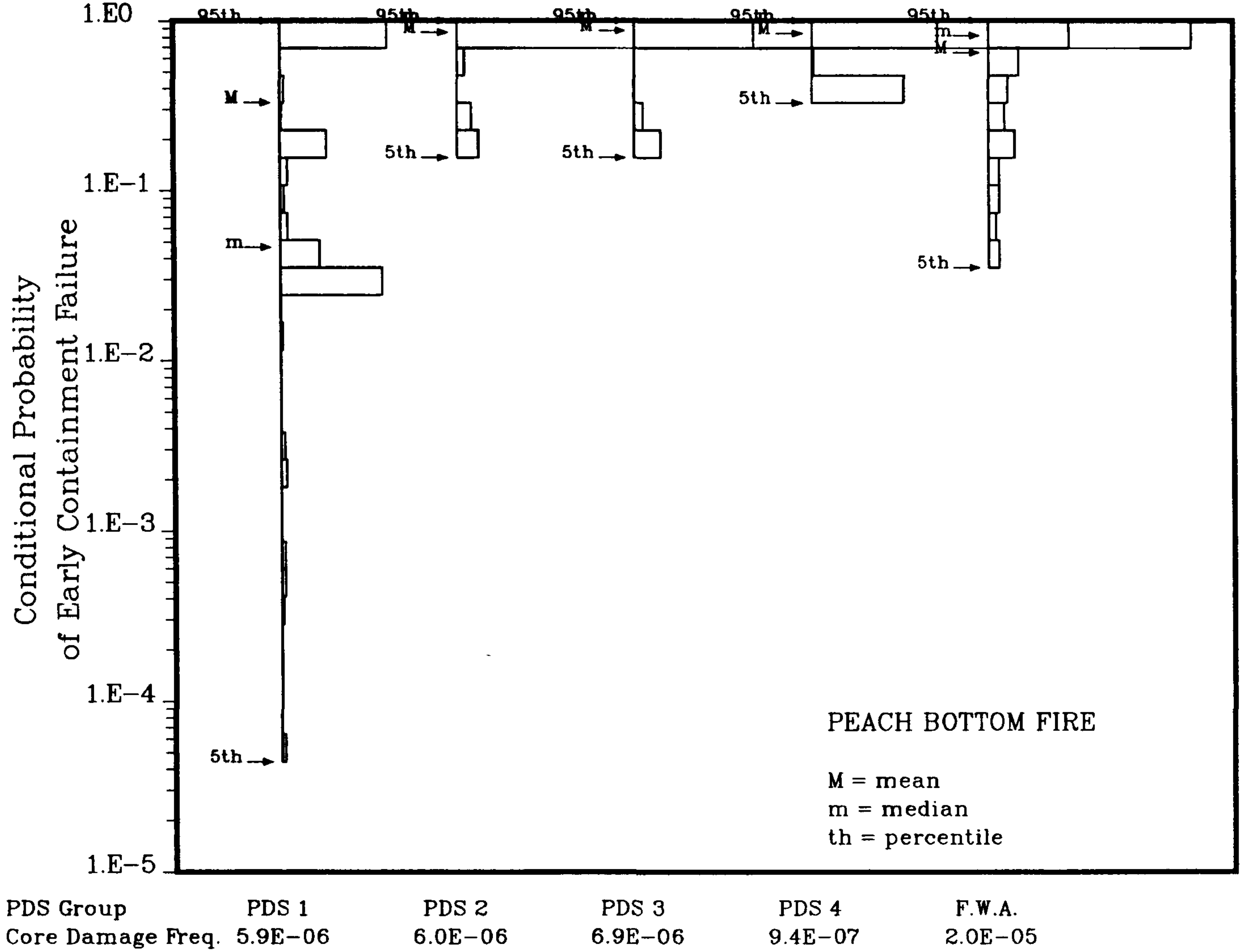
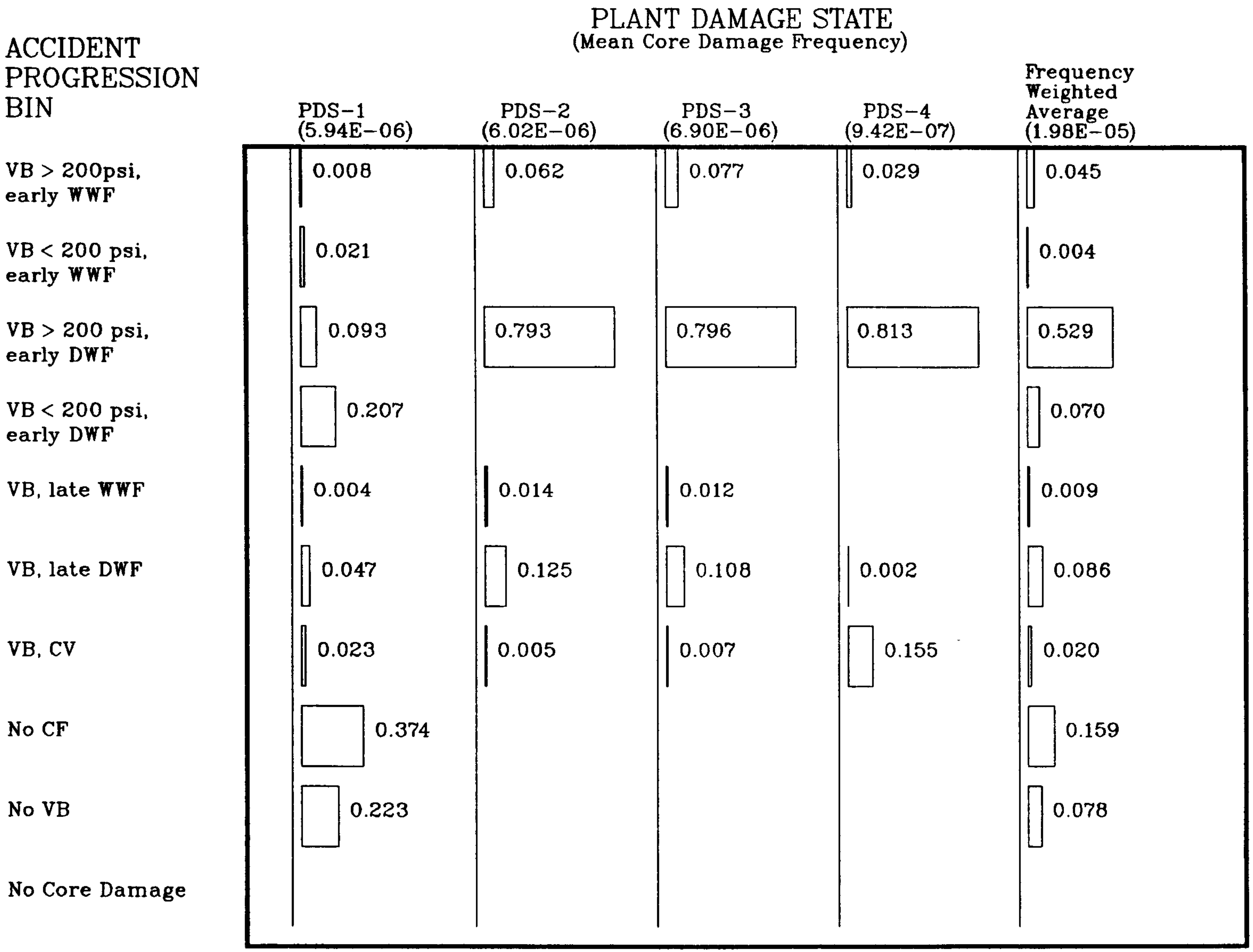


Figure 2.5-8
Conditional Probability of Early Containment Failure for Fire PDSs



VB = Vessel Breach
WWF = Wetwell Failure
DWF = Drywell Failure
CV = Containment Venting
CF = Containment Failure

Peach Bottom

FIRE

Figure 2.5-9
Conditional Probability of Collapsed APBs for Fire PDSs

2.5.4 Sensitivity Analyses for Fire Initiators

2.5.4.1 No Drywell Shell Meltthrough

In this section, we will discuss the implications of a sensitivity calculation run through the APET which investigated the effect of removing completely the possibility of drywell shell meltthrough. This sensitivity analysis was done only on the APET; the results were not propagated through to risk. The fire PDSs were run through the APET with the question pertaining to drywell meltthrough set so that meltthrough never occurred. The results can be summarized in Tables 2.5-16 and 2.5-17 which list, for each PDS, the mean conditional probabilities of each mode of containment failure for the no drywell meltthrough and drywell meltthrough cases. Both early and late failures are listed so that, by comparing the drywell meltthrough and no drywell meltthrough cases, we can see how the failure modes shift around.

Because of the nature of the dominant PDSs in the fire analysis, the effect of removing drywell meltthrough is even less significant then in the case of the internal event analysis. In fact, in three of the four PDSs, the probability of early containment failure is 1.0 with or without drywell meltthrough! Only in the case of PDS 1, where there is successful containment heat removal by the CSS system, does the absence of drywell meltthrough allow for the possibility of no containment failure.

The conclusion that can be drawn is that removing drywell shell meltthrough would not change the early containment failure probability as much as expected and will not affect the probability of early containment failure in three of the four fire PDSs.

2.5.5 Results for Seismic Initiators

For the Peach Bottom analysis, the APET did not depend upon the level of the earthquake. The frequency of each PDS was different for the high (>0.6 g) and low (<0.6 g) earthquakes; but, the conditional probability of the accident evolving in a given way after the PDS occurred was not different for the different seismic levels. The difference in the hazard curves also did not make a difference, except for PDS 7, since it too only affects the frequency of entering a given PDS. For PDS 7, the APET grouped two sequences from the Level 1 analysis which represented intermediate and small LOCAs. The relative split between these two sequences changed when the hazard curve changed. However, the change was very small and not only were the dominant accident progression bins identical for the two hazard curves but the conditional probabilities of the APBs are almost identical for the two cases. Because of the small difference or no difference between the four cases (LLNL Hig, LLNL Lowg, EPRI Hig, and EPRI Lowg), we only describe the results for one case in this section. In later sections where the result depends upon the frequencies of the PDSs in a more direct manner, we describe each case separately.

Table 2.5-16
PEACH BOTTOM FIRE PDS
CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY)
SENSITIVITY CASE: NO DRYWELL MELTTHROUGH

APET QUES	PDS1	PDS2	PDS3	PDS4
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
28op	0.0000E+00	3.7500E-04	7.5000E-04	8.0000E-02
59v	0.0000E+00	2.7040E-02	4.1930E-02	8.0000E-01
61op	0.0000E+00	2.1730E-02	3.1340E-02	1.5440E-01
83a	8.1680E-03	9.9570E-04	9.9600E-04	1.0100E-03
98ped	4.6310E-02	1.4910E-01	1.5230E-01	1.5210E-01
101op	5.4170E-02	2.5540E-01	3.1680E-01	1.1290E-01
103dwmth	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
ECF-SUM	1.0865E-01	4.5464E-01	5.4412E-01	1.3004E+00
ECF-EVNTRE	1.0860E-01	4.3370E-01	5.1330E-01	9.9336E-01
124v	3.8740E-02	0.0000E+00	0.0000E+00	0.0000E+00
127pedop	6.6200E-02	2.4200E-02	2.1400E-02	2.0900E-02
128optemp	0.0000E+00	1.8860E-01	1.8600E-01	1.8560E-01
130op	8.8640E-03	5.5510E-01	4.7720E-01	6.4070E-03
TCF-SUM	2.2245E-01	1.2225E+00	1.2287E+00	1.5133E+00
TCF-EVNTRE	2.1640E-01	1.0000E+00	1.0000E+00	1.0000E+00

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability.

Table 2.5-17
PEACH BOTTOM FIRE PDS
CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY)
BASE CASE: DRYWELL MELTTHROUGH ALLOWED

APET QUES	PDS1	PDS2	PDS3	PDS4
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
28op	0.0000E+00	3.7500E-04	7.5000E-04	8.0000E-02
59v	0.0000E+00	2.7040E-02	4.1930E-02	8.0000E-01
61op	0.0000E+00	2.1730E-02	3.1340E-02	1.5440E-01
83a	8.1680E-03	9.9570E-04	9.9600E-04	1.0100E-03
98ped	4.6310E-02	1.4910E-01	1.5230E-01	1.5210E-01
101op	5.4170E-02	2.5540E-01	3.1680E-01	1.1290E-01
103dwmth	2.5750E-01	7.3060E-01	7.3060E-01	7.3040E-01
ECF-SUM	3.6615E-01	1.1852E+00	1.2747E+00	2.0308E+00
ECF-EVNTRE	3.2920E-01	8.6070E-01	8.8090E-01	9.9756E-01
ECFWODWMTH	7.1700E-02	1.3010E-01	1.5030E-01	2.6716E-01
124v	2.6150E-02	0.0000E+00	0.0000E+00	0.0000E+00
127pedop	4.5400E-02	9.8000E-03	9.5000E-03	9.4000E-03
128optemp	0.0000E+00	5.2070E-02	5.2290E-02	4.9670E-02
130op	5.9940E-03	1.3490E-01	1.1510E-01	2.2960E-03
TCF-SUM	4.4369E-01	1.3820E+00	1.4516E+00	2.0922E+00
TCF-EVNTRE	4.0260E-01	1.0000E+00	1.0000E+00	1.0000E+00
TCFWODWMTH	1.4510E-01	2.6940E-01	7.2100E-01	2.6960E-01

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF, ECFWODWMTH = the probability of ECF subtracting out DWMTH.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability, TCFWODWMTH = the probability of TCF subtracting out DWMTH.

2.5.5.1 Results for PDS Group EQ 1 - FSB RPV

This PDS is composed of one sequence with a seismically induced LOSP followed by RPV vessel rupture. All injection is lost and early core damage ensues. Some onsite AC is available; but, containment heat removal is not available. Early containment failure occurs as a result of the seismic event. This PDS contributes 1.2% of the mean seismic core damage frequency.

Table 2.5-18 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 47 source term bins for this PDS. In order to represent 95% of the probability, 22 bins are required. The fifteen most probable bins represent 0.90% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection. Seven have a small ex-vessel steam explosion, two have a large ex-vessel steam explosion, and six have neither. All have containment failure initially from the seism but five by leakage, four by rupture, and in six drywell meltthrough supersedes the initial failure.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 1.0 which occurs initially as a result of the earthquake. Drywell meltthrough also occurs 52% of the time (See Section 2.5.6.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00 since RPV rupture is the initiator. The probability of recovering AC and averting VB is 0.00.

2.5.5.2 Results for PDS Group EQ 2 - FSB LLOCA

This PDS is composed of one sequence with a seismically induced LOSP followed by a loss of all onsite AC leading to a station blackout. A large LOCA is also induced by the seismic event resulting in high pressure injection failure (only steam-driven systems are available and these fail on low pressure in the RPV) and early core damage results. Early containment failure occurs as a result of the seismic event. This PDS contributes 22.6% of the mean seismic core damage frequency.

Table 2.5-19 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 51 source term bins for this PDS. In order to represent 95% of the probability, 27 bins are required. The fifteen most probable bins represent 0.85% of the probability.

Table 2.5-18
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 1 - FSB RPV

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACA	1.8798E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
2	AABDBAAACA	1.3793E-01	HIZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
3	AABEFBAACA	7.7468E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
4	ABBDBAAACA	7.5115E-02	LOZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	ABBDFBAACA	7.1393E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
6	ABBEFBAACA	6.3530E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
7	AABDEAAACA	6.0926E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
8	AABEBAAACA	5.9490E-02	HIZROX	LOP-nLPI	nDCH-SE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
9	ABBEBAAACA	3.5159E-02	LOZROX	LOP-nLPI	nDCH-SE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
10	ABBDEAAACA	3.1628E-02	LOZROX	LOP-nLPI	LOEXSE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
11	AABEEAAACA	2.5797E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
12	ABBCFBAACA	2.3584E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
13	AABDFBAACB	2.2508E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
14	ABBEEAAACA	1.8432E-02	LOZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
15	AABCBAAACA	1.3305E-02	HIZROX	LOP-nLPI	HIEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-19
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 2 - FSB LLOCA

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACA	1.7539E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
2	AABDBAAACA	1.2836E-01	HIZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
3	AABEFBAACA	6.8361E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
4	ABBDBAAACA	6.8286E-02	LOZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	ABBDFBAACA	6.7662E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
6	AABEBAAACA	5.7394E-02	HIZROX	LOP-nLPI	nDCH-SE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
7	ABBEFBAACA	5.5831E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
8	AABDEAAACA	5.5825E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
9	AABDFBAACB	3.5105E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
10	ABBEBAAACA	3.0855E-02	LOZROX	LOP-nLPI	nDCH-SE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
11	ABBDEAAACA	2.8339E-02	LOZROX	LOP-nLPI	LOEXSE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
12	AABEEAAACA	2.4375E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
13	ABBCFBAACA	2.3048E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
14	ABBEEAAACA	1.5924E-02	LOZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
15	ABBDBAAACB	1.3208E-02	LOZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBLGBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

None of the top fifteen bins have core damage arrest. For this PDS, offsite AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection. Eight have a small ex-vessel steam explosion, one has a large ex-vessel steam explosion, and six have neither. All have containment failure initially from the seism. Five fail initially by leakage, four fail initially by rupture, and in the remaining six drywell meltthrough supersedes the initial failure.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 1.0 which occurs initially as a result of the earthquake. Drywell meltthrough also occurs 52% of the time (See Section 2.5.6.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.5.3 Results for PDS Group EQ 3 - FSB LLOCA

This PDS is the same as PDS-2 except that DC power has also failed. This has no effect on accident progression since all systems have failed anyway. This PDS contributes 4.0% of the mean seismic core damage frequency.

Table 2.5-20 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 51 source term bins for this PDS. In order to represent 95% of the probability, 28 bins are required. The fifteen most probable bins represent 0.85% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, offsite AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection. Eight have a small ex-vessel steam explosion, one has a large ex-vessel steam explosion, and six have neither. All have containment failure initially from the seism. Five fail initially by leakage, four fail initially by rupture, and in the remaining six drywell meltthrough supersedes the initial failure.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 1.0 which occurs initially as a result of the earthquake. Drywell meltthrough also occurs 52% of the time (See Section 2.5.6.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

Table 2.5-20
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 3 - FSB LLOCA

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACA	1.7539E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
2	AABDBAAACA	1.2836E-01	HIZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
3	AABEFBAACA	6.8361E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
4	ABBDBAAACA	6.8286E-02	LOZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	ABBDFBAACA	6.7662E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
6	AABEBAAACA	5.7394E-02	HIZROX	LOP-nLPI	nDCH-SE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
7	ABBEFBAACA	5.5831E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
8	AABDEAAACA	5.5825E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
9	AABDFBAACB	3.5105E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
10	ABBEBAAACA	3.0855E-02	LOZROX	LOP-nLPI	nDCH-SE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
11	ABBDEAAACA	2.8339E-02	LOZROX	LOP-nLPI	LOEXSE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
12	AABEEAAACA	2.4375E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
13	ABBCFBAACA	2.3048E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
14	ABBEEAAACA	1.5924E-02	LOZROX	LOP-nLPI	nDCH-SE	DWR	ECF	NO-Spr	DRYCCI	COMPBY	RBSMBY
15	ABBDBAAACB	1.3208E-02	LOZROX	LOP-nLPI	LOEXSE	DWL	ECF	NO-Spr	DRYCCI	COMPBY	RBLGBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

2.5.5.4 Results for PDS Group EQ 4 - Slow SBO

This PDS is composed of one sequence with a seismically induced LOSP followed by a loss of all AC leading to station blackout. HPCI succeeds until battery depletion or high suppression pool temperature results in HPCI failure and late core damage. This PDS contributes 49.1% of the mean seismic core damage frequency.

Table 2.5-21 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 518 source term bins for this PDS. In order to represent 95% of the probability, 121 bins are required. The fifteen most probable bins represent 0.64% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection. Two have a large DCH event, ten have a small DCH event, and three have a small ex-vessel steam explosion. All have containment failure at vessel breach, nine by drywell meltthrough, three by drywell rupture, two by drywell head leakage, and one by wetwell rupture.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.86 of which 0.73 is from drywell meltthrough (see Section 2.5.6.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.5.5 Results for PDS Group EQ 5 - Fast SBO

This PDS is composed of two sequences, one with a stuck open SRV and one without. Both sequences have a seismically induced LOSP followed by a loss of all AC resulting in station blackout. High pressure injection fails initially upon Radwaste/Turbine building failure and early core damage ensues. This PDS contributes 4.3% of the mean seismic core damage frequency.

Table 2.5-22 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 178 source term bins for this PDS. In order to represent 95% of the probability, 61 bins are required. The fifteen most probable bins represent 0.68% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except

Table 2.5-21
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 4 - Slow SBO

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	GAABFBAAAA	1.7110E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	GBABFBAAAA	1.0417E-01	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	GAABEBAAAA	5.8621E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
4	GAABFBAAAB	4.7930E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
5	FAABFBAAAA	3.6289E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
6	GAADFBAAAA	3.5341E-02	HIZROX	HIP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
7	GBABEBAAAA	3.1795E-02	LOZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	FBABFBAAAA	2.2295E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
9	GBAAFBAAAA	2.2221E-02	LOZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
10	GAAAFBAAAA	2.1561E-02	HIZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
11	GAABACAAAB	2.0506E-02	HIZROX	HIP-nLPI	LODCH	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
12	GBABFBAAAB	1.8604E-02	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
13	GAABHBAAAA	1.6875E-02	HIZROX	HIP-nLPI	LODCH	WWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
14	GBADACAAAB	1.5410E-02	LOZROX	HIP-nLPI	LOEXSE	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
15	GAADEBAAAA	1.3497E-02	HIZROX	HIP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-22
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 5 - Fast SBO

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	EAABFBAAAA	2.1161E-01	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
2	EBABFBAAAA	1.2948E-01	LOZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
3	EAAEFBAAAA	4.8799E-02	HIZROX	HIP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
4	EAABFBAAAB	3.7718E-02	HIZROX	HIP-nLPI	LODCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBLGBY
5	EAABEBAAAA	3.5625E-02	HIZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
6	EAABACAAAB	3.1153E-02	HIZROX	HIP-nLPI	LODCH	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
7	EABEFBAAAA	2.7409E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
8	EAAAFBAAAA	2.5289E-02	HIZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
9	EBAAFBAAAA	2.2829E-02	LOZROX	HIP-nLPI	HIDCH	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
10	EBAEFBAAAA	2.2098E-02	LOZROX	HIP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
11	EBABEBAAAA	1.8947E-02	LOZROX	HIP-nLPI	LODCH	DWR	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY
12	EBAEACAAAB	1.8835E-02	LOZROX	HIP-nLPI	nDCH-SE	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
13	EAAEACAAAB	1.8324E-02	HIZROX	HIP-nLPI	nDCH-SE	DWHL	LCF	NO-Spr	DRYCCI	NOBY	RBLGBY
14	EBABBCAAAA	1.6713E-02	LOZROX	HIP-nLPI	LODCH	DWL	LCF	NO-Spr	DRYCCI	NOBY	RBSMBY
15	EBBEFBAAAA	1.6614E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	NOBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. Thirteen of the most probable bins have vessel breach with the RPV at high pressure and without any injection, two at low pressure with no injection. Two have a large DCH event, seven have a small DCH event, and six have no DCH or ex-vessel steam explosions. Nine have containment failure at vessel breach by drywell meltthrough and two by drywell rupture. Two have containment failure late by drywell head leakage, and one by drywell leak.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.75 of which 0.71 is from drywell meltthrough (see Section 2.5.6.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.5.6 Results for PDS Group EQ 6 - FSB ILOCA

This PDS is composed of one sequence with a seismically induced LOSP, failure of onsite AC due to cooling water failure, and a seismically induced intermediate LOCA. HPCI works until primary pressure drops below working pressure and early core damage ensues. This PDS contributes 6.2% of the mean seismic core damage frequency.

Table 2.5-23 lists the fifteen most probable APBs since the top five bins all have VB and early CF. The evaluation of the APET produced 98 source term bins for this PDS. In order to represent 95% of the probability, 45 bins are required. The fifteen most probable bins represent 0.66% of the probability.

None of the top fifteen bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection. Nine have a small ex-vessel steam explosion, one has a large ex-vessel steam explosion, and five have neither. All have containment failure at vessel breach, nine by drywell meltthrough, two by drywell rupture, two by wetwell rupture, and one each by wetwell leak and drywell head leak.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.96 of which 0.52 is from drywell meltthrough (see Section 2.5.4.1 for a discussion of the impact of no drywell meltthrough). Early containment failure by overpressure has a probability of 0.73. The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

Table 2.5-23
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 6 - FSB ILOCA

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACA	1.1823E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
2	AABDFBAACB	9.2454E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
3	AABDHBAACA	5.8788E-02	HIZROX	LOP-nLPI	LOEXSE	WWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
4	AABEFBAACA	5.5098E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	ABBDFBAACA	4.8710E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
6	AABDEBAACA	4.6181E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
7	ABBEFBAACA	4.5021E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
8	AABDCBAACA	2.9234E-02	HIZROX	LOP-nLPI	LOEXSE	WWL	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
9	AABEFBAACB	2.7403E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
10	ABBDFBAACB	2.4271E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
11	ABBEFBAACB	2.4213E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
12	ABBCFBAACA	2.3048E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
13	AABDEBAACB	2.2909E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
14	ABBDABAACB	2.2192E-02	LOZROX	LOP-nLPI	LOEXSE	DWHL	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
15	AABEHBAACA	2.1602E-02	HIZROX	LOP-nLPI	nDCH-SE	WWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.
** Mean Probability conditional on the occurrence of the PDS.

2.5.5.7 Results for PDS Group EQ 7 - FSB I/SLOCA

This PDS is composed of two sequences both with a seismically induced LOSP followed by a loss of onsite AC resulting in station blackout. A seismically induced intermediate or small LOCA occurs and high pressure injection fails when RPV pressure drops below the systems working pressures resulting in early core damage. This PDS contributes 2.1% of the mean seismic core damage frequency.

Table 2.5-24 lists the ten most probable APBs with VB, since the top five bins all have VB, and the top five bins with VB and early CF. The evaluation of the APET produced 168 source term bins for this PDS. In order to represent 95% of the probability, 70 bins are required. The ten most probable bins represent 0.52% of the probability.

None of the top ten bins have core damage arrest. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the ten most probable bins have vessel breach with the RPV at low pressure and without any injection. Three have a small ex-vessel steam explosion, and seven have no ex-vessel steam explosions. Six have containment failure at vessel breach by drywell meltthrough and one by wetwell rupture. Three have late containment failure, two by drywell head leakage and one by drywell rupture.

For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.69 of which 0.52 is from drywell meltthrough (see Section 2.5.6.1 for a discussion of the impact of no drywell meltthrough). The probability that AC power is recovered before VB is 0.00. The probability of recovering AC and averting VB is 0.00.

2.5.5.8 Core Damage Arrest, Avoidance of VB.

For the dominant PDSs in the seismic analysis, no PDS has a possibility of recovering injection after core damage has begun. As was mentioned previously, damage from the seism was assessed to be non-recoverable for off-site power within the time frame of interest. Recovery of onsite power from none seismic failures in order to prevent core damage was allowed in the Level I analyses; but no further credit was taken in the accident progression analysis because the failures were either easy to recover and so would be before core damage took place or so difficult that recovery within the time frame of interest was negligible.

2.5.5.9 Early Containment Failure.

For seismically initiated events, the probability of early containment failure is high (70% or greater). This is driven by the nature of the seismic event which does not allow AC power recovery and the

Table 2.5-24
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 7 - FSB I/SLOCA

Ten Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	EABEFBAABA	1.2879E-01	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBSMBY
2	EBBEFBAABA	8.1743E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBSMBY
3	EABEACAABB	6.4995E-02	HIZROX	LOP-nLPI	nDCH-SE	DWHL	LCF	NO-Spr	DRYCCI	PARTBY	RBLGBY
4	AABDFBAACA	4.7597E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	EABEFBAABB	4.1971E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBLGBY
6	EBBEACAABB	3.8636E-02	LOZROX	LOP-nLPI	nDCH-SE	DWHL	LCF	NO-Spr	DRYCCI	PARTBY	RBLGBY
7	AABDFBAACB	3.3185E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
8	EABEFBAACA	3.2198E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
9	EABEECAABA	2.7272E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	LCF	NO-Spr	DRYCCI	PARTBY	RBSMBY
10	AABDHBAACA	2.1928E-02	HIZROX	LOP-nLPI	LOEXSE	WWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY

Five Most Probable Bins that have VB and Early CF*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	EABEFBAABA	1.2879E-01	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBSMBY
2	EBBEFBAABA	8.1743E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBSMBY
4	AABDFBAACA	4.7597E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	EABEFBAABB	4.1971E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	PARTBY	RBLGBY
7	AABDFBAACB	3.3185E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

characteristics of the dominant PDSs which do not have any continuing injection or containment heat removal. This leads to a high probability of drywell meltthrough since the drywell will, at most, only have the water in the reactor cavity sump or on the drywell floor and this is the most favorable condition for drywell meltthrough (i.e. as opposed to having some continuous supply of covering water). Figures 2.5-10a and 2.5-10b show the seismic early containment failure probability for each of the seven seismic PDSs for the LLNL and EPRI hazard curves, respectively. The conditional probability of early containment failure is identical except for the frequency weighted average, since the relative frequencies of the PDSs are different for the two hazard curves. Figure 2.5-4 shows the seismic early containment failure probability in relation to the probability for the other initiators (internal and fire).

2.5.5.10 Summary.

Figures 2.5-11a and 2.5-11b show the mean conditional probability of the seismic plant damage states for each of the collapsed accident progression bins for the LLNL and EPRI hazard curves, respectively. The results are identical except for PDS 7 as mentioned previously in Section 2.5.5 and the frequency weighted average as explained above in Section 2.5.5.9. Figure 2.5-6 shows the mean conditional probabilities for seismic events in relation to the probabilities of the other initiators (internal and fire).

The seismic PDSs are dominated by scenarios (100%) that do not allow for the recovery of injection or containment heat removal (CHR) and they look much like short or long-term station blackout sequences. The impossibility of recovering injection or CHR, however, means that the containment failure probability will be very high from overpressure related events since the base pressure in containment can not be reduced before vessel breach and long term containment failure from overpressure can not be mitigated.

For the seismically initiated PDSs, no PDS has a significant probability of being able to cool the core debris by adding water and thereby preventing CCI. All the PDSs have a dry CCI with a possibility in some cases of an initial layer of water from a LOCA or CRD leakage.

2.5.6 Sensitivity Analyses for Seismic Initiators

2.5.6.1 No Drywell Shell Meltthrough

In this section, we will discuss the implications of a sensitivity calculation run through the APET which investigated the effect of removing completely the possibility of drywell shell meltthrough. This sensitivity analysis was done only on the APET; the results were not propagated through to risk. The seismic PDSs were run through the APET with the question pertaining to drywell meltthrough set so that meltthrough never occurred. The results can be summarized in Tables 2.5-25 and 2.5-26 which list, for each PDS, the mean conditional probabilities of each mode of containment

Table 2.5-25
PEACH BOTTOM SEISMIC PDS - CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY)
SENSITIVITY CASE: NO DRYWELL MELTTHROUGH

APET QUES	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
14pre	1.0000E+00	1.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
28op	0.0000E+00	0.0000E+00	0.0000E+00	3.7500E-04	0.0000E+00	0.0000E+00	0.0000E+00
59v	0.0000E+00	0.0000E+00	0.0000E+00	2.7040E-02	3.1320E-03	9.9000E-02	5.6350E-02
61op	0.0000E+00	0.0000E+00	0.0000E+00	2.1730E-02	3.3590E-03	7.3350E-01	2.8900E-01
83a	9.9610E-03	9.9610E-03	9.9610E-03	9.9580E-04	1.8580E-03	9.9610E-03	9.9610E-03
98ped	3.0900E-02	3.0900E-02	3.0900E-02	1.4910E-01	1.0360E-01	3.0950E-02	9.8580E-03
101op	3.2570E-02	3.2570E-02	3.2570E-02	2.5540E-01	2.0110E-02	4.8490E-01	1.7580E-01
103dwmth	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
ECF-SUM	1.0734E+00	1.0734E+00	1.0734E+00	4.5464E-01	1.3206E-01	1.3583E+00	5.4097E-01
ECF-EVNTRE	1.0000E+00	1.0000E+00	1.0000E+00	4.3370E-01	1.2940E-01	9.2346E-01	3.7590E-01
124v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
127pedop	1.2050E-01	1.2040E-01	1.2050E-02	2.4300E-02	6.5500E-02	1.0670E-01	1.4040E-01
128optemp	0.0000E+00	0.0000E+00	0.0000E+00	1.8860E-01	2.0350E-01	1.5010E-01	1.8450E-01
130op	0.0000E+00	0.0000E+00	0.0000E+00	5.5500E-01	8.3670E-01	7.0370E-02	5.7440E-01
TCF-SUM	1.1939E+00	1.1939E+00	1.1939E+00	1.2225E+00	1.2378E+00	1.6855E+00	1.4403E+00
TCF-EVNTRE	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	9.9910E-01	1.0000E+00	1.0000E+00

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

14pre = seismic event fails containment initially, 17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability.

Table 2.5-26
PEACH BOTTOM SEISMIC PDS - CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY)
BASE CASE: DRYWELL MELTTHROUGH ALLOWED

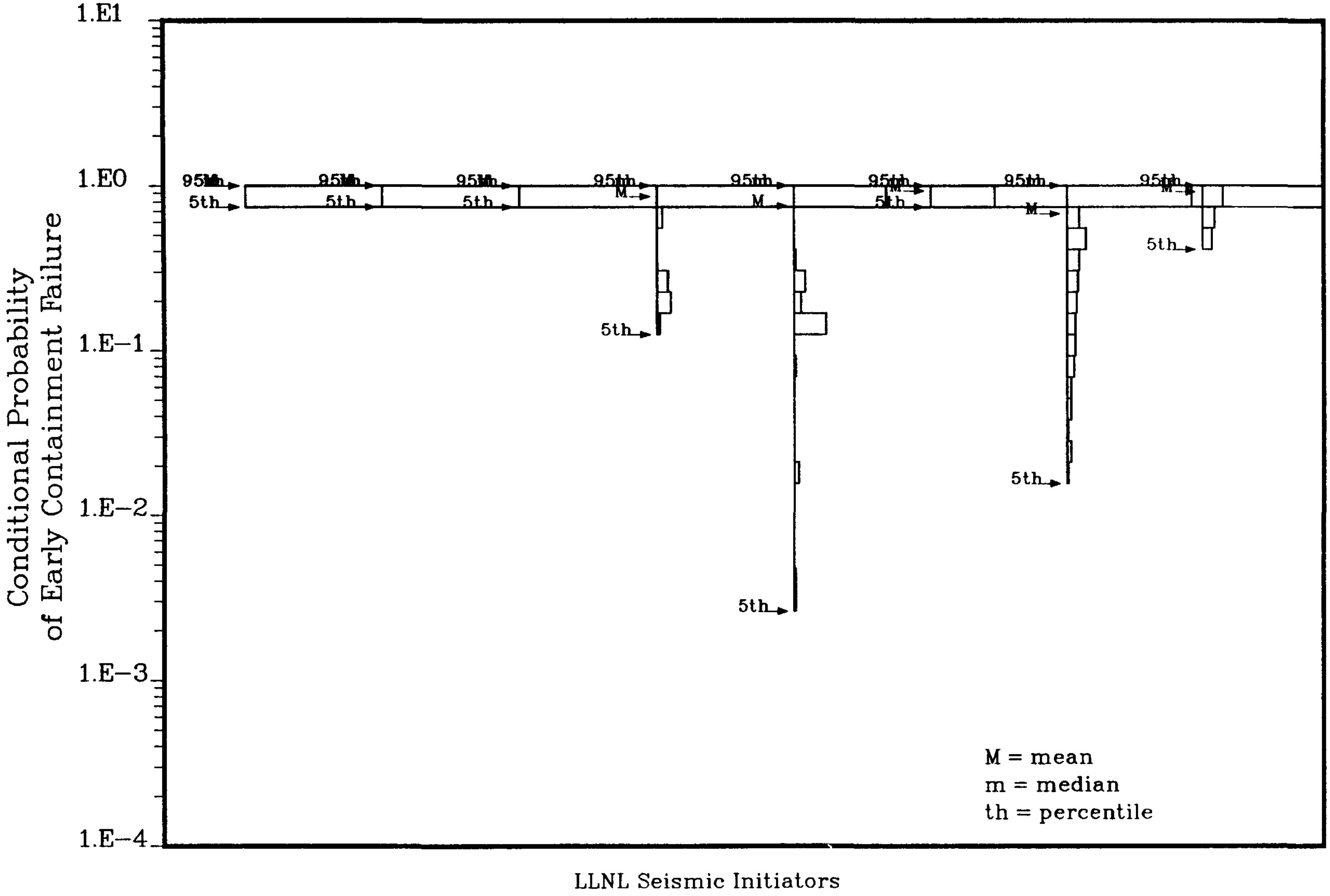
APET QUES	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
14pre	1.0000E+00	1.0000E+00	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
28op	0.0000E+00	0.0000E+00	0.0000E+00	3.7500E-04	0.0000E+00	0.0000E+00	0.0000E+00
59v	0.0000E+00	0.0000E+00	0.0000E+00	2.7040E-02	3.1320E-03	9.9000E-02	5.6350E-02
61op	0.0000E+00	0.0000E+00	0.0000E+00	2.1730E-02	3.3590E-03	7.3350E-01	2.8900E-01
83a	9.9610E-03	9.9610E-03	9.9610E-03	9.9580E-04	1.8580E-03	9.9610E-03	9.9610E-03
98ped	3.0900E-02	3.0900E-02	3.0900E-02	1.4910E-01	1.0360E-01	3.0900E-02	9.8580E-03
101op	3.2570E-02	3.2570E-02	3.2570E-02	2.5540E-01	2.0110E-02	4.8490E-01	1.7580E-01
103dwmth	5.2250E-01	5.2250E-01	5.2250E-01	7.3060E-01	7.1060E-01	5.2250E-01	5.2250E-01
ECF-SUM	1.5959E+00	1.5959E+00	1.5959E+00	1.1852E+00	8.4266E-01	1.8808E+00	1.0635E+00
ECF-EVNTRE	1.0000E+00	1.0000E+00	1.0000E+00	8.6070E-01	7.5160E-01	9.6333E-01	6.9280E-01
ECFWODWMTH	4.7750E-01	4.7750E-01	4.7750E-01	1.3010E-01	4.1000E-02	4.4083E-01	1.7030E-01
124v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
127pedop	5.3500E-02	5.3500E-02	5.3500E-02	9.8000E-03	1.9400E-02	4.9900E-02	6.5700E-02
128optemp	0.0000E+00	0.0000E+00	0.0000E+00	5.2070E-02	5.8830E-02	7.2170E-02	8.9250E-02
130op	0.0000E+00	0.0000E+00	7.4110E-02	1.3490E-01	2.3830E-01	3.3530E-02	2.8290E-01
TCF-SUM	1.6494E+00	1.6494E+00	1.7235E+00	1.3820E+00	1.1592E+00	2.0364E+00	1.5013E+00
TCF-EVNTRE	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	9.9970E-01	1.0000E+00	1.0000E+00
TCFWODWMTH	4.7750E-01	4.7750E-01	4.7750E-01	2.6940E-01	2.8910E-01	4.7750E-01	4.7750E-01

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

14pre = seismic event fails containment initially, 17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF, ECFWODWMTH = the probability of ECF subtracting out DWMTH.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability, TCFWODWMTH = the probability of TCF subtracting out DWMTH.



Plant Damage States	PDS–1	PDS–2	PDS–3	PDS–4	PDS–5	PDS–6	PDS–7	F.W.A.
Core Damage Freq.	8.8E–06	1.7E–05	3.0E–06	3.7E–05	3.2E–06	4.7E–06	1.6E–06	7.5E–05

Figure 2.5-10a
Conditional Probability of Early Containment Failure for Seismic PDSs - LLNL

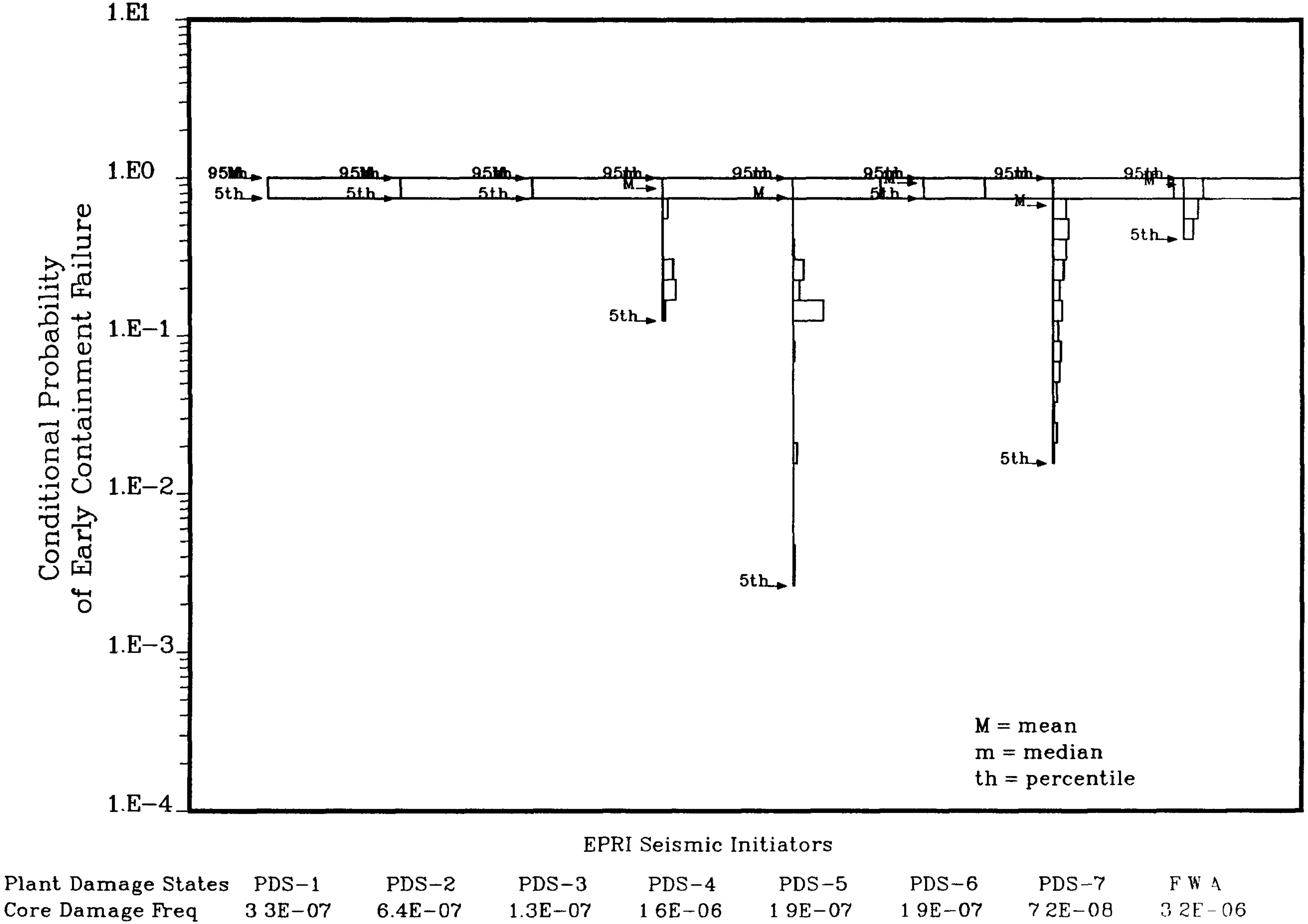
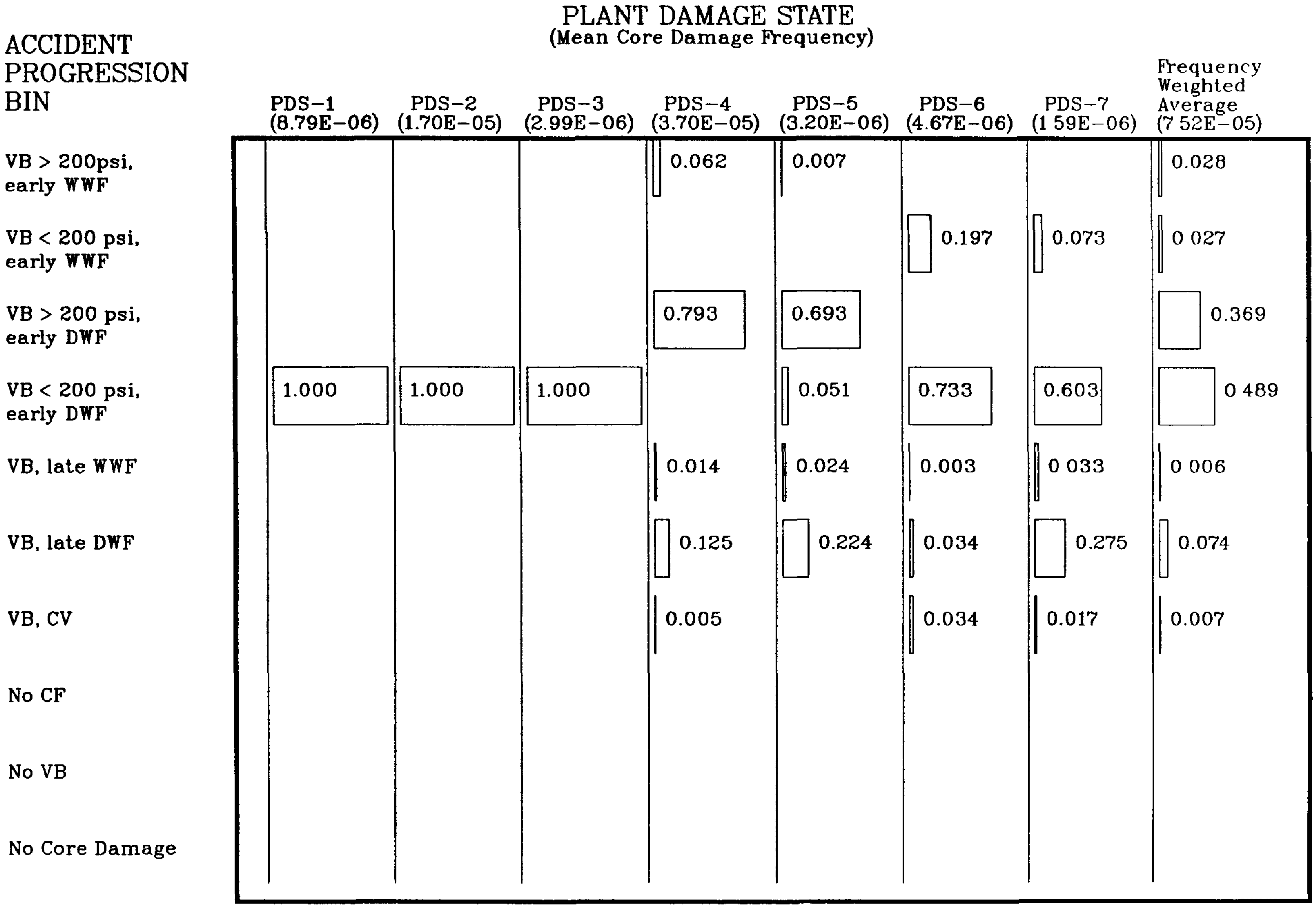


Figure 2.5-10b
Conditional Probability of Early Containment Failure for Seismic PDSs - EPRI



PLANT DAMAGE STATE
(Mean Core Damage Frequency)

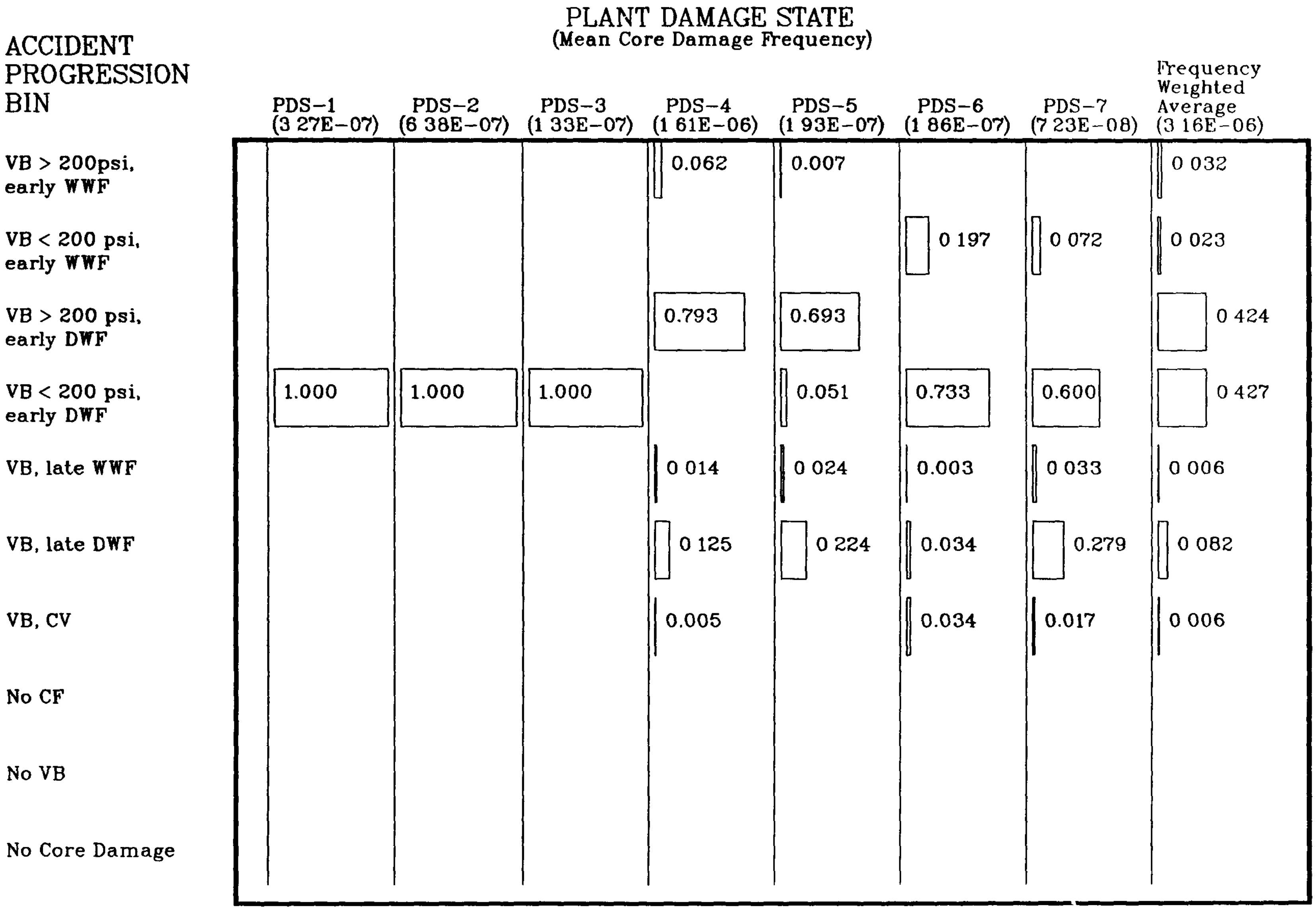
ACCIDENT PROGRESSION BIN	PDS-1 (8.79E-06)	PDS-2 (1.70E-05)	PDS-3 (2.99E-06)	PDS-4 (3.70E-05)	PDS-5 (3.20E-06)	PDS-6 (4.67E-06)	PDS-7 (1 59E-06)	Frequency Weighted Average (7 52E-05)
VB > 200psi, early WWF				0.062	0.007			0.028
VB < 200 psi, early WWF						0.197	0.073	0 027
VB > 200 psi, early DWF				0.793	0.693			0.369
VB < 200 psi, early DWF	1.000	1.000	1.000		0.051	0.733	0.603	0 489
VB, late WWF				0.014	0.024	0.003	0 033	0 006
VB, late DWF				0.125	0.224	0.034	0.275	0.074
VB, CV				0.005		0.034	0.017	0.007
No CF								
No VB								
No Core Damage								

VB = Vessel Breach
WWF = Wetwell Failure
DWF = Drywell Failure
CV = Containment Venting
CF = Containment Failure

Peach Bottom

LLNL

Figure 2.5-11a
Conditional Probability of Collapsed APBs for Seismic PDSs - LLNL



VB = Vessel Breach
WWF = Wetwell Failure
DWF = Drywell Failure
CV = Containment Venting
CF = Containment Failure

Peach Bottom

EPRI

Figure 2.5-11b
Conditional Probability of Collapsed APBs for Seismic PDSs - EPRI

failure for the no drywell meltthrough and drywell meltthrough cases. Both early and late failures are listed so that, by comparing the drywell meltthrough and no drywell meltthrough cases, we can see how the failure modes shift around.

For PDSs 1-3, one must be careful in interpreting the results since the containment has failed initially due to the seismic event. However, in 90% of the cases this is a drywell leak and in only 10% is it a drywell rupture. This affects the final result because the initial leak will prevent overpressure failures later. Also, the severity of the containment failure would be less if the failure was a leak as instead of a rupture. So, removing drywell meltthrough will not change the early containment failure probability for these PDSs, but it will change the source term. In the dominant PDS (PDS 4), drywell meltthrough is very likely (0.73); but, removing it only decreases the early failure probability by a factor of two since the other modes can occur simultaneously with drywell meltthrough. The late failure modes increase significantly in probability and containment failure is certain (1.0) by the late time frame. In fact, for all the PDSs, containment failure occurs some time during the accident whether or not drywell meltthrough can occur.

Because of the nature of the dominant PDSs in the seismic analysis, the effect of removing drywell meltthrough is even less significant then in the case of the internal event or fire analyses. In fact, in all of the seven PDSs, the probability of late containment failure is 1.0 with or without drywell meltthrough. Only in the case of PDS 5, which is a fast station blackout with a dry cavity, does the absence of drywell meltthrough allow for a significant reduction in the early containment failure probability, but it still fails late (the other fast station blackouts all involve LOCAs and have a wet drywell, vessel breach occurs at low pressure, and there is some improved possibility of preventing drywell meltthrough and pedestal failure from CCI early.

The conclusion that can be drawn is that removing drywell shell meltthrough would not change the early containment failure probability as much as expected and will not significantly affect the probability of early containment failure in four of the seven seismic PDSs.

2.5.6.2 No CFs at the Start due to RPV Support Failures

For the seismic initiators, one sensitivity was carried all the way through the analysis. The sensitivity involved the effects of elimination of the possibility of initial containment failure as a result of the seism inducing a twisting motion to the RPV which results in a tearing of the drywell shell wall at one of the penetrations. The differences in the containment failure modes for those PDSs in which this is possible (PDS 1-3) is discussed in this section.

As for the drywell shell meltthrough sensitivity, a table was constructed to show the differences in the probabilities of the various containment failure modes with and without initial containment failure, Table 2.5-27. One can clearly see that removing the initial containment failure hardly affects the probability of early containment failure because of compensating increases in the other failure modes. Containment failure is ultimately assured in all cases. In order to assess how this affects the source terms by changing the spectrum of failure sizes and locations see chapter 3 on the source term analysis.

Tables 2.5-28-30 show the dominant accident progression bins for PDSs 1-3 with no initial containment failure. By comparing the fifteen most probable bins for each PDS in the two cases, we see that the most obvious difference is the reduction in the number of bins with large reactor building bypass. This is primarily due to the fact that the initial leak allows the hydrogen produced during the in-vessel phase of the accident and after to be released more continuously and that the releases occur at lower pressures. This results in lower hydrogen concentrations, lower peak pressures both with and without burns, and lower bypass levels.

Also the nine out of fifteen bins that have initial containment failure that was not superseded by drywell meltthrough are now replaced by other containment failure modes during core damage or at vessel breach such as: wetwell venting, overpressure failures in the wetwell or drywell, and drywell failures induced by pedestal failure.

2.6 Insights From the Accident Progression Analysis

There are significant differences between the internal events results and the external events results. Both of the external events had a much lower probability (if any at all) for recovering injection during core damage and for having continuous water flow onto the debris in the cavity and drywell. These two differences imply that the external events PDSs will, in general, have a higher probability of early containment failure, a higher probability of drywell meltthrough, that ultimately the containment will almost certainly fail by some mechanism, and that core damage arrest will not be likely. The external events PDSs are mainly similar to short term station blackout sequences with no recovery of AC power and can have compounding events, such as LOCAs.

Removing the possibility of drywell meltthrough will decrease the probability of early containment failure but not as much as would seem to be possible from its calculated frequency because of the fact that multiple failure modes are possible and if one does not occur than another will. Also the probability of containment failure at some time in the accident is not much affected since the probability of the late failure modes will increase to compensate for eliminating drywell meltthrough. For internal events, the total containment failure probability decreases from 0.82 to 0.70; for fire events, it decreases from 0.84 to 0.78; and, for seismic events, it does not change from 1.0.

Table 2.5-27
PEACH BOTTOM SEISMIC PDS - CONTAINMENT FAILURE AT OR BEFORE VESSEL BREACH (EARLY) COMPARISON: INITIAL CONTAINMENT FAILURE VS NO INITIAL CONTAINMENT FAILURE

APET QUES	PDS1-CF	PDS1-NCF	PDS2-CF	PDS2-NCF	PDS3-CF	PDS3-NCF
14pre	1.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00	0.0000E+00
17v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
28op	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
59v	0.0000E+00	7.9200E-01	0.0000E+00	9.9000E-02	0.0000E+00	9.9000E-02
61op	0.0000E+00	1.6300E-01	0.0000E+00	7.3350E-01	0.0000E+00	7.3350E-01
83a	9.9610E-03	9.9610E-03	9.9610E-03	9.9610E-03	9.9610E-03	9.9610E-03
98ped	3.0900E-02	3.0900E-02	3.0900E-02	3.0900E-02	3.0900E-02	3.0900E-02
101op	3.2570E-02	1.1430E-01	3.2570E-02	4.8490E-01	3.2570E-02	4.8490E-01
103dwmth	5.2250E-01	5.2250E-01	5.2250E-01	5.2250E-01	5.2250E-01	5.2250E-01
ECF-SUM	1.5959E+00	1.6326E+00	1.5959E+00	1.8808E+00	1.5959E+00	1.8808E+00
ECF-EVNTRE	1.0000E+00	9.9131E-01	1.0000E+00	9.6333E-01	1.0000E+00	9.6333E-01
124v	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
127pedop	5.3500E-02	5.7300E-02	5.3500E-02	4.9900E-02	5.3500E-02	1.9400E-02
128optemp	0.0000E+00	9.0870E-02	0.0000E+00	7.2170E-02	0.0000E+00	7.2170E-02
130op	0.0000E+00	7.9470E-03	0.0000E+00	3.3530E-02	7.4110E-02	3.3530E-02
TCF-SUM	1.6494E+00	1.7888E+00	1.6494E+00	2.0364E+00	1.7235E+00	2.0059E+00
TCF-EVNTRE	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

There is some overlap among the failure modes since some modes can occur even if some other modes have already occurred.

14pre = seismic event fails containment initially, 17v = venting before core damage, 28op = overpressure failure before core damage, 59v = venting during core damage, 61op = overpressure failure during core damage, 83a = alpha mode failure, 98ped = pedestal failure after VB induces DW failure, 101op = overpressure failure at VB, 103 dwmth = drywell shell meltthrough, 124v = late venting, 127pedop = late pedestal failure from CCI induces failure, 128optemp = late overpressure failure with DW at high temperatures, 130op = late overpressure failure.

ECF-SUM = sum of probabilities for early CF, ECF-EVNTRE = final realized probability taking into account multiple failures for early CF.

TCF-SUM = sum of all failure probabilities for early and late CF, TCF-EVNTRE = final realized probability taking into account multiple failures for the total CF probability.

Table 2.5-28
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 1 - FSB RPV, No Initial Containment Failure

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACB	1.9699E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
2	AABDGBAACB	1.1353E-01	HIZROX	LOP-nLPI	LOEXSE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
3	AABEFBAACB	7.4456E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
4	ABBDFBAACB	6.5266E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
5	ABBDGBAACB	6.4855E-02	LOZROX	LOP-nLPI	LOEXSE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
6	ABBEFBAACB	6.1189E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
7	AABDEBAACB	4.9506E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
8	AABEGBAACB	4.7395E-02	HIZROX	LOP-nLPI	nDCH-SE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
9	AABDFBAACA	2.8972E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
10	ABBEGBAACB	2.8212E-02	LOZROX	LOP-nLPI	nDCH-SE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
11	ABBDEBAACB	2.6522E-02	LOZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
12	AABEEBAACB	2.2266E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
13	ABBCFBAACB	2.1083E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
14	ABBEEBAACB	1.4030E-02	LOZROX	LOP-nLPI	nDCH-SE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
15	ABBDFBAACA	1.3703E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.
** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-29
Results of the Accident Progression Analysis for Peach Bottom
Seismic Initiators - PDS 2 - FSB LLOCA, No Initial Containment Failure

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACA	1.1823E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
2	AABDFBAACB	9.2454E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
3	AABDHBAACA	5.8788E-02	HIZROX	LOP-nLPI	LOEXSE	WWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
4	AABEFBAACA	5.5098E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
5	ABBDFBAACA	4.8710E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
6	AABDEBAACA	4.6181E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
7	ABBEFBAACA	4.5021E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
8	AABDCBAACA	2.9234E-02	HIZROX	LOP-nLPI	LOEXSE	WWL	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
9	AABEFBAACB	2.7403E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
10	ABBDFBAACB	2.4271E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
11	ABBEFBAACB	2.4213E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
12	ABBCFBAACA	2.3048E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
13	AABDEBAACB	2.2909E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
14	ABBDABAACB	2.2192E-02	LOZROX	LOP-nLPI	LOEXSE	DWHL	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
15	AABEHBAACA	2.1602E-02	HIZROX	LOP-nLPI	nDCH-SE	WWR	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

Table 2.5-30
Results of the Accident Progression Analysis for Peach Bottom Seismic Initiators - PDS 3 - FSB LLOCA, No Initial Containment Failure

Fifteen Most Probable Bins*

Order	Bin	Prob.**	ZROXID	VB	DCH-SE	CFM	CFT	DWS	MCCI	SPBY	RBBY
1	AABDFBAACB	1.9699E-01	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
2	AABDGBAACB	1.1353E-01	HIZROX	LOP-nLPI	LOEXSE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
3	AABEFBAACB	7.4456E-02	HIZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
4	ABBDFBAACB	6.5266E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
5	ABBDGBAACB	6.4855E-02	LOZROX	LOP-nLPI	LOEXSE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
6	ABBEFBAACB	6.1189E-02	LOZROX	LOP-nLPI	nDCH-SE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
7	AABDEBAACB	4.9506E-02	HIZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
8	AABEGBAACB	4.7395E-02	HIZROX	LOP-nLPI	nDCH-SE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
9	AABDFBAACA	2.8972E-02	HIZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY
10	ABBEGBAACB	2.8212E-02	LOZROX	LOP-nLPI	nDCH-SE	WWVENT	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
11	ABBDEBAACB	2.6522E-02	LOZROX	LOP-nLPI	LOEXSE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
12	AABEEBAACB	2.2266E-02	HIZROX	LOP-nLPI	nDCH-SE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
13	ABBCFBAACB	2.1083E-02	LOZROX	LOP-nLPI	HIEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
14	ABBEEBAACB	1.4030E-02	LOZROX	LOP-nLPI	nDCH-SE	DWR	ICF	NO-Spr	DRYCCI	COMPBY	RBLGBY
15	ABBDFBAACA	1.3703E-02	LOZROX	LOP-nLPI	LOEXSE	DWMTH	ICF	NO-Spr	DRYCCI	COMPBY	RBSMBY

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* A listing of all bins, and a listing by observation are available on computer media.

** Mean Probability conditional on the occurrence of the PDS.

2.7 References

1. A. M. Kolaczkowski, W. R. Cramond, T. T. Sype, K. J. Maloney, T. A. Wheeler, and S. L. Daniel," Analysis of Core Damage Frequency: Peach Bottom, Unit 2, Internal Events," NUREG/CR-4550, Vol. 4, Rev. 1, Part 1, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, August 1989.

   J. A. Lambright, M. P. Bohn, S. L. Daniel, J. J. Johnson, M. K. Ravindra, P. O. Hashimoto, M. J. Mraz, W. H. Tong, and D. A. Brosseau, "Analysis of Core Damage Frequency from Internal Events: Peach Bottom, Unit 2, External Events," NUREG/CR-4550, Vol. 4, Part 3, Rev. 1, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, December 1990.

2. D. M. Ericson Jr, T. A. Wheeler, T. T. Sype, M. T. Drouin, W. R. Cramond, A. L. Camp, K. J. Maloney, and F. T. Harper,"Analysis of Core Damage Frequency: Internal Events Methodology," NUREG/CR-4550, Vol. 1, SAND86-2084, Sandia National Laboratories, Albuquerque, NM, January 1990.

3. RADIOLOGICAL SOURCE TERM ANALYSIS

The source term is the information passed to the next analysis so that the offsite consequences can be calculated for each group of accident progression bins. The source term for a given bin consists of the release fractions for the nine radionuclide groups for the early release and for the late release, and additional information about the timing of the releases, the energy associated with the releases, and the height of the releases.

Source term analysis is performed by a relatively small computer code: PBSOR. The aim of this code is not to calculate the behavior of the fission products from their chemical and physical properties and the flow and temperature conditions in the reactor and the containment. Instead, the purpose is to represent the results of the more detailed codes that do consider these quantities.

A more complete discussion of the source term analysis, and of PBSOR in particular, may be found in NUREG/CR-5360.* The methods on which PBSOR is based are presented in Volume 1 of this report on Methodology and the source term issues considered by the expert panels are described more fully in Volume 2, Part 4 of this report on Source Term Issues.

Section 3.1 summarizes the features of the Peach Bottom plant that are important to the magnitude of the radionuclide release. Section 3.2 presents a brief overview of the PBSOR code, and Section 3.3 presents the results of the source term analysis for the various initiators. Section 3.4 discusses the partitioning of the thousands of source terms into groups for the consequence analysis. Section 3.5 concludes this chapter with a summary of the insights gained from the source term analysis.

3.1 Peach Bottom Features Important to the Source Term Analysis

Peach Bottom Unit 2 is a boiling water reactor (BWR-4) that is housed in a Mark I containment. The containment is a steel shell with two parts: a light-bulb shaped drywell and a torus shaped wetwell. The RPV is located inside the drywell. The drywell volume communicates to the wetwell volume through vent lines which go to a header in the wetwell and then to downcomers that open under the surface of the suppression pool in the torus.

The primary barrier between the radionuclides released from the core and the outside environment is the containment structure. The containment structure has a design pressure of 56 psig and an assessed mean failure

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* H.-N. Jow, W. B. Murfin, and J. D. Johnson,"XSOR Codes Users Manual," NUREG/CR-5360, SAND89-0943, Sandia National Laboratories, Albuquerque, NM, to be published.

pressure of 150 psig. Because of this relatively high failure pressure (relative to the loads that are imposed on it during the course of the accident), it was determined during the accident progression analysis that the containment is not likely to fail by overpressure for short term accidents that progress to core damage. For long term accidents, the overpressure failure, of course, becomes more likely as the time to vessel breach increases because the containment pressure continues to increase from the decay heat load. However, the containment does fail at vessel breach in many of the accident progressions analyzed. This is due to other modes of failure such as: drywell meltthrough, reactor pedestal failure inducing drywell failure, and venting. Hydrogen burns are not likely at Peach Bottom because the containment is inerted using nitrogen during operations.

Although the results of this study indicate that the containment is likely to fail, there are a number of plant characteristics that help to reduce the amount of radionuclides that can potentially be released to the environment. Because of the suppression pool's ability to effectively trap radionuclides, it provides the potential for substantial mitigation of the source terms in accidents. In addition to the suppression pool, another feature that can potentially reduce the source term is the use of the containment spray system. The Peach Bottom reactor cavity does not have the ability to form a deep pool which could scrub radionuclide releases as in some other designs (the downcomers to the wetwell are about 34 in. off the floor of the drywell).

There are two pathways by which radionuclides enter the suppression pool. The first pathway is through the SRV tail pipes. Because most of the dominant contributors to the core damage frequency in all three of the analyses were transient initiated events, the in-vessel releases exit the vessel via the steam lines, pass through the SRV tail pipes, and are then discharged into the suppression pool through the T-quenchers at the end of the tail pipes. For the in-vessel releases to bypass the suppression pool, an SRV tail pipe vacuum breaker must stick open during core damage <u>and</u> the drywell must be failed. If the drywell is not failed, the releases will enter the drywell volume and then will be directed to the suppression pool via the vents to the wetwell. These vents are the second pathway for radionuclides to enter the suppression pool. If the drywell is intact, the ex-vessel releases (or in-vessel releases for those PDSs which involve LOCAs) will also enter the suppression pool via this pathway. The first pathway is more effective than the second pathway at trapping radionuclides. However, the second pathway still offers a significant mechanism for mitigating the source term.

The containment sprays can also be effective at reducing the amount of airborne radionuclides. The unavailability of the sprays early in the accident is not particularly important because as mentioned previously, the majority of the in-vessel releases pass through the suppression pool. In the dominant internal event PDSs, it is likely that the AC power can be recovered or is always available so that sprays will be on after vessel breach and, therefore, any release from CCI will be scrubbed. The decontamination factor (DF) associated with the sprays is roughly the same as the DF associated with the suppression pool when the radionuclides enter through the vents. For one fire PDS (PDS 1) this is also true; but, in most of the fire and all the seismic event PDSs, no sprays are available.

The Peach Bottom reactor cavity is roughly a right cylindrical volume that is located directly below the RPV. While this volume is large enough to contain the core debris that is released from the RPV should vessel breach occur, the cavity floor is level with the drywell floor and a doorway is present that will allow the core debris to flow out of the cavity and spread across the drywell floor. (Also, energetic events such as DCH and ex-vessel steam explosions can disperse core debris outside the cavity.) Thus, the core debris generally exits the reactor cavity and can come in contact with the drywell shell wall where it penetrates the floor. Any water on the drywell floor will be displaced by the core debris and exit through the vents to the wetwell. If there is no continuous source of water, the covering layer remaining will soon be boiled off. The possibility exists, therefore, that the hot debris may contact the drywell shell wall and cause failure of the shell. This is called drywell meltthrough. Because of the controversy involving the likelihood of this event under various conditions in the drywell and various possibilities of the state of the core debris when it exits the vessel, an expert panel was assembled to evaluate the probability of drywell meltthrough for the various cases. During long-term PDSs leaking equipment (e.g., recirculation pumps) can also be an important source of water.

The presence of continuous supplies of water in the cavity and drywell is important for four reasons. First, if there is a large amount of water present, it is possible that the core debris that is released from the vessel will be cooled and, therefore, CCI will not be initiated. Second, if CCI is initiated following vessel breach and the drywell contains water, the pool above the core debris will scrub the CCI releases. Third, the probability of drywell meltthrough is substantially reduced , according to the experts, if a continuous source of water is available to cool the debris and, fourth, ex-vessel steam explosions at vessel breach are possible if the cavity contains water. An ex-vessel steam explosion will increase the amount of airborne radionuclides in the drywell. The first three effects of the presence of water mitigate the source term. The last effect increases the radionuclide release. Thus, the presence of water can be both beneficial and detrimental.

3.2 Description of the PBSOR Code

This section describes the manner in which the source term is computed for each accident progression bin (APB). The source term is more than the fission product release fractions for each radionuclide class; it also contains information about the timing of the release, the height of the release, and the energy associated with the release. The next subsection presents a brief overview of the parametric model used to calculate the source terms. Section 3.2.2 discusses the model in some detail; a complete discussion of PBSOR may be found in Reference 1. Section 3.2.3 presents the parameters sampled in the source term portion of this analysis.

3.2.1 Overview of the Parametric Model

PBSOR is a fast-running, parametric computer code used to calculate the source terms for each APB for each observation for Peach Bottom. As there are typically a few thousand bins for each observation, and 200 observations in the sample, the need for a source calculation method that requires a minimum of computer time for one evaluation is obvious. PBSOR is <u>not</u> designed to calculate the behavior of the fission products from their basic chemical and physical properties and the flow and temperature conditions in the reactor and the containment. The purpose of PBSOR is to provide a framework for integrating the results of the more detailed codes that do consider these quantities. Since many of the parameters PBSOR utilizes to calculate the release fractions were determined by a panel of experts, the results of the detailed codes enter PBSOR "filtered" through the experts.

The 60 radionuclides (also referred to as isotopes, or fission products) considered in the consequence calculation are not dealt with individually in the source term calculation. Some different elements behave similarly enough both chemically and physically in the release path that they can be considered together. The sixty isotopes are placed in nine radionuclide classes as shown in Table 3.2-1. It is these nine classes which are treated individually in the source term analysis.

3.2.2 Description of PBSOR

Since the consequences will generally depend on the timing of containment failure, PBSOR considers three time regimes in which the containment can fail: before vessel breach, at or near the time of VB, and late in the accident. Furthermore, PBSOR considers two releases from the containment. The first release occurs roughly at the time of containment failure (assuming the containment fails after core damage). The second release begins after the first release has finished (unless CCI initiation is delayed in which case the second release is also delayed). When the containment fails before VB, the first release is due to fission products that escape from the fuel while the core is still in the RPV (i.e., in-vessel releases). For this case, the second release includes fission products that are released at the time of vessel breach and after vessel breach. Releases after vessel breach include fission products from CCI releases, material revolatilized from the RPV after vessel breach and iodine released from the suppression pool (and in some cases the RPV cavity water). These releases will be referred to as the late releases. When the containment fails around the time of vessel breach the first release includes in-vessel releases as well as fission products that are released at the time of vessel breach. The second release is due to the late releases. For situations where the containment fails many hours after

Table 3.2-1
Isotopes in Each Radionuclide Release Class

Release Class	Isotopes Included
1. Inert Gases	Kr-85, Kr-85M, Kr-87, Kr-88, Xe-133, Xe-135
2. Iodine	I-131, I-132, I-133, I-134, I-135
3. Cesium	Rb-86, Cs-134, Cs-136, Cs-137
4. Tellurium	Sb-127, Sb-129, Te-127, Te-127M, Te-129, Te-129M, Te-131M, Te-132
5. Strontium	Sr-89, Sr-90, Sr-91, Sr-92
6. Ruthenium	Co-58, Co-60, Mo-99, Tc-99M, Ru-103, Ru-105, Ru-106, Rh-105
7. Lanthanum	Y-90, Y-91, Y-92, Y-93, Zr-95, Zr-97, Nb-95, La-140, La-141, La-142, Pr-143, Nd-147, Am-241, Cm-242, Cm-244
8. Cerium	Ce-141, Ce-143, Ce-144, Np-239, Pu-238, Pu-239, Pu-240, Pu-241
9. Barium	Ba-139, Ba-140

vessel breach, both releases consist of in-vessel releases, fission products released at vessel breach, and the late releases. The timing and duration of these releases depend primarily on the PDS and the time and mode of containment failure.

For radionuclide class i, the basic parametric equation for PBSOR has the following form:

$$
\begin{aligned}
ST_i = {} & FCOR_i * FVES_i * (RELF1 + RELF2) * FCONV_i \ / \ RBDF_i) \\
& + FCONC_i * VBPUF_i * RELF3 \ / \ RBDF_i \\
& + (1.0 - FCOR_i - VBPUF_i) * FLV * FHPE * FDCH_i * RELF3 * FCONC_i \ / \\
& \quad RBDF_i) \\
& + (1.0 - FCOR_i - VBPUF_i) * FLV * EVSE * FEVSE_i * RELF3 * FCONC_i \ / \\
& \quad RBDF_i \\
& + (1.0 - FCOR_i - VBPUF_i) * FLV * XCCI * FCCI_i * RELF4 * FCONC_i \ / \\
& \quad RBDF_i \\
& + FCOR_i * (1 - FVES_i) * FREVO_i * RELF3 * FCONC_i \ / \ RBDF_i \\
& \quad (i = 2,\ 3,\ \text{or } 4 \text{ only}) \\
& + [FLTI1 * POOLI + FLTI2 * CAVWI * RELF5] * RELF6. \\
& \quad (i = 2 \text{ only})
\end{aligned}
\qquad (3.1)
$$

where:

$$
\begin{aligned}
RELF1 &= FPLBY/MAX(DFCPA_i,\ DFSPRV_i) && \text{if ECF \& WWF or not ECF} \\
&= FPLBY/DFSPRV_i && \text{if ECF \& not WWF} \\[1ex]
RELF2 &= (1-FPLBY)/DFVPA_i && \text{if ECF \& WWF} \\
&= (1-FPLBY)/MAX(DFSPRV_i,\ DFVPA_i) && \text{if ECF \& not WWF or not ECF} \\[1ex]
RELF3 &= 1/MAX(DFCPA_i,\ DFSPRC_i) && \text{if ECF \& WWF or Late CF} \\
&= 1/DFSPRC_i && \text{if ECF \& DWF} \\[1ex]
RELF4 &= 1/MAX(DFCAV_i,\ DFCPA_i,\ DFSPRC_i) && \text{if WWF} \\
&= 1/MAX(DFCAV_i,\ DFSPRC_i) && \text{if not WWF} \\[1ex]
RELF5 &= 1/DFCPA_2 && \text{if WWF} \\
&= 1 && \text{if not WWF} \\[1ex]
RELF6 &= FCONC_2 && \text{if no CF} \\
&= 1 && \text{if CF} \\[1ex]
XCCI &= 1-FPHE && \text{if FPHE>0} \\
&= 1-EVSE && \text{if EVSE>0} \\
&= 1 && \text{ELSE}
\end{aligned}
$$

The first summation term on the right side of Equation (3.1) represents the in-vessel release. The second term describes the puff release at vessel breach. The third term represents the DCH release. The fourth term represents the ex-vessel steam explosion release and is mutually exclusive with the third term (i.e., the experts said if DCH occurred then EVSE should not be considered separately). The fifth term represents the CCI release. The fourth term is the revolatilization release from the reactor coolant system after vessel breach and is for I, Cs, and Te classes only. The last term represents the late iodine release from the suppression pool and reactor cavity/drywell water after the containment failure. This equation is valid for most APBs, but is not complete; there are additional terms, which apply only in certain situations, that are not shown in this summary for reasons of expediency. For example, Equation 3.1 is modified slightly for APBs that involve a stuck open tail pipe vacuum breaker. In these APBs, some of the in-vessel fission products pass through the tail pipe vacuum breaker and enter the drywell rather than being released directly into the suppression pool. The modified equation includes the term FTLP which is the fraction of flow that passes through the tail pipe vacuum breaker during the in-vessel release phase of the accident. A discussion of these additional terms is included in NUREG/CR-5360.* The FORTRAN listing of PBSOR is contained in Appendix B.

The definition of each the parameter in Equation 3.1 is as follows:

CAVWI = fraction of initial iodine core inventory scrubbed by the cavity water during CCI release.

$DFSPRC_i$ = scrubbing decontamination factor for sprays acting on species i released into containment after vessel breach.

$DFSPRV_i$ = scrubbing decontamination factor for sprays acting on species i released into containment from vessel.

$DFCAV_i$ = scrubbing decontamination factor for aerosol species i released into cavity water during CCI release.

$DFCPA_i$ = scrubbing decontamination factor for aerosol species i flowing from containment to the suppression pool.

$DFVPA_i$ = scrubbing decontamination factor for aerosol species i flowing from the vessel to the suppression pool.

$FCCI_i$ = fraction of material released from the melt during molten CCI.

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* H.-N. Jow, W. B. Murfin, and J. D. Johnson,"XSOR Codes Users Manual," NUREG/CR-5360, SAND89-0943, Sandia National Laboratories, Albuquerque, NM, to be published.

$FCONC_i$ = fraction of species i released from containment for material released into containment by CCI and other releases after vessel breach, not including the effects of scrubbing by pools and sprays.

$FCONV_i$ = fraction of species i released from containment for material released into containment before vessel breach, not including the effects of scrubbing by pools and sprays.

$FCOR_i$ = fraction of initial inventory of species i released from the fuel prior to vessel failure.

$FDCH_i$ = fraction of radionuclide in the portion of the core involved in direct containment heating that is released to the drywell at vessel breach.

FHPE = fraction of core material leaving the vessel that is participating in either the direct containment heating or the steam explosion and therefore not available for molten CCI release later.

FLV = fraction of the core material that leaves the vessel after the vessel breach.

FREVO = fraction of the core material that is deposited on the surfaces of the reactor vessel and structural materials that is revaporized and released in the drywell after VB.

FPLBY = fraction of pool bypass before the vessel breach as a result of either a LOCA or a stuck open SRV tail pipe vacuum breaker.

$FVES_i$ = fraction of material released from the fuel that is released from the vessel.

FLTI1 = fraction of iodine in the suppression pool that is volatilized and released after vessel breach.

FLTI2 = fraction of iodine in the cavity water that is volatilized and released after vessel breach.

POOLI = fraction of initial core inventory for iodine scrubbed by the pool.

$RBDF_i$ = scrubbing decontamination factor for aerosol species i from the reactor building to the environment.

ST_i = fraction of the initial core inventory of species i that is ultimately released to the environment.

$VBPUF_i$ = fraction of initial core inventory of species i that is released to the drywell as puff at the time of vessel breach.

Figure 3.2-1 depicts the parametric equations schematically in terms of a flow diagram. Coming in from the left is all the radioactivity in any radionuclide class. The black arrows represent releases to the environment and the white arrows represent material retained in the RCS or in the containment. This figure is read as follows: the first division of the radioactive material is indicated by FCOR. The top branch, indicated by FCOR, represented the fraction released from the core before VB, and the lower branch, an amount 1-FCOR, represents the amount still in the RCS at VB. The FCOR branch is then split into that which leaves the RCS before or at VB, FVES, and that which is retained in the RCS past VB, 1-FVES. Of the material retained in the RCS at VB, a fraction FLATE is revolatilized later. Of the revolatilized fraction, a portion is removed by engineered removal mechanisms such as sprays, parameter 1/DFL, and a another portion is removed by natural mechanisms such as deposition, parameter FCONRL. The part of the revolatilized fraction that is not removed escapes to the environment as indicated by the top black arrow in Figure 3.2-1. FCONRL is the containment release fraction for the late revolatilization release, and is set equal to the FCONC value for tellurium.

When evaluated as part of the integrated risk analysis, PBSOR is run in the "sampling mode". That is, most of the parameters in the release fraction equations are determined by sampling from distributions for that parameter, and the value for each parameter varies from observation to observation. Many of these distributions were provided by an expert panel.

The equation above contains 21 parameters. Nine of them were considered by the Source Term Expert Panel. An additional eight parameters were quantified either by the expert panel for the previous draft of this report or internally. The values for three of these parameters (i.e., CAVWI, FLV, POOLI) are determined by various combinations of previously defined parameters.

3.2.3 Variables Sampled in the Source Term Analysis

The thirteen parameters that were sampled for the source term analysis are listed in Table 3.2-2. That is, when PBSOR was evaluated for all the bins generated by the APET evaluation for a given observation, all the sampled parameters in PBSOR had values chosen specifically for that observation. These values were selected by the LHS program from distributions that were previously defined. Many of these distributions were determined by the expert panel on source terms. Eight issues were considered by the Source Term Expert Panel:

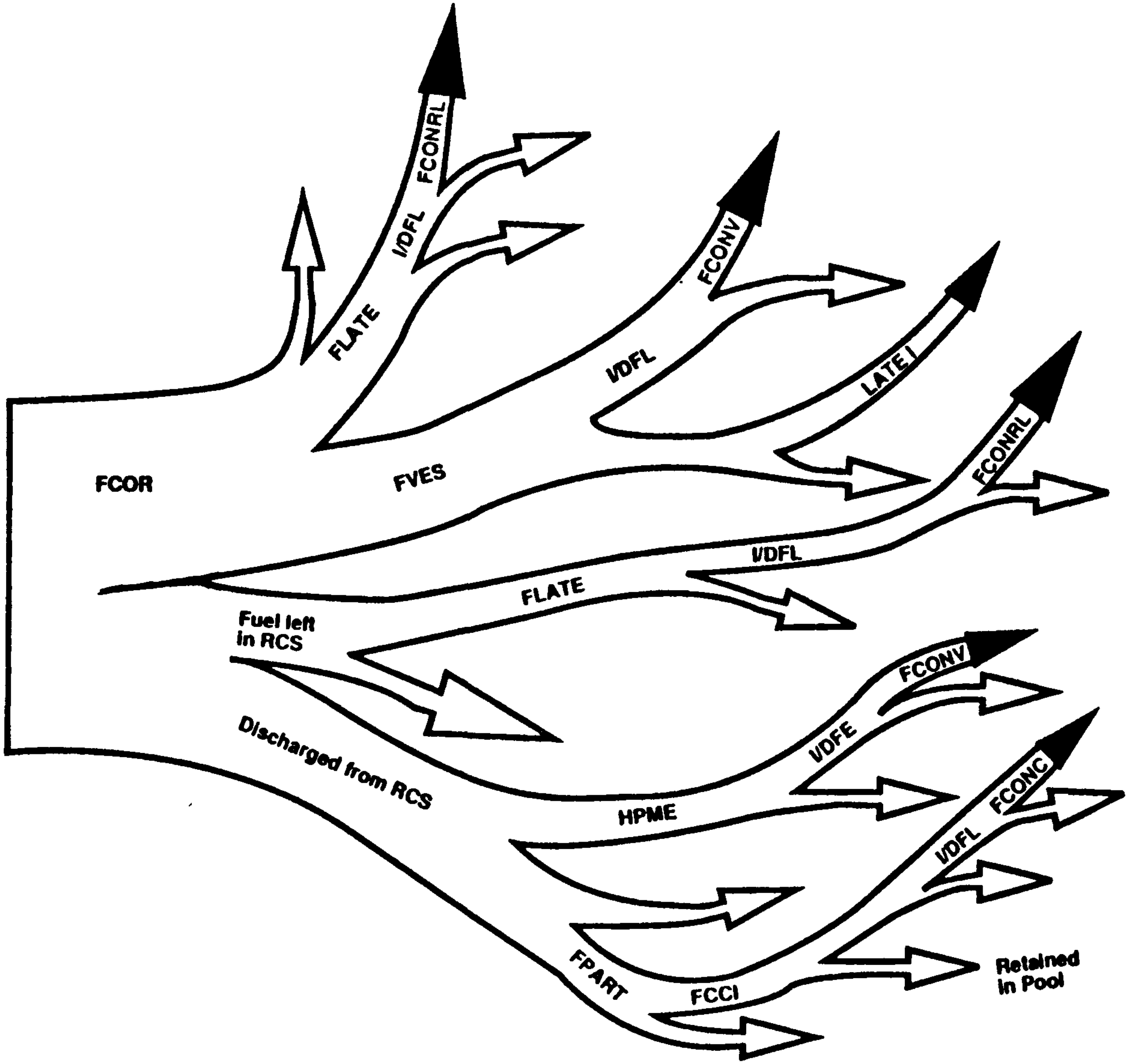

Figure 3.2-1. Blood Flow Diagram for PBSOR.

Table 3.2-2
Variables Sampled in the Source Term Analysis

Variable	LHS #	Description
DFCAV	211	Decontamination factor for aerosols released into the cavity water from the CCI release. This DF is applied when the core debris is not coolable and CCI proceeds under water. There is one case: the reactor cavity is flooded with a continuous supply of water. This issue was not assessed by the Source Term Expert Panel. The distributions for this parameter were modified from the first draft NUREG/CR-4551, Volume 4.[1]
DFPOOL	209	This variable in the LHS sample is used for both DFVPA and DFCPA (i.e., the subvariables are completely correlated). This issue was not assessed by the Source Term Expert Panel. The distributions for these parameters were modified from the first draft NUREG/CR-4551, Volume 3.[2] DFVPA: Decontamination factor for in-vessel releases that are released into the suppression pool. DFCPA: Decontamination factor for aerosol releases flowing from the drywell to the suppression pool.
DFSPRAY	210	This variable in the LHS sample is used for both DFSPRV and DFSPRC (i.e., the subvariables are completely correlated). This issue was not assessed by the Source Term Expert Panel. The distributions for these parameters were modified from the first draft NUREG/CR-4551, Volume 1.[3] DFSPRV: Decontamination factor for sprays acting on fission product groups released into the containment from the vessel. DFSPRC: Decontamination factor for sprays acting on fission product groups released into the containment after vessel breach.
FCCI	203	Fraction of each fission product group in the core material at the start of CCIs that is released to the drywell. There are four cases: low zirconium oxidation in the core and no overlaying water, low zirconium oxidation in the core with overlaying water, high zirconium oxidation in the core and no overlaying water, and high zirconium oxidation in the core with overlaying water. This parameter was assessed by the Source Term Expert Panel.

Table 3.2-2 (Continued)
Variables Sampled in the Source Term Analysis

Variable	LHS #	Description
FCONC	205	Fraction of each fission product group released from the containment for CCI and other releases after vessel breach, not including the effects of scrubbing by pools and sprays. There are seven cases: early containment leakage and a subcooled suppression pool, early containment leakage and a saturated suppression pool, early containment rupture and a subcooled suppression pool, early containment rupture and a saturated suppression pool, late containment leak, late containment rupture, and no containment failure. This parameter was assessed by the Source Term Expert Panel.
FCONV	204	Fraction of each fission product group released from containment for material released into containment before vessel breach, not including the effects of scrubbing by pools and sprays. There are seven cases: early containment leakage and a subcooled suppression pool, early containment leakage and a saturated suppression pool, early containment rupture and a subcooled suppression pool, early containment rupture and a saturated suppression pool, late containment leak, late containment rupture, and no containment failure. This parameter was assessed by the Source Term Expert Panel.
FCOR	200	Fraction of each fission product group released from the core to the vessel before vessel breach. There are two cases: high and low zirconium oxidation. This parameter was assessed by the Source Term Expert Panel.
FDCH	208	Fraction of each fission product group in the core material that participates in a direct containment heating event (DCH) that is released to the drywell. Given the occurrence of DCH, there is only one case. This parameter was assessed by the Source Term Expert Panel.
FEVSE	212	Fraction of each fission product group in the core material that participates in an ex-vessel steam explosion that is released to the drywell. Given the occurrence of an ex-vessel steam explosion, there is only one case. This parameter was not assessed by the Source Term Expert Panel. It is assumed that the release fractions for the ex-vessel steam explosion phenomena are sufficiently similar to the release fractions associated with DCH that the DCH distributions are also used to quantify this parameter.

Table 3.2-2 (Concluded)
Variables Sampled in the Source Term Analysis

Variable	LHS #	Description
FLTI	206	This variable in the LHS sample is used for both FLTI1 and FLTI2 (i.e., the subvariables are completely correlated). These parameters were assessed by the Source Term Expert Panel. FLTI1: Fraction of iodine in the suppression pool that is volatilized and released after vessel breach. There are two cases: the suppression pool is subcooled and the suppression pool is saturated. FLTI2: Fraction of iodine in the cavity water that is volatilized and released after vessel breach. There are two cases: the reactor cavity is flooded with a continuous supply of water and the reactor cavity is dry.
FREVO	202	Fraction of the deposited amount of each fission product group in the RPV which revolatilized after VB and released to the drywell. There are three cases: no water injection after vessel breach and a high drywell temperature, no water injection after vessel breach and low drywell temperature, and water injection to the vessel after vessel breach. This parameter was assessed by the Source Term Expert Panel.
FVES	201	Fraction of each fission product group released from the core which is released from the vessel. There are three cases: short-term SBO with the RPV at system pressure, short-term SBO with the RPV at low pressure, and ATWS with the RPV at system pressure. This parameter was assessed by the Source Term Expert Panel.
RBDF	207	Decontamination factor for aerosol releases flowing from the reactor building to the environment. There are six cases: drywell rupture and a subcooled suppression pool, drywell rupture and a saturated suppression pool, drywell meltthrough and a subcooled suppression pool, drywell meltthrough and a saturated suppression pool, drywell head leak and a subcooled suppression pool, and drywell head leak and a saturated suppression pool.

1. FCOR and FVES
2. Ice Condenser DF (not applicable to Peach Bottom)
3. Late Releases from the RPV
4. FCCI
5. FCONV and FCONC
6. Late Iodine
7. Reactor Building DF
8. DCH Releases

One of these issues was not applicable to Peach Bottom. For each issue considered by the expert panel, the result is an aggregate distribution for the nine radionuclide release classes defined in Table 3.2-1. These distributions are not necessarily discrete. While the experts provided separate distributions for all nine classes for FCOR, for other parameters, for example, they stated that classes 5 through 9 should be considered together as an aerosol class.

The sampling process works somewhat differently for the source term analysis than it does for the accident progression analysis. In the source term analysis, LHS was used only to determine a random number between 0.0 and 1.0 for each parameter to be sampled. The actual distributions are contained in a data file (listed in Appendix B) that is read by PBSOR before execution.

The variable identifiers given in Table 3.2-2 are used in several ways in the source term analysis. Consider the first variable in Table 3.2-2: FCOR. FCOR in the equation for fission product release is the actual fraction of each fission product group released from the core to the vessel before vessel breach for the observation in question. But, FCOR is also used to refer to the experts' aggregate distributions from which the nine values (one for each radionuclide class or fission product group) for FCOR are chosen. Further, in the sampling process, FCOR is used to refer to the random number from the Latin Hypercube Sampling which is used to select the values from these distributions. That is, as used in sampling, FCOR defines a quantile in these distributions. The release fractions associated with this quantile are used in PBSOR as the FCOR values. Thus, in Table 3.2-2, the end use of each variable is given although the actual sampled variable is a random number between 0.0 and 1.0 used to select an actual value from the distribution.

The variables selected by LHS are used to define quantiles in the parameter distributions; the values associated with these quantiles are used as parameter values in PBSOR. In use, the process works like this. Say LHS selects a value of 0.05 for FCOR for Observation 1. Referring to the data tables in Appendix B.2, it may be seen that, for low Zr oxidation in-vessel, the 0.05 quantile values for FCOR are 0.084 for inert gases, 0.0092 for I, 0.009 for Cs, etc. There is no correlation between any of the source term variables, but complete correlation within a variable. FCOR is not correlated with FVES, FCONV, or any other variable, but the values for the different cases and for the different radionuclide classes are completely correlated. That is, if the 0.05 quantile value is chosen for I for low zirconium oxidation, the 0.05 quantile value is also chosen for all the other radionuclide classes and for all values for high zirconium oxidation.

As all the source term variables are uniformly distributed from 0.0 to 1.0, and are uncorrelated, there are no columns for this information in Table 3.2-2 as there are in Table 2.3-2. There is a separate distribution for each radionuclide class for each variable in this table unless otherwise noted in the variable description. The different cases for each variable are noted in the description. Not all the cases considered by PBSOR are listed in Table 3.2-2; parameter values for other cases are determined internally in PBSOR, often from the values for the cases listed. For example, there is no distribution for FVES for long-term SBOs. The value of FVES for the long-term SBOs were derived from the distributions for other cases.

For each parameter that was assessed by the Source Term Expert Panel, the distribution for the parameter, the reasoning that led each expert to his conclusions, and the aggregation of the individual distributions are fully described in Volume 2, Part 4 of this report on Source Term Issues. The distributions for the remaining parameters are presented in Appendix B. A discussion of these parameters may be found in NUREG/CR-5360.*

3.3 Results of Source Term Analysis

This section presents the results of computing the source terms for the APBs produced by evaluating the APET. The APET's evaluation produced a large number of APBs, so, as in Section 2.5, only a sample of the more likely and more important APBs are discussed here. However, source terms were computed for all the APBs for each of the 200 observations in the sample. The source term is composed of release fractions for the nine radionuclide groups for a first and a second release as well as release timing, release height, and release energy. As discussed above, the source terms are computed by a fast-running parametric computer code, PBSOR.

Section 3.3.1 presents the results for the internal initiators. The tables in this section present only a very small portion of the output obtained by computing source terms for each APB. More detailed results are contained in Appendix B, and complete listings are available on computer media by request. Section 3.3.2 presents the results for fire initiators. Section 3.3.3 presents the results for the seismic initiators.

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* H.-N. Jow, W. B. Murfin, and J. D. Johnson,"XSOR Codes Users Manual," NUREG/CR-5360, SAND89-0943, Sandia National Laboratories, Albuquerque, NM, to be published.

3.3.1 Results for Internal Initiators

In a manner analogous to Section 2.5.1, the results of the source term analysis for internal initiators are presented for each PDS group. The tables in this section only provide a sample of APBs and their associated mean source terms for the various PDSs.

3.3.1.1 Results for PDS 1: LOCA

As discussed in Section 2.5.1.1, this PDS represents two scenarios: 1) a large LOCA followed by immediate failure of all injection, and 2) a medium LOCA with initial HPCI success but almost immediate failure as the vessel depressurizes below HPCI working pressure, all other injection has failed. Early core damage results with the vessel at low pressure. CRD and containment heat removal are working. Venting is available. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.39. The probability of averting vessel breach is 0.00.

Table 2.5-1 lists the ten most probable APBs for PDS 1, since they all also have VB, and the five most probable APBs that have VB and early CF. Table 3.3-1 lists the mean source terms for these same APBs. Although the same bins are shown in both tables, and the structures of both tables are roughly analogous, there are some important differences in the nature of the material presented. In Table 2.5-1, the bin itself was well defined, i.e., the characteristics of the bin did not vary from observation-to-observation. The only item in the table that varied from observation-to-observation was the probability of the occurrence of the bin itself. Thus, Table 2.5-1 lists a conditional probability averaged over the 200 observations in the sample. In Table 3.3-1, the bin is still well defined, but, as many of the parameters that are utilized in calculating the fission product release vary from observation-to-observation, the source term for a specific bin varies with the observation. Thus, the entries in all columns in Table 3.3-1 except the Order and Bin columns represent averages over the 200 observations in the sample.

For example, consider the first APB in Table 3.3-1: AADDICDBCA. Of the 200 observations in the sample, 75 had non-zero conditional probabilities for this bin. As source terms are not computed for zero-probability bins, there are 75 source terms associated with APB AADDICDBCA. These 75 source terms were summed and then divided by 75 to produce the mean source term given in the first two lines of Table 3.3-1.

The most probable APB, AADDICDBCA, involves accidents that proceed to VB. Once VB occurs the core debris is released into the reactor cavity and CCI takes place with a continuous supply of water being added by the containment spray system. For this APB, the containment never fails since containment heat removal is working and drywell meltthrough and pedestal failure do not occur. The release fractions for this bin are, therefore, very small.

Table 3.3-1
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 1 - LOCA

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Ten Most Probable Bins*															
1	AADDICDBCA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.4E-08	5.9E-09	4.1E-09	2.7E-10	2.4E-10	5.1E-10	3.4E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.4E-08	5.9E-09	4.1E-09	2.7E-10	2.4E-10	5.1E-10	3.4E-09
2	ABDDICDBCA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	9.5E-09	4.4E-09	3.9E-09	1.6E-10	2.7E-10	5.9E-10	3.4E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	9.5E-09	4.4E-09	3.9E-09	1.6E-10	2.7E-10	5.9E-10	3.4E-09
3	AABDFBBACA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.9E-01	5.1E-03	4.2E-03	2.1E-03	8.9E-04	2.5E-04	8.8E-05	5.2E-04	9.2E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	6.5E-02	6.2E-02	2.8E-02	3.1E-02	9.7E-05	2.2E-03	4.3E-03	2.2E-02
4	AADDICDCCA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.0E-03	1.5E-05	5.5E-09	2.7E-09	5.2E-10	2.3E-10	5.6E-11	1.6E-10	5.7E-10
				4.8E+04	3.1E+04	2.2E+04	2.0E-03	1.5E-05	5.5E-09	2.7E-09	5.2E-10	2.3E-10	5.6E-11	1.6E-10	5.7E-10
5	AADDFBDBCA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.8E-01	4.4E-03	3.4E-03	1.8E-03	7.9E-04	2.1E-04	7.4E-05	4.6E-04	8.2E-04
				7.2E+04	1.3E+04	1.4E+04	2.2E-01	1.2E-01	5.5E-03	1.8E-03	2.0E-03	1.4E-06	1.2E-04	2.2E-04	1.6E-03
6	ABBDFBBACA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.6E-01	1.3E-02	1.2E-02	5.1E-03	2.1E-03	6.2E-04	2.2E-04	7.9E-04	2.1E-03
				3.7E+05	1.3E+04	1.4E+04	3.4E-01	1.5E-01	1.5E-01	5.7E-02	3.1E-02	2.9E-05	1.6E-03	2.5E-03	2.0E-02
7	AADEICDBCA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.7E-04	1.4E-08	5.7E-09	4.1E-09	1.6E-10	2.2E-10	4.8E-10	3.4E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.7E-04	1.4E-08	5.7E-09	4.1E-09	1.6E-10	2.2E-10	4.8E-10	3.4E-09
8	ABDDFBDBCA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.9E-01	1.0E-02	8.8E-03	4.2E-03	1.8E-03	3.3E-04	1.5E-04	6.7E-04	1.9E-03
				7.2E+04	1.3E+04	1.4E+04	3.1E-01	2.0E-01	6.6E-03	2.2E-03	2.2E-03	1.5E-06	1.2E-04	2.3E-04	1.8E-03
9	AADDECDBCA	4.0E+03	3.0E+01	1.3E+07	2.2E+04	1.8E+02	9.0E-01	8.6E-02	3.0E-03	2.4E-03	1.7E-03	1.0E-04	1.1E-04	2.3E-04	1.5E-03
				7.2E+04	2.2E+04	1.4E+04	1.0E-01	9.5E-03	3.3E-04	2.6E-04	1.9E-04	1.1E-05	1.2E-05	2.6E-05	1.7E-04
10	ABDDICDCCA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.8E-03	1.7E-05	3.0E-09	1.8E-09	7.3E-10	1.5E-10	4.7E-11	1.6E-10	7.5E-10
				4.8E+04	3.1E+04	2.2E+04	1.8E-03	1.7E-05	3.0E-09	1.8E-09	7.3E-10	1.5E-10	4.7E-11	1.6E-10	7.5E-10
Mean Source Terms for Five Most Probable Bins that have VB and Early CF*															
3	AABDFBBACA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.9E-01	5.1E-03	4.2E-03	2.1E-03	8.9E-04	2.5E-04	8.8E-05	5.2E-04	9.2E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	6.5E-02	6.2E-02	2.8E-02	3.1E-02	9.7E-05	2.2E-03	4.3E-03	2.2E-02
5	AADDFBDBCA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.8E-01	4.4E-03	3.4E-03	1.8E-03	7.9E-04	2.1E-04	7.4E-05	4.6E-04	8.2E-04
				7.2E+04	1.3E+04	1.4E+04	2.2E-01	1.2E-01	5.5E-03	1.8E-03	2.0E-03	1.4E-06	1.2E-04	2.2E-04	1.6E-03
6	ABBDFBBACA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.6E-01	1.3E-02	1.2E-02	5.1E-03	2.1E-03	6.2E-04	2.2E-04	7.9E-04	2.1E-03
				3.7E+05	1.3E+04	1.4E+04	3.4E-01	1.5E-01	1.5E-01	5.7E-02	3.1E-02	2.9E-05	1.6E-03	2.5E-03	2.0E-02
8	ABDDFBDBCA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.9E-01	1.0E-02	8.8E-03	4.2E-03	1.8E-03	3.3E-04	1.5E-04	6.7E-04	1.9E-03
				7.2E+04	1.3E+04	1.4E+04	3.1E-01	2.0E-01	6.6E-03	2.2E-03	2.2E-03	1.5E-06	1.2E-04	2.3E-04	1.8E-03
13	AABEFBBACA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.9E-01	4.7E-03	3.8E-03	2.1E-03	8.9E-04	2.0E-04	7.8E-05	5.7E-04	9.2E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	6.7E-02	6.3E-02	3.0E-02	3.5E-02	1.2E-04	2.6E-03	5.0E-03	2.5E-02

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* A listing of source terms for all bins is available on computer media

For the APBs with containment failure at vessel breach, the most probable bins have failure occurring by drywell meltthrough. This is a large containment failure and the subsequent release is not scrubbed by the suppression pool. The releases, both initial and late, are correspondingly larger than the no containment failure cases with the late release typically larger than the early release for most species.

For APBs that have late containment failure, if containment fails in the rupture mode late in the accident (i.e., the ninth most probable APB, AADDECDBCA), PBSOR groups 90% of the radionuclides that are available to be released from the containment (i.e., those radionuclides that have not been trapped by the water pools or plated out in the vessel or containment) in the first release and the remaining 10% in the second release. When the containment develops a leak late in the accident, PBSOR releases 50% of the radionuclides from the containment in the first release and the remaining 50% in the second release. For this PDS, only bin nine falls into this category, the initial release, at the time of containment failure, is a rupture and is roughly a factor of ten larger than the second release.

For APBs that do not proceed to vessel failure but do result in early containment failure, all of the radionuclides, except iodine, are grouped in the first release. Iodine that is released from the vessel but is not trapped in the suppression pool is contained in the first release. A fraction of the iodine that was trapped by the suppression pool is subsequently revolatilized from the pool and released into the containment. The revolatilized iodine is grouped in the second release. All of the APBs for PDS 1 proceed to VB.

The mean source terms in Table 3.3-1 can be used to compare the releases associated with specific APBs. However, as these mean source terms are typically not calculated over the same sample elements, fine distinctions between source terms associated with different APBs may be lost in the averaging process.

For accident progression bins which have containment venting as the containment failure mode, the release energy assigned to the bin was wrong. The release energy affects how high the releases are lofted in the atmosphere. For accidents in which the containment is vented, the release energy was inadvertently set to zero. Because the plume is not lofted as high as it should have been, the early fatalities may be slightly over estimated for these accidents (sensitivity studies performed for Peach Bottom show that the results for risk are not very sensitive to the release energy until the energy is > about 1MW). The latent cancer fatalities are not particularly sensitive to this parameter and, thus, the affect on this consequence measure is expected to be very minor.

Table 3.3-1 presents mean source terms but does not contain any frequency information. In contrast, Figure 3.3-1 presents information on both source term size and frequency. The frequency of each PDS is presented in section 2.2. Figure 3.3-1 summarizes the release fraction CCDFs for the I, Cs, Sr,

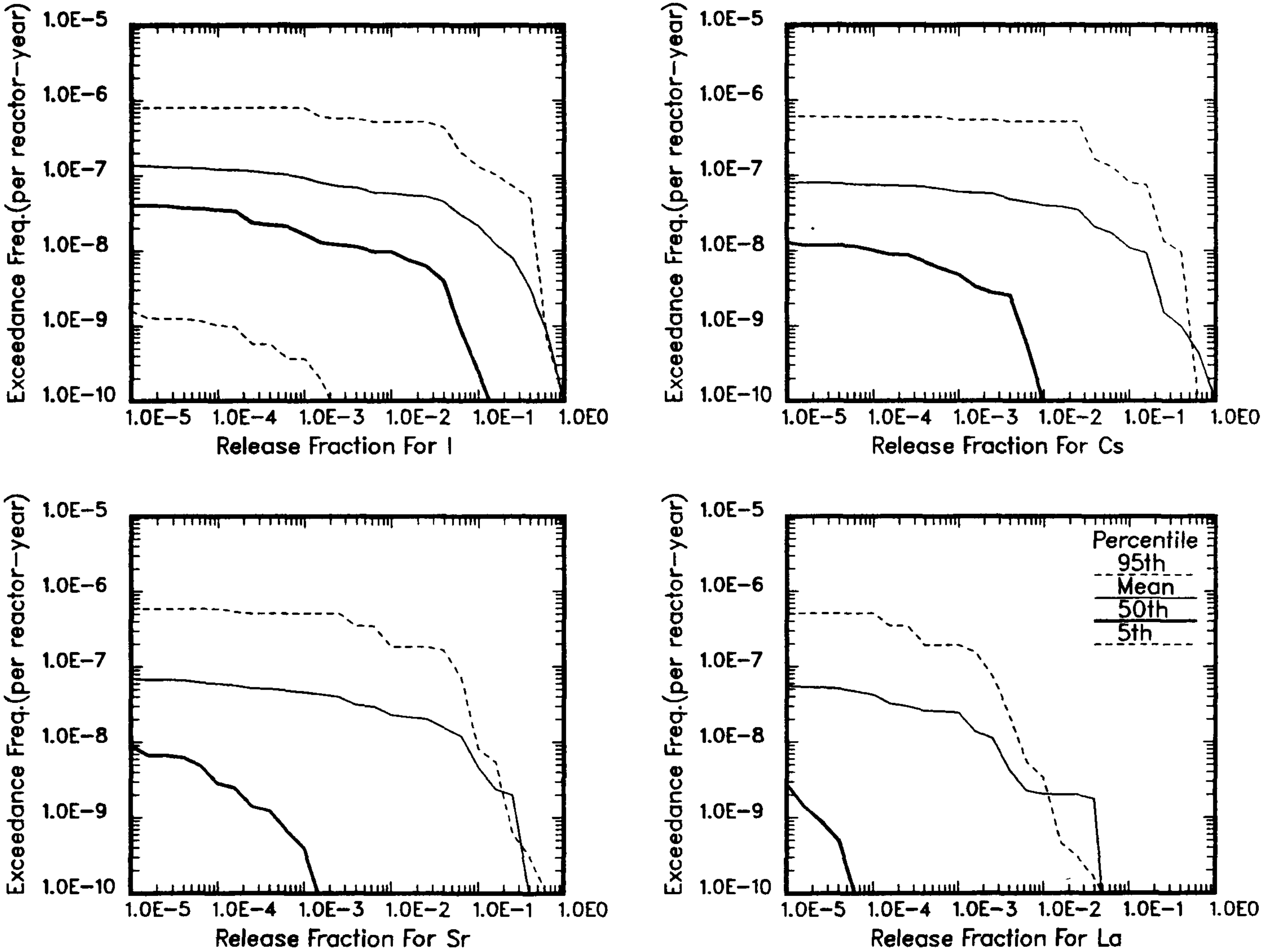

Figure 3.3-1
Peach Bottom: PDS 1 - LOCA
Source Term CCDF

and La radionuclide classes. It indicates the frequency with which different values of the release fraction are exceeded, and displays the uncertainty in that frequency. The curves in Figure 3.3-1 are derived in the following manner: for each observation, evaluation of the APET produced a conditional probability for each APB. When multiplied by the frequency of the PDS for that observation, a frequency for the APB is obtained. Calculation of the source term for the APB gives a total release fraction for each APB. When all the APBs are considered, a curve of exceedance frequency vs. release fraction can be plotted for each observation. Figure 3.3-1 is a summary presentation of these curves for the 200 observations in the sample.

Instead of placing all 200 curves on one figure, only four statistical measures are shown. These measures are generated by analyzing the curves in the vertical direction. For each release fraction on the abscissa, there are 200 values of the exceedance frequency (one for each sample element). From these 200 values it is possible to calculate mean, median (50th quantile), 95th quantile and 5th quantile values. When this is done for each value of the release fraction, the curves in Figure 3.3-1 are obtained. Thus, Figure 3.3-1 provides information on the relationship between the size of the release fractions associated with PDS 1 and the frequency at which these release fractions are exceeded, as well as the variation in that relationship between the observations in the sample.

As an illustration of the information in Figure 3.3-1, the mean frequency (yr^{-1}) at which a release fraction of 1E-05 is exceeded due to PDS 1 is roughly, 1.3E-07, 7.9E-08, 6.8E-08, and 5.4E-08 for the I, Cs, Sr and La release classes, respectively. For a release fraction of 0.1, the corresponding mean exceedance frequencies are 2.2E-08, 1.1E-08, 4.6E-09, and 6.1E-14, respectively. The three quantiles (i.e., the median, 95th and 5th) provide an indication of the spread between observations, which is often large. Typically, a point where the 95th quantile curve begins to drop very rapidly and move below the mean curve. This happens when the mean curve is dominated by a few large observations; this often occurs for large release fractions because only a few of the sample observations have nonzero exceedance frequencies for these large release fractions. Taken as a whole, the results in Figure 3.3-1 indicate that the occurrence of large source terms (e.g., release fractions $\geq$ 0.1) in conjunction with PDS 1 is very infrequent (less than 2E-08 for I, Cs, Sr, and La).

3.3.1.2 Results for PDS 2: Fast Transient

This PDS represents four scenarios involving four different transient initiators followed by two stuck open SRVs (the equivalent of an intermediate LOCA). HPCI works initially but fails when the vessel depressurizes below HPCI working pressure; all other injection has failed and early core damage results with the vessel at low pressure. CRD and containment heat removal are working as in PDS-1 but steam is directed through the SRVs to the suppression pool not to the drywell as in PDS-1. Venting is available. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.39. The probability of averting vessel breach is 0.00.

Table 2.5-2 lists the ten most probable APBs since the top five bins all have VB for this PDS and the five most probable APBs that have VB and the early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.2. Table 3.3-2 lists the mean source terms for these same APBs. For APBs that have containment failure, the source terms for the first release are slightly less than for PDS 1 since the in-vessel releases are scrubbed by the suppression pool.

Figure 3.3-2 summarizes the release fraction CCDFs for PDS 2.

3.3.1.3 Results for PDS 3: Fast Transient

This PDS is similar to PDS-2 except that containment heat removal is not working and CRD may not be working for some subgroups (CRD is assumed to be working since the cut sets where it is not are negligible contributors). HPSW failed due to operator failure and can be recovered during core degradation. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.27. The probability of recovering HPSW and averting VB is 0.25.

Table 2.5-3 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.3. Table 3.3-3 lists the mean source terms for these same APBs. For this PDS, there are no containment sprays; but, injection is recovered in all of the top five APBs (the HPSW system). The source terms for the cases with core damage arrest are lower than source terms for APBs with no containment failure in PDS 2. For those APBs with drywell meltthrough the initial release is about the same as for the wetwell venting case; but, the second release is significantly larger. If we compare the drywell meltthrough cases for PDS 2 and PDS 3, we find (for similar APBs, PDS 2 APB 13 vs PDS 3 APB 12) that the releases are smaller in PDS 2 with sprays than in PDS 3 where injection is restored to the vessel and after vessel breach pours down onto the core debris.

Figure 3.3-3 summarizes the release fraction CCDFs for PDS 3.

3.3.1.4 Results for PDS 4: Fast SBO

This PDS is a short-term station blackout with DC power failed. It consists of two scenarios: one with a stuck open SRV (8.8%) and one without (91.2%). Early core damage results from the immediate loss of all injection. The vessel may or may not be at low pressure depending on the stuck open SRV split. Venting is possible if AC power is restored (manual venting is possible if AC is not restored but considered unlikely). For this PDS, the probability of early containment failure (i.e. before or

Table 3.3-2
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 2 - Fast Transient

Mean Source Terms for Ten Most Probable Bins*

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
1	BADDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.2E-08	4.6E-09	3.9E-09	2.1E-10	2.3E-10	4.7E-10	3.2E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.2E-08	4.6E-09	3.9E-09	2.1E-10	2.3E-10	4.7E-10	3.2E-09
2	BBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	7.8E-09	3.3E-09	3.4E-09	9.2E-11	2.5E-10	4.9E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	7.8E-09	3.3E-09	3.4E-09	9.2E-11	2.5E-10	4.9E-10	2.9E-09
3	BABDFBBAAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.9E-01	3.2E-03	2.9E-03	1.3E-03	4.4E-04	1.5E-04	4.8E-05	2.1E-04	4.7E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	6.5E-02	6.2E-02	2.8E-02	3.1E-02	9.7E-05	2.2E-03	4.3E-03	2.2E-02
4	BADDICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.0E-03	1.6E-05	2.9E-09	1.4E-09	3.0E-10	1.7E-10	4.6E-11	1.3E-10	3.3E-10
				4.8E+04	3.1E+04	2.2E+04	2.0E-03	1.6E-05	2.9E-09	1.4E-09	3.0E-10	1.7E-10	4.6E-11	1.3E-10	3.3E-10
5	BADDFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.8E-01	2.5E-03	2.1E-03	1.1E-03	3.9E-04	1.2E-04	3.9E-05	1.8E-04	4.2E-04
				7.2E+04	1.3E+04	1.4E+04	2.2E-01	1.2E-01	5.5E-03	1.8E-03	2.0E-03	1.4E-06	1.2E-04	2.2E-04	1.6E-03
6	BBBDFBBAAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.6E-01	6.5E-03	6.3E-03	2.8E-03	1.6E-03	5.5E-04	2.0E-04	7.2E-04	1.7E-03
				3.7E+05	1.3E+04	1.4E+04	3.4E-01	1.5E-01	1.5E-01	5.7E-02	3.1E-02	2.9E-05	1.6E-03	2.5E-03	2.0E-02
7	BADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.7E-04	1.2E-08	4.4E-09	3.8E-09	9.5E-11	2.1E-10	4.5E-10	3.1E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.7E-04	1.2E-08	4.4E-09	3.8E-09	9.5E-11	2.1E-10	4.5E-10	3.1E-09
8	BBDDFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.9E-01	4.2E-03	3.9E-03	2.2E-03	1.5E-03	2.6E-04	1.3E-04	6.1E-04	1.5E-03
				7.2E+04	1.3E+04	1.4E+04	3.1E-01	2.0E-01	6.6E-03	2.2E-03	2.2E-03	1.5E-06	1.2E-04	2.3E-04	1.8E-03
9	BADDECDBAA	4.0E+03	3.0E+01	1.3E+07	2.2E+04	1.8E+02	9.0E-01	8.5E-02	2.2E-03	1.9E-03	1.6E-03	8.2E-05	1.1E-04	2.2E-04	1.4E-03
				7.2E+04	2.2E+04	1.4E+04	1.0E-01	9.4E-03	2.5E-04	2.1E-04	1.8E-04	9.1E-06	1.2E-05	2.4E-05	1.6E-04
10	BBDDICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.8E-03	1.8E-05	1.2E-09	7.1E-10	2.1E-10	8.6E-11	2.3E-11	5.3E-11	2.2E-10
				4.8E+04	3.1E+04	2.2E+04	1.8E-03	1.8E-05	1.2E-09	7.1E-10	2.1E-10	8.6E-11	2.3E-11	5.3E-11	2.2E-10

Mean Source Terms for Five Most Probable Bins that have VB and Early CF*

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
3	BABDFBBAAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.9E-01	3.2E-03	2.9E-03	1.3E-03	4.4E-04	1.5E-04	4.8E-05	2.1E-04	4.7E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	6.5E-02	6.2E-02	2.8E-02	3.1E-02	9.7E-05	2.2E-03	4.3E-03	2.2E-02
5	BADDFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.8E-01	2.5E-03	2.1E-03	1.1E-03	3.9E-04	1.2E-04	3.9E-05	1.8E-04	4.2E-04
				7.2E+04	1.3E+04	1.4E+04	2.2E-01	1.2E-01	5.5E-03	1.8E-03	2.0E-03	1.4E-06	1.2E-04	2.2E-04	1.6E-03
6	BBBDFBBAAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.6E-01	6.5E-03	6.3E-03	2.8E-03	1.6E-03	5.5E-04	2.0E-04	7.2E-04	1.7E-03
				3.7E+05	1.3E+04	1.4E+04	3.4E-01	1.5E-01	1.5E-01	5.7E-02	3.1E-02	2.9E-05	1.6E-03	2.5E-03	2.0E-02
8	BBDDFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.9E-01	4.2E-03	3.9E-03	2.2E-03	1.5E-03	2.6E-04	1.3E-04	6.1E-04	1.5E-03
				7.2E+04	1.3E+04	1.4E+04	3.1E-01	2.0E-01	6.6E-03	2.2E-03	2.2E-03	1.5E-06	1.2E-04	2.3E-04	1.8E-03
13	BABEFBBAAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.9E-01	3.1E-03	2.6E-03	1.4E-03	4.5E-04	9.3E-05	3.5E-05	2.2E-04	4.8E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	6.7E-02	6.3E-02	3.0E-02	3.5E-02	1.2E-04	2.6E-03	5.0E-03	2.5E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-3
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 3 - Fast Transient

		Warning Time	Elevation	Release Energy	Release Start	Release Duration	Release Fractions								
Order	Bin	(s)	(m)	(W)	(s)	(s)	NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Five Most Probable Bins*															
1	BBEEICACAA	4.0E+03	3.0E+01	1.3E+06	2.2E+04	9.0E+03	1.7E-03	1.6E-05	9.3E-10	4.8E-10	1.5E-10	2.2E-11	8.9E-12	4.0E-11	1.6E-10
				2.4E+05	3.1E+04	2.2E+04	1.7E-03	1.6E-05	9.3E-10	4.8E-10	1.5E-10	2.2E-11	8.9E-12	4.0E-11	1.6E-10
2	BBDEGCABAB	4.0E+03	3.0E+01	0.0E+00	2.2E+04	1.8E+02	9.0E-01	4.9E-02	5.9E-03	5.2E-03	4.3E-03	5.5E-05	3.2E-04	6.5E-04	3.8E-03
				0.0E+00	2.2E+04	1.4E+04	1.0E-01	5.4E-03	6.5E-04	5.8E-04	4.7E-04	6.1E-06	3.6E-05	7.2E-05	4.2E-04
3	BAEEICACAA	4.0E+03	3.0E+01	1.3E+06	2.2E+04	9.0E+03	1.9E-03	1.5E-05	5.9E-09	3.8E-09	1.1E-09	2.5E-10	8.6E-11	5.0E-10	1.1E-09
				2.4E+05	3.1E+04	2.2E+04	1.9E-03	1.5E-05	5.9E-09	3.8E-09	1.1E-09	2.5E-10	8.6E-11	5.0E-10	1.1E-09
4	BBDEFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.8E-01	6.8E-03	6.2E-03	4.4E-03	3.5E-03	4.8E-04	3.3E-04	1.7E-03	3.5E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.2E-01	4.9E-02	1.3E-02	9.5E-03	1.2E-05	6.5E-04	1.3E-03	8.0E-03
5	BADEGCABAB	4.0E+03	3.0E+01	0.0E+00	2.2E+04	1.8E+02	9.0E-01	3.4E-02	4.2E-03	4.1E-03	3.4E-03	7.8E-05	2.3E-04	4.5E-04	3.0E-03
				0.0E+00	2.2E+04	1.4E+04	1.0E-01	3.8E-03	4.7E-04	4.5E-04	3.8E-04	8.6E-06	2.5E-05	5.0E-05	3.3E-04
Mean Source Terms for Five Most Probable Bins that have VB*															
2	BBDEGCABAB	4.0E+03	3.0E+01	0.0E+00	2.2E+04	1.8E+02	9.0E-01	4.9E-02	5.9E-03	5.2E-03	4.3E-03	5.5E-05	3.2E-04	6.5E-04	3.8E-03
				0.0E+00	2.2E+04	1.4E+04	1.0E-01	5.4E-03	6.5E-04	5.8E-04	4.7E-04	6.1E-06	3.6E-05	7.2E-05	4.2E-04
4	BBDEFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.8E-01	6.8E-03	6.2E-03	4.4E-03	3.5E-03	4.8E-04	3.3E-04	1.7E-03	3.5E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.2E-01	4.9E-02	1.3E-02	9.5E-03	1.2E-05	6.5E-04	1.3E-03	8.0E-03
5	BADEGCABAB	4.0E+03	3.0E+01	0.0E+00	2.2E+04	1.8E+02	9.0E-01	3.4E-02	4.2E-03	4.1E-03	3.4E-03	7.8E-05	2.3E-04	4.5E-04	3.0E-03
				0.0E+00	2.2E+04	1.4E+04	1.0E-01	3.8E-03	4.7E-04	4.5E-04	3.8E-04	8.6E-06	2.5E-05	5.0E-05	3.3E-04
6	BBDDGCABAB	4.0E+03	3.0E+01	0.0E+00	2.2E+04	1.8E+02	9.0E-01	4.8E-02	6.0E-03	5.4E-03	4.3E-03	2.4E-04	3.5E-04	6.7E-04	3.9E-03
				0.0E+00	2.2E+04	1.4E+04	1.0E-01	5.4E-03	6.7E-04	6.0E-04	4.8E-04	2.7E-05	3.9E-05	7.5E-05	4.3E-04
7	BBDDFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.1E-01	9.8E-03	9.2E-03	5.9E-03	4.6E-03	8.8E-04	4.8E-04	2.2E-03	4.7E-03
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	2.1E-01	4.4E-02	1.3E-02	1.0E-02	1.2E-05	7.3E-04	1.4E-03	8.6E-03
Mean Source Terms for Five Most Probable Bins that have VB and Early CF*															
4	BBDEFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.8E-01	6.8E-03	6.2E-03	4.4E-03	3.5E-03	4.8E-04	3.3E-04	1.7E-03	3.5E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.2E-01	4.9E-02	1.3E-02	9.5E-03	1.2E-05	6.5E-04	1.3E-03	8.0E-03
7	BBDDFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.1E-01	9.8E-03	9.2E-03	5.9E-03	4.6E-03	8.8E-04	4.8E-04	2.2E-03	4.7E-03
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	2.1E-01	4.4E-02	1.3E-02	1.0E-02	1.2E-05	7.3E-04	1.4E-03	8.6E-03
8	BADEFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	9.3E-03	7.6E-03	4.3E-03	8.4E-04	2.1E-04	5.9E-05	2.9E-04	9.1E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	1.2E-01	2.5E-02	8.2E-03	7.9E-03	5.5E-05	4.5E-04	8.6E-04	6.4E-03
12	BABEFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	9.3E-03	7.6E-03	4.3E-03	8.4E-04	2.1E-04	5.9E-05	2.9E-04	9.1E-04
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	8.4E-02	9.0E-02	4.1E-02	3.9E-02	3.9E-04	2.4E-03	4.9E-03	2.9E-02
13	BADDFBABAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	8.4E-03	7.5E-03	4.6E-03	1.6E-03	3.6E-04	1.1E-04	5.1E-04	1.7E-03
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	1.2E-01	7.8E-03	3.8E-03	6.2E-03	4.2E-08	1.8E-04	3.1E-04	4.5E-03

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* A listing of source terms for all bins is available on computer media

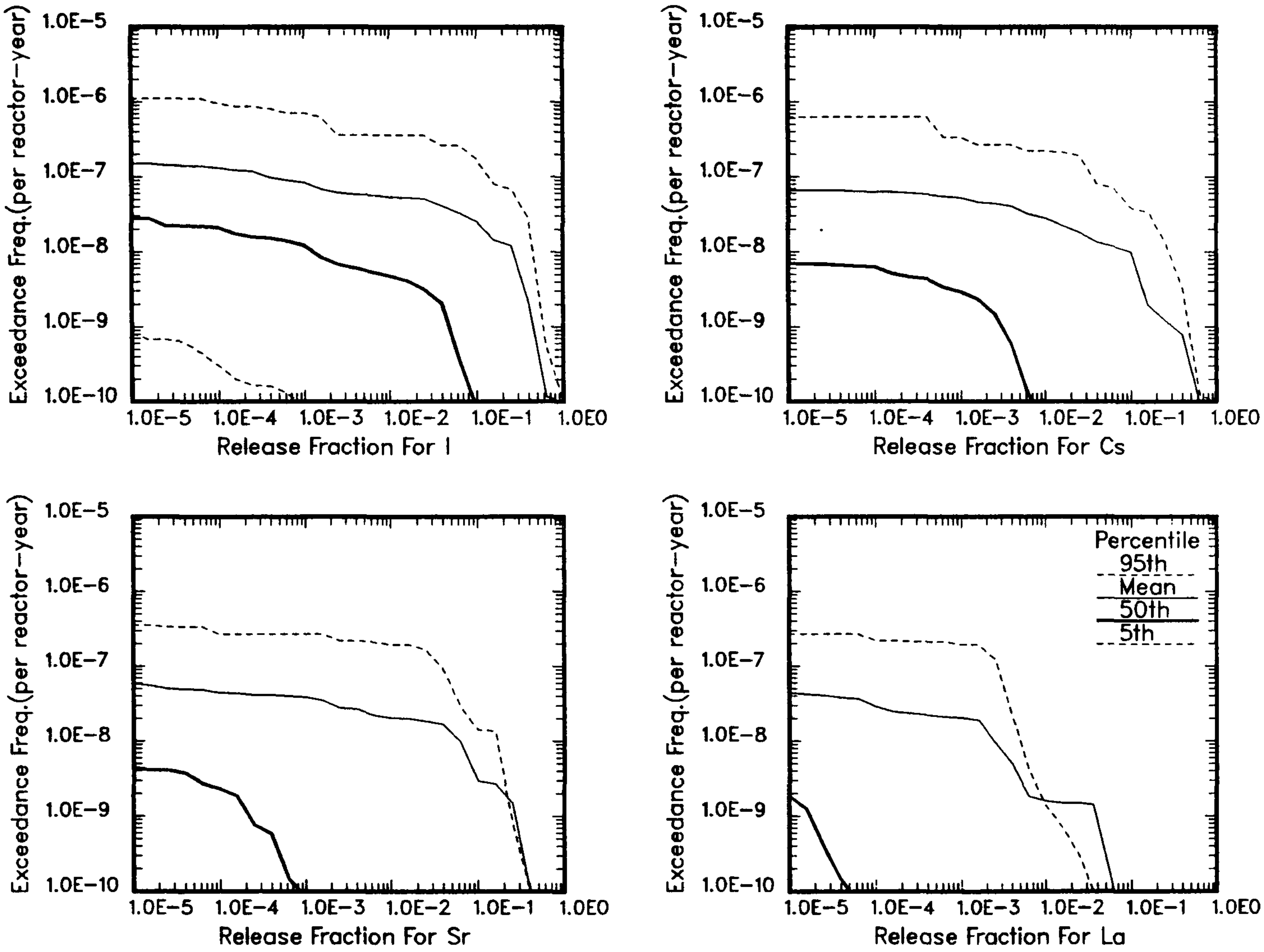

Figure 3.3-2
Peach Bottom: PDS 2 - Fast Transient
Source Term CCDF

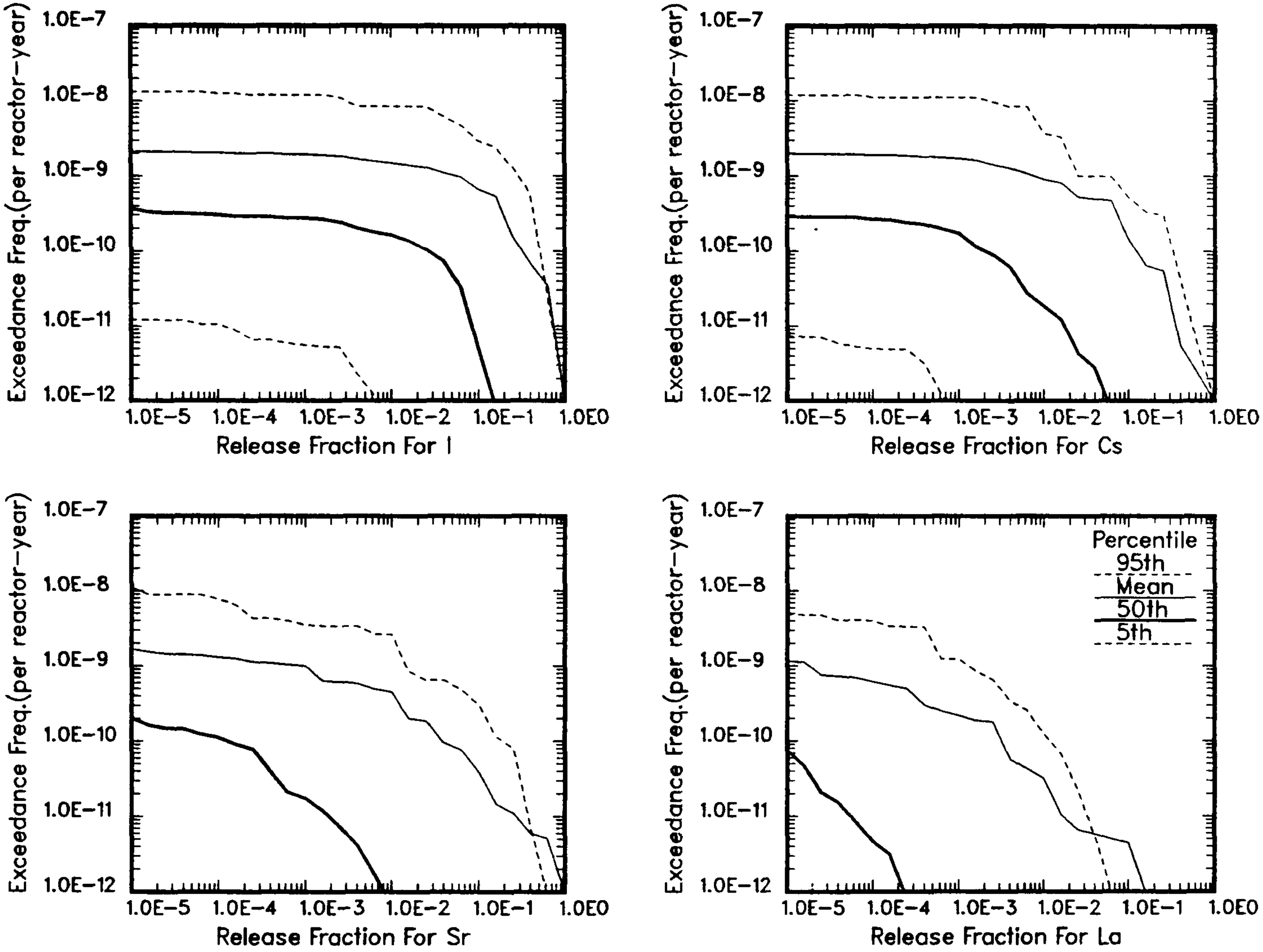

Figure 3.3-3
Peach Bottom: PDS 3 - Fast Transient
Source Term CCDF

close to the time of VB) is 0.33. The probability of recovering AC and averting VB is 0.25.

Table 2.5-4 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.4. Table 3.3-4 lists the mean source terms for these same APBs. For this PDS, all of the top five APBs have AC power recovery during core degradation and in two of them core damage arrest occurs. Any in-vessel releases are scrubbed by the suppression pool. Containment failure does not occur in the dominant APBs and the releases are small.

Figure 3.3-4 summarizes the release fraction CCDFs for PDS 4.

3.3.1.5 Results for PDS5: Slow SBO

This PDS is a long-term station blackout. It is composed of two scenarios. High pressure injection is initially working. AC power is not recovered and either: 1) the batteries deplete, resulting in injection failure, reclosure of the ADS valves, and repressurization of the RPV (in those cases where an SRV is not stuck open), followed by boiloff of the primary coolant and core damage at high or low RPV pressure depending on if an SRV is stuck open or not, or 2) HPCI and RCIC fail on high suppression pool temperature or high containment pressure, respectively, followed by boiloff and core damage at low RPV pressure (since if DC has not failed, ADS would still be possible, or an SRV is stuck open). The containment is at high pressure but less than or equal to the saturation pressure corresponding to the temperature at which HPCI will fail (i.e., about 40 psig at the start of core damage). For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.75. The probability of recovering AC and averting VB is 0.085.

Table 2.5-5 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.5. Table 3.3-5 lists the mean source terms for these same APBs. This PDS, along with PDS 8, is the dominant PDS for internal initiators at Peach Bottom and its characteristics determine the overall risk profile at the plant. The dominant APBs correspond to the case with the RPV at high pressure at the time of vessel breach. A small DCH event occurs, AC power is not recovered, and early drywell failure occurs. The in-vessel releases are scrubbed in the suppression pool; but, the ex-vessel releases are dry and released directly from the drywell to the reactor building.

Figure 3.3-5 summarizes the release fraction CCDFs for PDS 5.

3.3.1.6 Results for PDS 6: Fast ATWS

This PDS is an ATWS with SLC working. HPCI works and the vessel is not manually depressurized. Injection fails on high suppression pool

Table 3.3-4
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 4 - Fast SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Five Most Probable Bins*															
1	EBEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.7E-03	1.6E-05	7.7E-10	3.8E-10	1.2E-10	1.7E-11	6.3E-12	2.8E-11	1.2E-10
				4.8E+04	3.1E+04	2.2E+04	1.7E-03	1.6E-05	7.7E-10	3.8E-10	1.2E-10	1.7E-11	6.3E-12	2.8E-11	1.2E-10
2	EADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.5E-04	1.3E-08	4.6E-09	3.9E-09	1.3E-10	2.0E-10	4.6E-10	3.1E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.5E-04	1.3E-08	4.6E-09	3.9E-09	1.3E-10	2.0E-10	4.6E-10	3.1E-09
3	EBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.7E-04	1.0E-08	3.6E-09	3.7E-09	2.1E-11	2.3E-10	4.4E-10	3.0E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.7E-04	1.0E-08	3.6E-09	3.7E-09	2.1E-11	2.3E-10	4.4E-10	3.0E-09
4	EAEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.9E-03	1.5E-05	2.2E-09	1.3E-09	3.4E-10	8.6E-11	2.7E-11	1.7E-10	3.6E-10
				4.8E+04	3.1E+04	2.2E+04	1.9E-03	1.5E-05	2.2E-09	1.3E-09	3.4E-10	8.6E-11	2.7E-11	1.7E-10	3.6E-10
5	EBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	1.0E-08	3.7E-09	3.7E-09	9.2E-11	2.4E-10	4.6E-10	3.1E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	1.0E-08	3.7E-09	3.7E-09	9.2E-11	2.4E-10	4.6E-10	3.1E-09
Mean Source Terms for Five Most Probable Bins that have VB*															
2	EADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.5E-04	1.3E-08	4.6E-09	3.9E-09	1.3E-10	2.0E-10	4.6E-10	3.1E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.5E-04	1.3E-08	4.6E-09	3.9E-09	1.3E-10	2.0E-10	4.6E-10	3.1E-09
3	EBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.7E-04	1.0E-08	3.6E-09	3.7E-09	2.1E-11	2.3E-10	4.4E-10	3.0E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.7E-04	1.0E-08	3.6E-09	3.7E-09	2.1E-11	2.3E-10	4.4E-10	3.0E-09
5	EBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	1.0E-08	3.7E-09	3.7E-09	9.2E-11	2.4E-10	4.6E-10	3.1E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	1.0E-08	3.7E-09	3.7E-09	9.2E-11	2.4E-10	4.6E-10	3.1E-09
6	EBDEFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.0E-01	3.7E-03	3.4E-03	1.9E-03	9.5E-04	1.3E-04	8.1E-05	4.0E-04	9.8E-04
				3.7E+05	1.3E+04	1.4E+04	3.0E-01	2.2E-01	4.9E-02	1.4E-02	1.1E-02	1.3E-05	8.0E-04	1.5E-03	9.5E-03
7	EADDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.4E-04	1.3E-08	4.7E-09	3.8E-09	2.5E-10	2.3E-10	4.8E-10	3.1E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.4E-04	1.3E-08	4.7E-09	3.8E-09	2.5E-10	2.3E-10	4.8E-10	3.1E-09
Mean Source Terms for Five Most Probable Bins that have VB and Early CF*															
6	EBDEFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.0E-01	3.7E-03	3.4E-03	1.9E-03	9.5E-04	1.3E-04	8.1E-05	4.0E-04	9.8E-04
				3.7E+05	1.3E+04	1.4E+04	3.0E-01	2.2E-01	4.9E-02	1.4E-02	1.1E-02	1.3E-05	8.0E-04	1.5E-03	9.5E-03
8	EBDEFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.6E-01	2.9E-03	2.6E-03	1.6E-03	9.9E-04	1.4E-04	8.5E-05	4.2E-04	1.0E-03
				7.2E+04	1.3E+04	1.4E+04	3.4E-01	1.9E-01	9.3E-03	2.7E-03	2.6E-03	2.4E-06	1.7E-04	3.2E-04	2.1E-03
11	EBDDFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.1E-01	5.0E-03	4.9E-03	2.1E-03	1.0E-03	4.0E-04	1.4E-04	4.5E-04	1.1E-03
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	2.0E-01	4.3E-02	1.3E-02	1.1E-02	1.2E-05	7.6E-04	1.5E-03	9.1E-03
12	EAABFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.5E-01	4.2E-03	4.1E-03	1.8E-03	3.8E-04	2.7E-04	8.6E-05	1.3E-04	4.5E-04
				3.7E+05	1.3E+04	1.4E+04	2.5E-01	9.1E-02	9.3E-02	4.1E-02	4.2E-02	4.7E-04	2.8E-03	5.5E-03	3.2E-02
13	EADEFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.6E-01	2.2E-03	1.9E-03	1.2E-03	3.9E-04	9.3E-05	2.8E-05	1.9E-04	4.1E-04
				7.2E+04	1.3E+04	1.4E+04	2.4E-01	1.2E-01	4.1E-03	1.2E-03	1.5E-03	1.1E-08	4.4E-05	7.6E-05	1.1E-03

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* A listing of source terms for all bins is available on computer media

Table 3.3-5
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 5 - Slow SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	GAABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	2.2E-03	2.2E-03	8.2E-04	2.4E-04	2.0E-04	4.3E-05	5.7E-05	2.8E-04
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	9.0E-02	6.7E-02	3.7E-02	4.0E-02	2.5E-04	2.7E-03	5.4E-03	3.0E-02
2	GBABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.1E-01	6.2E-03	6.3E-03	5.1E-03	3.9E-03	7.6E-04	4.2E-04	1.8E-03	4.0E-03
				1.9E+06	4.2E+04	1.4E+04	1.9E-01	1.8E-01	1.1E-01	6.0E-02	4.9E-02	7.8E-05	4.6E-03	7.2E-03	4.0E-02
3	GAABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.7E-01	3.6E-03	3.7E-03	1.6E-03	5.3E-04	5.0E-04	1.1E-04	1.2E-04	6.4E-04
				1.9E+06	4.2E+04	1.4E+04	2.3E-01	1.2E-01	1.0E-01	5.0E-02	4.3E-02	2.6E-04	2.7E-03	5.4E-03	3.2E-02
4	GBDEFBBBAA	2.9E+04	3.0E+01	1.5E+06	4.1E+04	9.0E+02	6.7E-01	3.4E-03	3.1E-03	1.8E-03	9.3E-04	1.3E-04	8.0E-05	4.0E-04	9.6E-04
				1.9E+06	4.2E+04	1.4E+04	3.3E-01	2.6E-01	4.6E-02	1.4E-02	1.1E-02	1.3E-05	7.8E-04	1.5E-03	9.2E-03
5	GAABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.5E-01	1.2E-02	1.2E-02	5.4E-03	1.7E-03	1.3E-03	3.5E-04	5.0E-04	1.9E-03
				1.9E+06	4.2E+04	1.4E+04	2.5E-01	3.0E-01	2.9E-01	1.6E-01	1.6E-01	1.3E-03	1.0E-02	2.1E-02	1.2E-01
6	GADEGBBBAB	2.9E+04	3.0E+01	0.0E+00	4.1E+04	9.0E+02	7.4E-01	8.8E-03	7.1E-03	3.5E-03	2.3E-04	1.0E-04	1.1E-05	3.6E-05	3.1E-04
				0.0E+00	4.2E+04	1.4E+04	2.6E-01	9.1E-02	3.2E-02	1.2E-02	1.0E-02	1.3E-05	4.0E-04	7.6E-04	7.9E-03
7	GBEEICDCAA	2.9E+04	3.0E+01	1.5E+05	4.7E+04	9.0E+03	1.7E-03	1.4E-04	6.9E-10	3.5E-10	1.0E-10	1.5E-11	5.7E-12	2.6E-11	1.1E-10
				2.5E+05	5.6E+04	2.2E+04	1.7E-03	1.4E-04	6.9E-10	3.5E-10	1.0E-10	1.5E-11	5.7E-12	2.6E-11	1.1E-10
8	FAABFBAAAA	1.4E+04	3.0E+01	7.7E+06	2.7E+04	9.0E+02	8.2E-01	6.8E-03	6.6E-03	4.1E-03	1.1E-03	6.0E-04	2.1E-04	4.3E-04	1.2E-03
				1.9E+06	2.8E+04	1.4E+04	1.8E-01	1.0E-01	9.4E-02	4.9E-02	4.3E-02	1.1E-03	3.2E-03	6.1E-03	3.5E-02
9	GBEEGCDCAB	2.9E+04	3.0E+01	0.0E+00	4.7E+04	9.0E+02	6.1E-01	5.4E-02	6.6E-04	4.7E-04	2.0E-04	2.5E-05	8.9E-06	3.7E-05	2.0E-04
				0.0E+00	4.8E+04	1.4E+04	6.8E-02	6.0E-03	7.3E-05	5.2E-05	2.2E-05	2.8E-06	9.9E-07	4.1E-06	2.3E-05
10	GAADFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	9.1E-01	1.1E-02	9.1E-03	5.6E-03	5.8E-04	4.5E-04	1.2E-04	3.3E-04	7.4E-04
				1.9E+06	4.2E+04	1.4E+04	9.3E-02	1.2E-01	4.6E-02	3.7E-02	3.5E-02	1.5E-06	1.4E-03	2.8E-03	2.4E-02
11	GAEEGBBCAB	2.9E+04	3.0E+01	0.0E+00	4.1E+04	9.0E+02	7.5E-01	6.7E-03	4.9E-03	2.9E-03	4.9E-04	1.6E-04	4.0E-05	2.8E-04	5.4E-04
				0.0E+00	4.2E+04	1.4E+04	0.0E+00	5.2E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
12	GBDEICDBAA	2.9E+04	3.0E+01	1.5E+05	4.7E+04	9.0E+03	2.5E-03	5.6E-04	6.0E-09	2.6E-09	2.8E-09	1.5E-11	1.5E-10	2.9E-10	2.2E-09
				2.5E+05	5.6E+04	2.2E+04	2.5E-03	5.6E-04	6.0E-09	2.6E-09	2.8E-09	1.5E-11	1.5E-10	2.9E-10	2.2E-09
13	GBABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	7.9E-03	8.0E-03	6.7E-03	5.2E-03	1.1E-03	5.6E-04	2.4E-03	5.3E-03
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	2.0E-01	1.3E-01	8.1E-02	6.8E-02	1.2E-04	5.8E-03	9.3E-03	5.5E-02
14	GBAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.3E-01	1.2E-02	1.3E-02	4.2E-03	3.1E-04	5.8E-04	3.5E-04	3.5E-04	5.5E-04
				1.9E+06	4.2E+04	1.4E+04	2.7E-01	1.2E-01	1.1E-01	5.9E-02	4.1E-02	3.5E-04	3.0E-03	4.6E-03	3.2E-02
15	FBABFBAAAA	1.4E+04	3.0E+01	7.7E+06	2.7E+04	9.0E+02	7.5E-01	2.4E-03	2.4E-03	6.1E-04	4.7E-04	8.0E-04	1.2E-04	1.1E-04	5.7E-04
				1.9E+06	2.8E+04	1.4E+04	2.5E-01	7.5E-02	5.3E-02	1.9E-02	3.3E-02	4.9E-03	8.2E-03	1.0E-02	3.0E-02

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* A listing of source terms for all bins is available on computer media

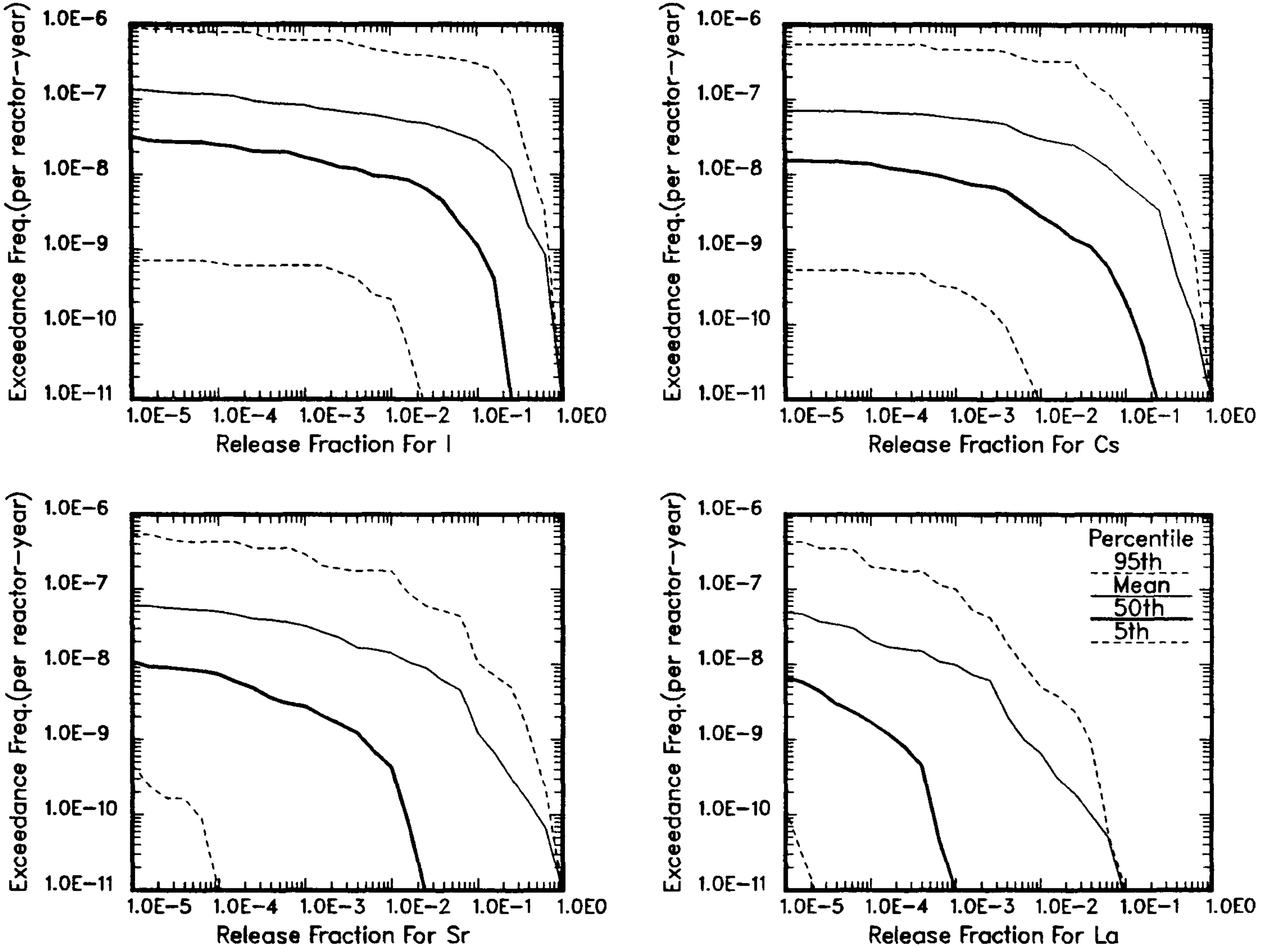

Figure 3.3-4
Peach Bottom: PDS 4 - Fast SBO
Source Term CCDF

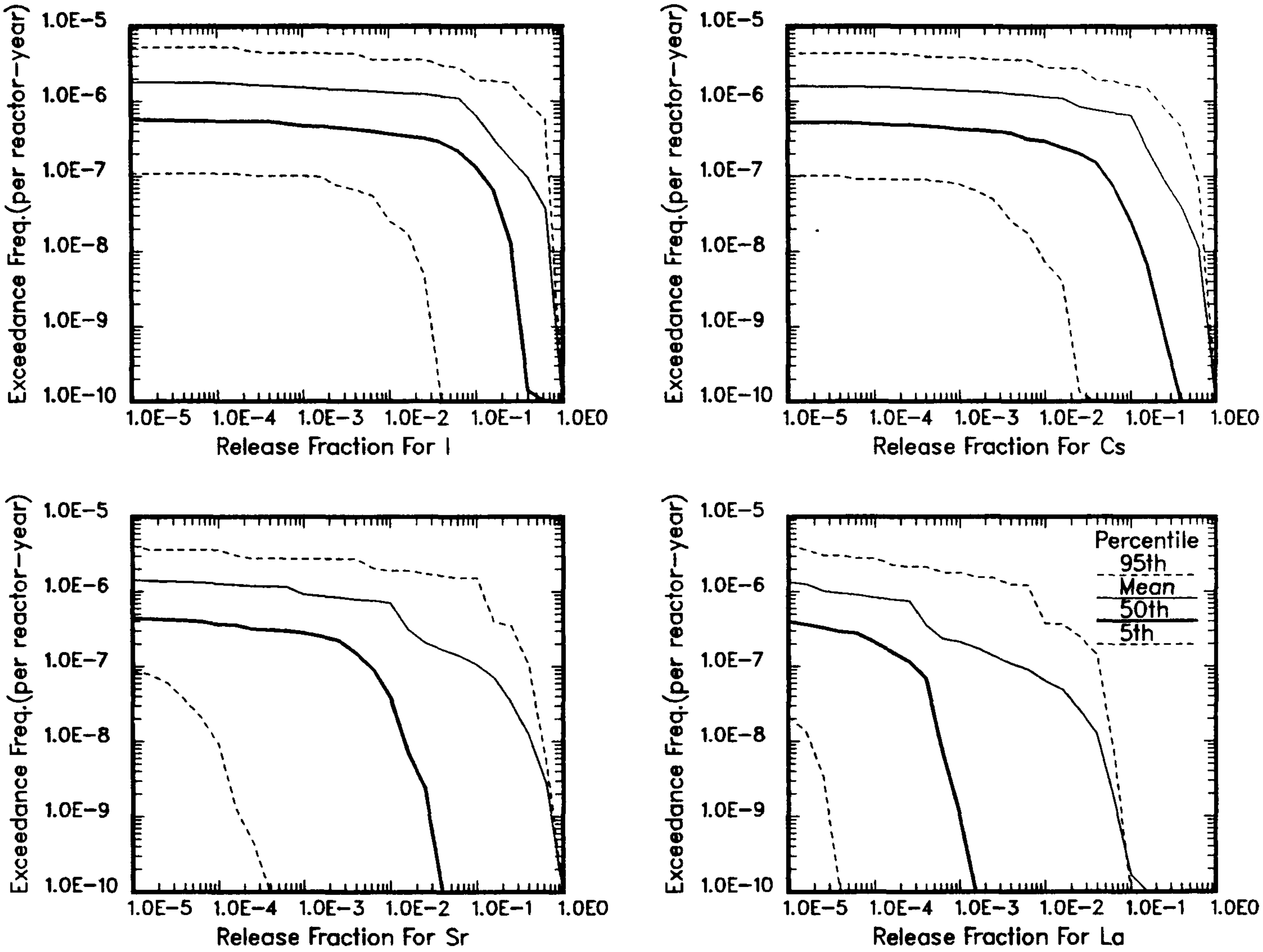

Figure 3.3-5
Peach Bottom: PDS 5 - Slow SBO
Source Term CCDF

temperature and early core damage ensues. Venting is available. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.32. The probability of recovering injection and averting VB is 0.20.

Table 2.5-6 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.6. Table 3.3-6 lists the mean source terms for these same APBs. For this PDS, injection fails early and core damage occurs before containment venting or failure is likely. Containment sprays and heat removal are working; so that, once core damage begins and recriticality does not occur, containment failure can be prevented in the dominant APBs. In two of the top five bins core damage arrest occurs.

Figure 3.3-6 summarizes the release fraction CCDFs for PDS 6.

3.3.1.7 Results for PDS 7: ATWS CV

This PDS is an ATWS with failure of SLC, the initiator is a stuck open SRV. High pressure injection fails on high suppression pool temperature and the reactor either is: 1) not manually depressurized or 2) the operator depressurizes and uses low pressure injection systems until either the injection valves fail due to excessive cycling or the containment fails or is vented and the injection systems fail due to harsh environments in the reactor building or loss of NPSH (condensate can not supply enough water since the CST can only supply about 800 gpm to the condenser, condensate can only last a few minutes). Early core damage ensues in case 1 and late core damage in case 2. Venting will not take place before core damage if the operator does not depressurize; but, it may, if he goes to low pressure systems. RHR and CSS are working and the containment pressure will begin to drop in case 1 or will level off at the venting or SRV reclosure pressure in case 2. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.85. The probability of recovering AC and averting VB is 0.1.

Table 2.5-7 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.7. Table 3.3-7 lists the mean source terms for these same APBs. For this PDS, the dominant APBs are a mixture of the two cases; but, they have certain common characteristics: Containment sprays fail, the CCI occurs in a dry cavity, and containment failure occurs early either by wetwell venting or drywell meltthrough. The APBs with drywell meltthrough having the larger early and late releases.

Figure 3.3-7 summarizes the release fraction CCDFs for PDS 7.

3.3.1.8 Results for PDS 8: ATWS CV

This PDS is an ATWS sequence with loss of an AC bus or PCS followed by failure to scram. Otherwise, it is the same as PDS 7. Since an SRV is not

Table 3.3-6
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 6 - Fast ATWS

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Five Most Probable Bins*															
1	CBEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
				4.8E+04	3.1E+04	2.2E+04	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
2	CADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
3	CBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
4	CAEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.9E-03	1.5E-05	2.2E-09	1.3E-09	3.4E-10	8.6E-11	2.7E-11	1.7E-10	3.6E-10
				4.8E+04	3.1E+04	2.2E+04	1.9E-03	1.5E-05	2.2E-09	1.3E-09	3.4E-10	8.6E-11	2.7E-11	1.7E-10	3.6E-10
5	CBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	8.0E-09	3.6E-09	3.5E-09	9.8E-11	2.4E-10	4.6E-10	3.0E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	8.0E-09	3.6E-09	3.5E-09	9.8E-11	2.4E-10	4.6E-10	3.0E-09
Mean Source Terms for Five Most Probable Bins that have VB*															
2	CADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
3	CBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
5	CBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	8.0E-09	3.6E-09	3.5E-09	9.8E-11	2.4E-10	4.6E-10	3.0E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	8.0E-09	3.6E-09	3.5E-09	9.8E-11	2.4E-10	4.6E-10	3.0E-09
6	CADDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.5E-04	1.1E-08	4.2E-09	3.6E-09	2.0E-10	2.1E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.5E-04	1.1E-08	4.2E-09	3.6E-09	2.0E-10	2.1E-10	4.4E-10	2.9E-09
7	CBDEFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.8E-01	3.8E-03	3.5E-03	1.9E-03	9.7E-04	1.3E-04	8.3E-05	4.1E-04	1.0E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.3E-01	5.3E-02	1.5E-02	1.2E-02	1.3E-05	8.2E-04	1.6E-03	9.8E-03
Mean Source Terms for Five Most Probable Bins that have VB and Early CF*															
7	CBDEFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.8E-01	3.8E-03	3.5E-03	1.9E-03	9.7E-04	1.3E-04	8.3E-05	4.1E-04	1.0E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.3E-01	5.3E-02	1.5E-02	1.2E-02	1.3E-05	8.2E-04	1.6E-03	9.8E-03
9	CBDEFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.8E-01	2.9E-03	2.6E-03	1.6E-03	9.7E-04	1.3E-04	8.3E-05	4.1E-04	9.8E-04
				7.2E+04	1.3E+04	1.4E+04	3.2E-01	1.9E-01	8.6E-03	2.6E-03	2.5E-03	2.4E-06	1.7E-04	3.2E-04	2.0E-03
12	CADEFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.5E-01	2.2E-03	1.8E-03	9.5E-04	3.3E-04	6.8E-05	2.5E-05	1.6E-04	3.5E-04
				7.2E+04	1.3E+04	1.4E+04	2.5E-01	1.3E-01	6.3E-03	2.1E-03	2.2E-03	1.4E-06	1.3E-04	2.4E-04	1.8E-03
13	CBDDFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.0E-01	5.3E-03	5.1E-03	2.2E-03	1.1E-03	4.2E-04	1.5E-04	4.8E-04	1.2E-03
				3.7E+05	1.3E+04	1.4E+04	3.0E-01	2.2E-01	4.3E-02	1.4E-02	1.1E-02	1.3E-05	8.0E-04	1.5E-03	9.5E-03
15	CBDDFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.0E-01	3.4E-03	3.1E-03	1.7E-03	1.0E-03	2.1E-04	1.0E-04	4.4E-04	1.1E-03
				7.2E+04	1.3E+04	1.4E+04	3.0E-01	1.8E-01	7.6E-03	2.5E-03	2.4E-03	2.3E-06	1.6E-04	3.1E-04	2.0E-03

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* A listing of source terms for all bins is available on computer media

Table 3.3-7
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 7 - ATWS CV

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	DABEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.7E-01	7.9E-03	6.5E-03	3.9E-03	7.3E-04	1.9E-04	5.1E-05	2.5E-04	7.9E-04
				2.3E+06	2.7E+04	1.4E+04	2.3E-01	1.1E-01	7.6E-02	3.7E-02	3.4E-02	3.3E-04	2.1E-03	4.2E-03	2.5E-02
2	DABEGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	7.4E-01	1.8E-03	1.3E-03	8.8E-04	4.5E-04	8.6E-05	3.7E-05	2.2E-04	4.6E-04
				0.0E+00	2.6E+04	1.4E+04	2.6E-01	1.3E-01	1.7E-02	1.0E-02	1.0E-02	1.9E-04	6.4E-04	1.2E-03	7.6E-03
3	DBBEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	6.5E-01	6.8E-03	6.4E-03	5.1E-03	4.1E-03	5.7E-04	3.9E-04	2.0E-03	4.1E-03
				2.3E+06	2.7E+04	1.4E+04	3.5E-01	1.8E-01	1.4E-01	6.8E-02	5.2E-02	1.5E-04	4.2E-03	6.7E-03	4.1E-02
4	DBBEGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	7.0E-01	9.5E-04	8.1E-04	6.0E-04	3.1E-04	3.9E-05	1.7E-05	7.5E-05	3.2E-04
				0.0E+00	2.6E+04	1.4E+04	3.0E-01	1.5E-01	1.5E-02	7.5E-03	7.0E-03	2.7E-04	1.0E-03	1.4E-03	6.2E-03
5	DADEGACBAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	7.2E-01	1.9E-03	1.3E-03	9.1E-04	4.7E-04	8.9E-05	3.8E-05	2.3E-04	4.7E-04
				0.0E+00	2.6E+04	1.4E+04	2.8E-01	1.4E-01	4.6E-03	2.1E-03	2.4E-03	1.7E-05	1.4E-04	2.6E-04	1.9E-03
6	DBDEGAABAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.8E-01	1.2E-03	9.9E-04	5.5E-04	1.7E-04	2.5E-05	8.9E-06	3.9E-05	1.7E-04
				0.0E+00	2.6E+04	1.4E+04	3.2E-01	1.6E-01	1.1E-02	5.2E-03	5.5E-03	8.3E-05	4.9E-04	9.4E-04	4.9E-03
7	DABEEAAAAA	1.7E+04	3.0E+01	6.4E+06	1.7E+04	9.0E+03	7.4E-01	2.6E-03	1.8E-03	1.2E-03	5.8E-04	1.2E-04	5.0E-05	3.0E-04	6.3E-04
				2.3E+06	2.6E+04	1.4E+04	2.6E-01	1.8E-01	1.3E-01	7.7E-02	7.7E-02	1.9E-03	5.3E-03	1.0E-02	6.0E-02
8	CBEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
				4.8E+04	3.1E+04	2.2E+04	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
9	DADEFBCBAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.7E-01	7.5E-03	6.0E-03	3.7E-03	7.3E-04	1.9E-04	5.1E-05	2.5E-04	7.9E-04
				4.4E+05	2.7E+04	1.4E+04	2.3E-01	1.6E-01	6.5E-03	2.1E-03	1.9E-03	2.4E-05	1.1E-04	2.2E-04	1.6E-03
10	DBEEGAACAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.5E-01	1.8E-03	1.4E-03	8.2E-04	3.0E-04	4.2E-05	1.8E-05	8.0E-05	3.0E-04
				0.0E+00	2.6E+04	1.4E+04	0.0E+00	5.0E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
11	DBBEEAAAAA	1.7E+04	3.0E+01	6.4E+06	1.7E+04	9.0E+03	7.1E-01	1.3E-03	1.1E-03	8.8E-04	4.7E-04	5.8E-05	2.6E-05	1.1E-04	4.7E-04
				2.3E+06	2.6E+04	1.4E+04	2.9E-01	2.0E-01	1.4E-01	9.1E-02	8.1E-02	1.8E-03	9.3E-03	1.4E-02	6.8E-02
12	DADEGAABAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	7.5E-01	5.5E-03	4.2E-03	2.6E-03	4.4E-04	1.3E-04	3.5E-05	2.0E-04	4.8E-04
				0.0E+00	2.6E+04	1.4E+04	2.5E-01	1.2E-01	9.3E-03	3.9E-03	3.3E-03	1.8E-05	1.8E-04	3.5E-04	2.7E-03
13	CADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
14	DBDEFBABAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	6.6E-01	6.1E-03	5.6E-03	4.4E-03	3.5E-03	4.9E-04	3.3E-04	1.7E-03	3.6E-03
				2.3E+06	2.7E+04	1.4E+04	3.4E-01	2.7E-01	4.5E-02	1.3E-02	9.4E-03	1.2E-05	6.6E-04	1.3E-03	7.9E-03
15	CBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09

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* A listing of source terms for all bins is available on computer media

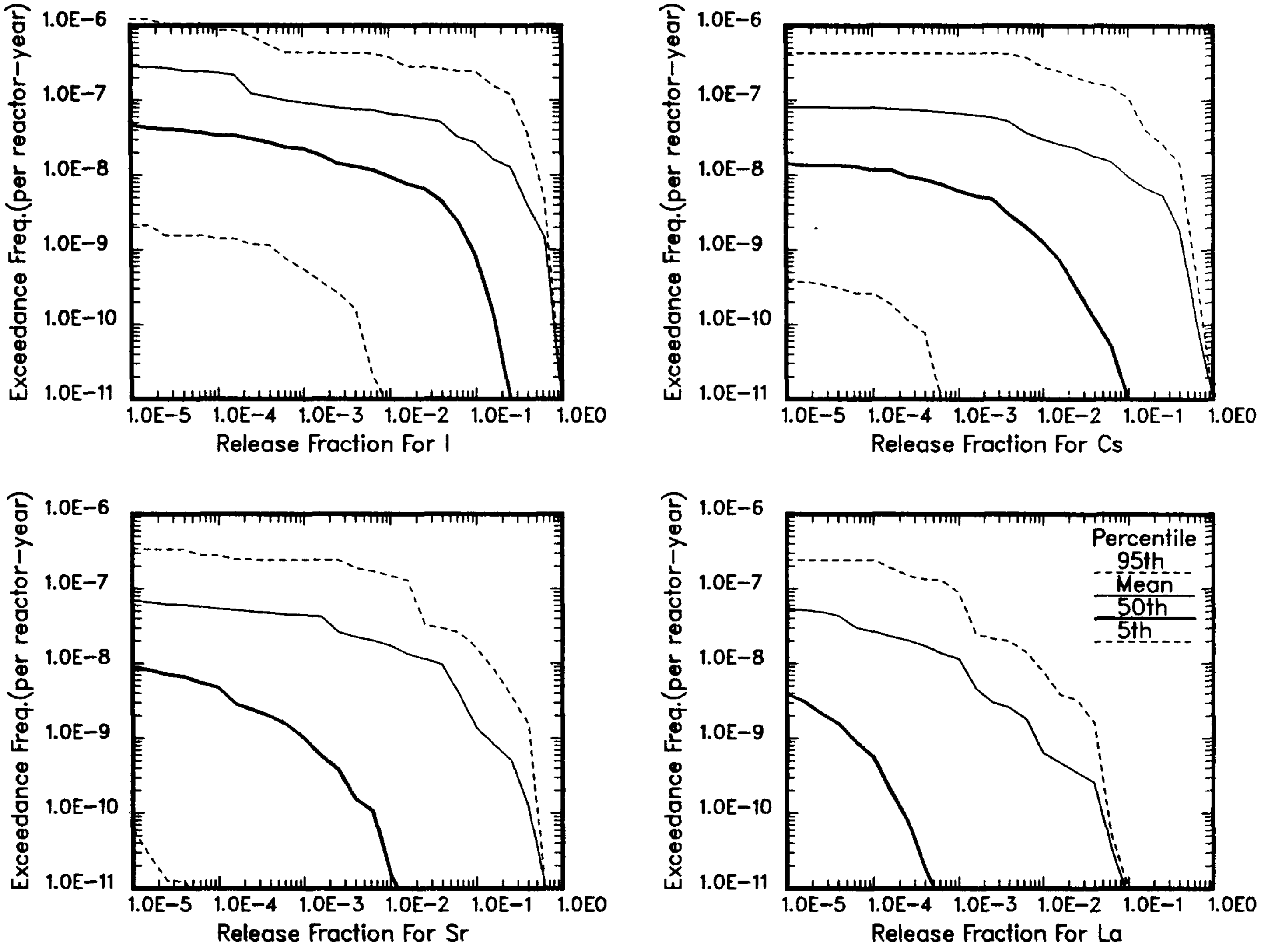

Figure 3.3-6
Peach Bottom: PDS 6 - Fast ATWS
Source Term CCDF

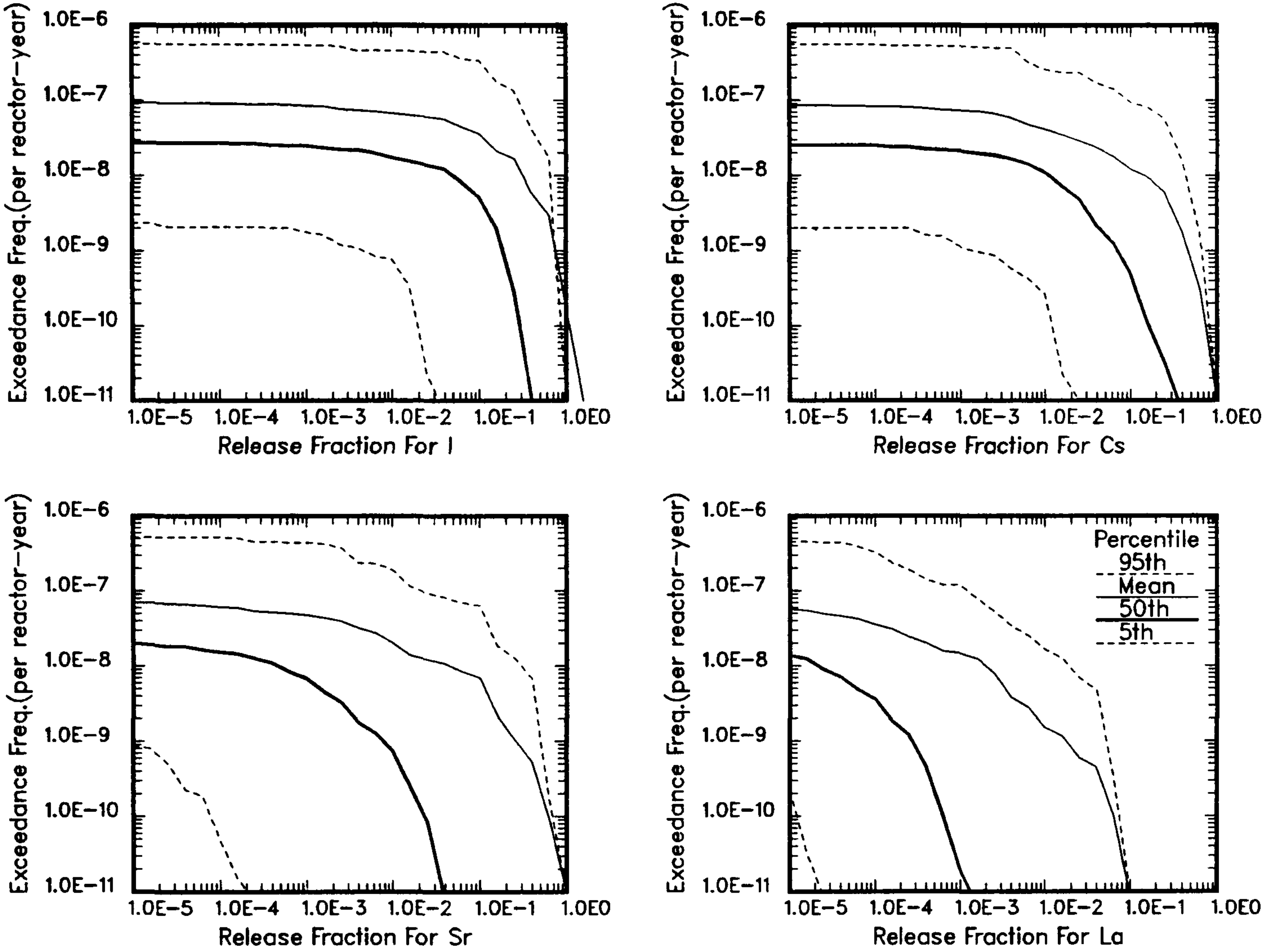

Figure 3.3-7
Peach Bottom: PDS 7 - ATWS CV
Source Term CCDF

stuck open, bins with VB with the RPV at high pressure are probable in this PDS. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.85. The probability of recovering AC and averting VB is 0.1.

Table 2.5-8 lists the fifteen most probable APBs since four of the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.8. Table 3.3-8 lists the mean source terms for these same APBs. Along with PDS 5, this is the dominant PDS for Peach Bottom and its characteristics determine the overall risk profile. The dominant bins for this PDS have the RPV at high pressure at VB, no injection recovery, and failure of containment heat removal. The in-vessel releases are scrubbed in the suppression pool; but, the ex-vessel release occurs with a dry cavity.

Figure 3.3-8 summarizes the release fraction CCDFs for PDS 8.

3.3.1.9 Results for PDS 9: ATWS CV

This PDS is an ATWS with failure of SLC, the initiator is T1 (LOSP); however, other AC is available. Otherwise, this PDS is the same as PDS-8.

Table 2.5-9 lists the fifteen most probable APBs since four of the top five bins all have VB and early CF. As can be seen from the table, the APBs are identical to those of PDS 8. A discussion of the accident characteristics for these APBs is presented in Section 2.5.1.9. Table 3.3-9 lists the mean source terms for these same APBs.

Figure 3.3-9 summarizes the release fraction CCDFs for PDS 9. Even though the source terms are identical for PDS 8 and 9, the exceedance frequencies are different since the PDS frequencies are different.

3.3.1.10 Results for Generalized Accident Progression Bins

The preceding nine subsections presented the source term results by PDS group. It is also possible to group the source terms in other ways. These other groupings are called generalized APBs. These generalized APBs are generated by sorting all of the bins from the ten PDSs on attributes of the accident. The generalized bins are composed of essentially five characteristics: the occurrence of core damage, the occurrence of vessel breach, the pressure at vessel breach, the location of containment failure, and the timing of containment failure with respect to vessel breach. A description of these reduced bins is presented in section 2.4.3.

Figure 3.3-10 shows the variation of the exceedance frequency with release fraction for the I, Cs, Sr, and La radionuclide classes for all the APBs in which the vessel fails at high pressure and early containment failure in the wetwell occurs. In-vessel and ex-vessel releases will be directed to the suppression pool before going to the reactor building. Many of these APBs will have some DCH event after vessel breach.

Table 3.3-8
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 8 - ATWS CV

Mean Source Terms for Fifteen Most Probable Bins*

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
1	DAABFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.6E-01	5.1E-03	4.5E-03	1.7E-03	4.4E-04	3.1E-04	8.7E-05	1.6E-04	5.0E-04
				2.3E+06	2.7E+04	1.4E+04	2.4E-01	1.1E-01	7.5E-02	3.5E-02	3.7E-02	8.1E-04	2.7E-03	5.2E-03	2.8E-02
2	DBABFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.7E-01	7.0E-03	6.6E-03	3.9E-03	2.7E-03	7.0E-04	3.2E-04	1.3E-03	2.8E-03
				2.3E+06	2.7E+04	1.4E+04	2.3E-01	1.7E-01	1.0E-01	5.9E-02	5.0E-02	9.4E-04	5.4E-03	8.0E-03	4.1E-02
3	CBEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
				4.8E+04	3.1E+04	2.2E+04	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
4	DBDEGAABAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.8E-01	1.2E-03	9.9E-04	5.5E-04	1.7E-04	2.5E-05	8.9E-06	3.9E-05	1.7E-04
				0.0E+00	2.6E+04	1.4E+04	3.2E-01	1.6E-01	1.1E-02	5.2E-03	5.5E-03	8.3E-05	4.9E-04	9.4E-04	4.9E-03
5	DABEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.7E-01	7.9E-03	6.5E-03	3.9E-03	7.3E-04	1.9E-04	5.1E-05	2.5E-04	7.9E-04
				2.3E+06	2.7E+04	1.4E+04	2.3E-01	1.1E-01	7.6E-02	3.7E-02	3.4E-02	3.3E-04	2.1E-03	4.2E-03	2.5E-02
6	DAAEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	8.4E-01	1.8E-02	1.3E-02	5.0E-03	3.1E-04	1.6E-04	2.8E-05	1.8E-04	3.9E-04
				2.3E+06	2.7E+04	1.4E+04	1.6E-01	1.3E-01	5.6E-02	3.9E-02	3.6E-02	1.1E-06	1.3E-03	2.5E-03	2.3E-02
7	DABEGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	7.4E-01	1.8E-03	1.3E-03	8.8E-04	4.5E-04	8.6E-05	3.7E-05	2.2E-04	4.6E-04
				0.0E+00	2.6E+04	1.4E+04	2.6E-01	1.3E-01	1.7E-02	1.0E-02	1.0E-02	1.9E-04	6.4E-04	1.2E-03	7.6E-03
8	DBEEGAACAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.5E-01	1.8E-03	1.4E-03	8.2E-04	3.0E-04	4.2E-05	1.8E-05	8.0E-05	3.0E-04
				0.0E+00	2.6E+04	1.4E+04	0.0E+00	5.0E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
9	DAABGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	8.3E-01	1.4E-03	9.3E-04	3.7E-04	1.3E-04	2.3E-05	5.1E-06	2.0E-05	1.3E-04
				0.0E+00	2.6E+04	3.6E+03	1.7E-01	1.3E-01	1.8E-02	1.1E-02	1.1E-02	6.5E-04	6.0E-04	1.1E-03	8.1E-03
10	DBABGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.0E-01	1.1E-03	9.3E-04	5.7E-04	2.8E-04	3.2E-05	1.1E-05	4.6E-05	2.8E-04
				0.0E+00	2.6E+04	3.6E+03	4.0E-01	2.2E-01	1.4E-02	9.7E-03	9.0E-03	5.3E-04	1.0E-03	1.5E-03	8.0E-03
11	DAABEBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.9E-01	5.9E-03	5.2E-03	2.3E-03	7.4E-04	5.9E-04	1.3E-04	1.9E-04	8.4E-04
				2.3E+06	2.7E+04	1.4E+04	2.1E-01	1.3E-01	8.5E-02	4.6E-02	4.6E-02	1.2E-03	3.5E-03	6.8E-03	3.6E-02
12	DBDDGAABAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.5E-01	1.3E-03	1.1E-03	5.9E-04	1.8E-04	2.7E-05	9.9E-06	4.4E-05	1.8E-04
				0.0E+00	2.6E+04	3.6E+03	3.5E-01	1.8E-01	1.2E-02	5.5E-03	5.3E-03	1.6E-04	4.1E-04	7.5E-04	4.6E-03
13	CADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
14	CBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
15	DBBEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	6.5E-01	6.8E-03	6.4E-03	5.1E-03	4.1E-03	5.7E-04	3.9E-04	2.0E-03	4.1E-03
				2.3E+06	2.7E+04	1.4E+04	3.5E-01	1.8E-01	1.4E-01	6.8E-02	5.2E-02	1.5E-04	4.2E-03	6.7E-03	4.1E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-9
Mean Source Terms for Peach Bottom
Internal Initiators - PDS 9 - ATWS CV

							Release Fractions								
Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	DAABFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.6E-01	5.1E-03	4.5E-03	1.7E-03	4.4E-04	3.1E-04	8.7E-05	1.6E-04	5.0E-04
				2.3E+06	2.7E+04	1.4E+04	2.4E-01	1.1E-01	7.5E-02	3.5E-02	3.7E-02	8.1E-04	2.7E-03	5.2E-03	2.8E-02
2	DBABFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.7E-01	7.0E-03	6.6E-03	3.9E-03	2.7E-03	7.0E-04	3.2E-04	1.3E-03	2.8E-03
				2.3E+06	2.7E+04	1.4E+04	2.3E-01	1.7E-01	1.0E-01	5.9E-02	5.0E-02	9.4E-04	5.4E-03	8.0E-03	4.1E-02
3	CBEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
				4.8E+04	3.1E+04	2.2E+04	1.6E-03	1.6E-05	8.4E-10	4.2E-10	1.3E-10	1.9E-11	7.0E-12	3.1E-11	1.3E-10
4	DBDEGAABAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.8E-01	1.2E-03	9.9E-04	5.5E-04	1.7E-04	2.5E-05	8.9E-06	3.9E-05	1.7E-04
				0.0E+00	2.6E+04	1.4E+04	3.2E-01	1.6E-01	1.1E-02	5.2E-03	5.5E-03	8.3E-05	4.9E-04	9.4E-04	4.9E-03
5	DABEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.7E-01	7.9E-03	6.5E-03	3.9E-03	7.3E-04	1.9E-04	5.1E-05	2.5E-04	7.9E-04
				2.3E+06	2.7E+04	1.4E+04	2.3E-01	1.1E-01	7.6E-02	3.7E-02	3.4E-02	3.3E-04	2.1E-03	4.2E-03	2.5E-02
6	DAAEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	8.4E-01	1.8E-02	1.3E-02	5.0E-03	3.1E-04	1.6E-04	2.8E-05	1.8E-04	3.9E-04
				2.3E+06	2.7E+04	1.4E+04	1.6E-01	1.3E-01	5.6E-02	3.9E-02	3.6E-02	1.1E-06	1.3E-03	2.5E-03	2.3E-02
7	DABEGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	7.4E-01	1.8E-03	1.3E-03	8.8E-04	4.5E-04	8.6E-05	3.7E-05	2.2E-04	4.6E-04
				0.0E+00	2.6E+04	1.4E+04	2.6E-01	1.3E-01	1.7E-02	1.0E-02	1.0E-02	1.9E-04	6.4E-04	1.2E-03	7.6E-03
8	DBEEGAACAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.5E-01	1.8E-03	1.4E-03	8.2E-04	3.0E-04	4.2E-05	1.8E-05	8.0E-05	3.0E-04
				0.0E+00	2.6E+04	1.4E+04	0.0E+00	5.0E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
9	DAABGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	8.3E-01	1.4E-03	9.3E-04	3.7E-04	1.3E-04	2.3E-05	5.1E-06	2.0E-05	1.3E-04
				0.0E+00	2.6E+04	3.6E+03	1.7E-01	1.3E-01	1.8E-02	1.1E-02	1.1E-02	6.5E-04	6.0E-04	1.1E-03	8.1E-03
10	DBABGAAAAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.0E-01	1.1E-03	9.3E-04	5.7E-04	2.8E-04	3.2E-05	1.1E-05	4.6E-05	2.8E-04
				0.0E+00	2.6E+04	3.6E+03	4.0E-01	2.2E-01	1.4E-02	9.7E-03	9.0E-03	5.3E-04	1.0E-03	1.5E-03	8.0E-03
11	DAABEBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	7.9E-01	5.9E-03	5.2E-03	2.3E-03	7.4E-04	5.9E-04	1.3E-04	1.9E-04	8.4E-04
				2.3E+06	2.7E+04	1.4E+04	2.1E-01	1.3E-01	8.5E-02	4.6E-02	4.6E-02	1.2E-03	3.5E-03	6.8E-03	3.6E-02
12	DBDDGAABAA	1.7E+04	3.0E+01	0.0E+00	1.7E+04	9.0E+03	6.5E-01	1.3E-03	1.1E-03	5.9E-04	1.8E-04	2.7E-05	9.9E-06	4.4E-05	1.8E-04
				0.0E+00	2.6E+04	3.6E+03	3.5E-01	1.8E-01	1.2E-02	5.5E-03	5.3E-03	1.6E-04	4.1E-04	7.5E-04	4.6E-03
13	CADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.6E-04	1.1E-08	4.1E-09	3.5E-09	9.1E-11	1.9E-10	4.1E-10	2.9E-09
14	CBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.8E-04	7.9E-09	3.5E-09	3.5E-09	2.1E-11	2.2E-10	4.4E-10	2.9E-09
15	DBBEFBAAAA	1.7E+04	3.0E+01	6.4E+07	2.6E+04	9.0E+02	6.5E-01	6.8E-03	6.4E-03	5.1E-03	4.1E-03	5.7E-04	3.9E-04	2.0E-03	4.1E-03
				2.3E+06	2.7E+04	1.4E+04	3.5E-01	1.8E-01	1.4E-01	6.8E-02	5.2E-02	1.5E-04	4.2E-03	6.7E-03	4.1E-02

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* A listing of source terms for all bins is available on computer media

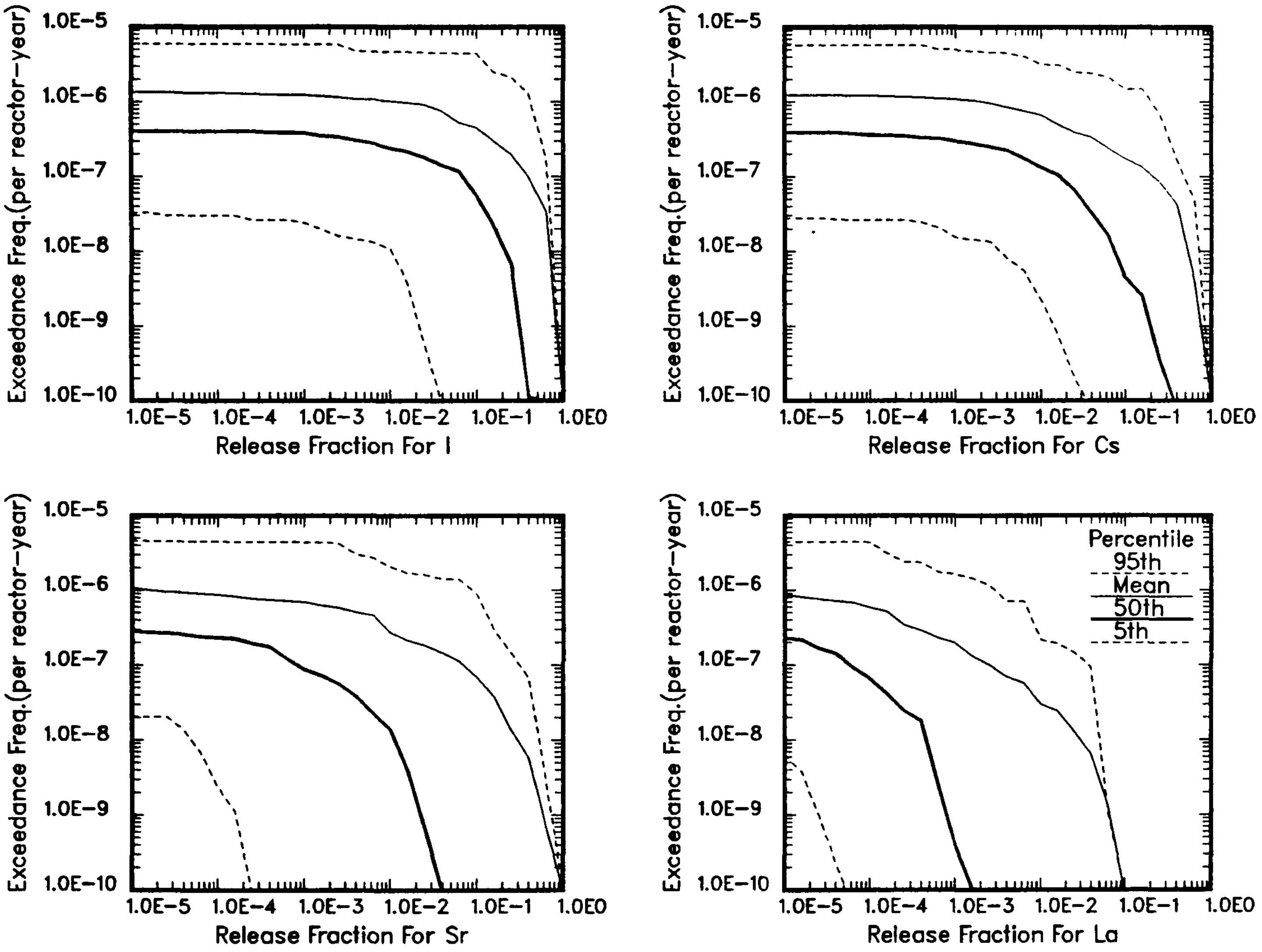

Figure 3.3-8
Peach Bottom: PDS 8 - ATWS CV
Source Term CCDF

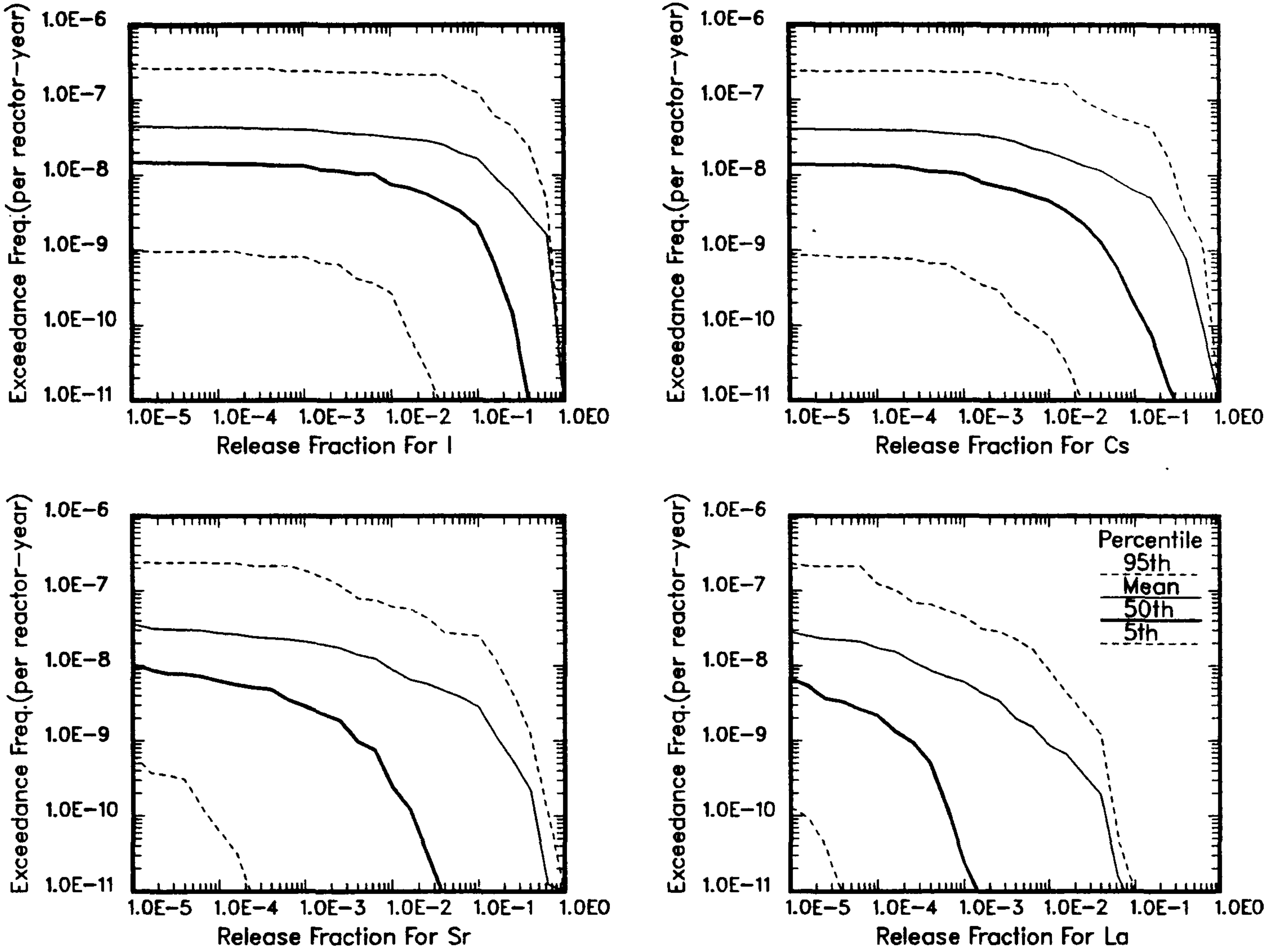

Figure 3.3-9
Peach Bottom: PDS 9 - ATWS CV
Source Term CCDF

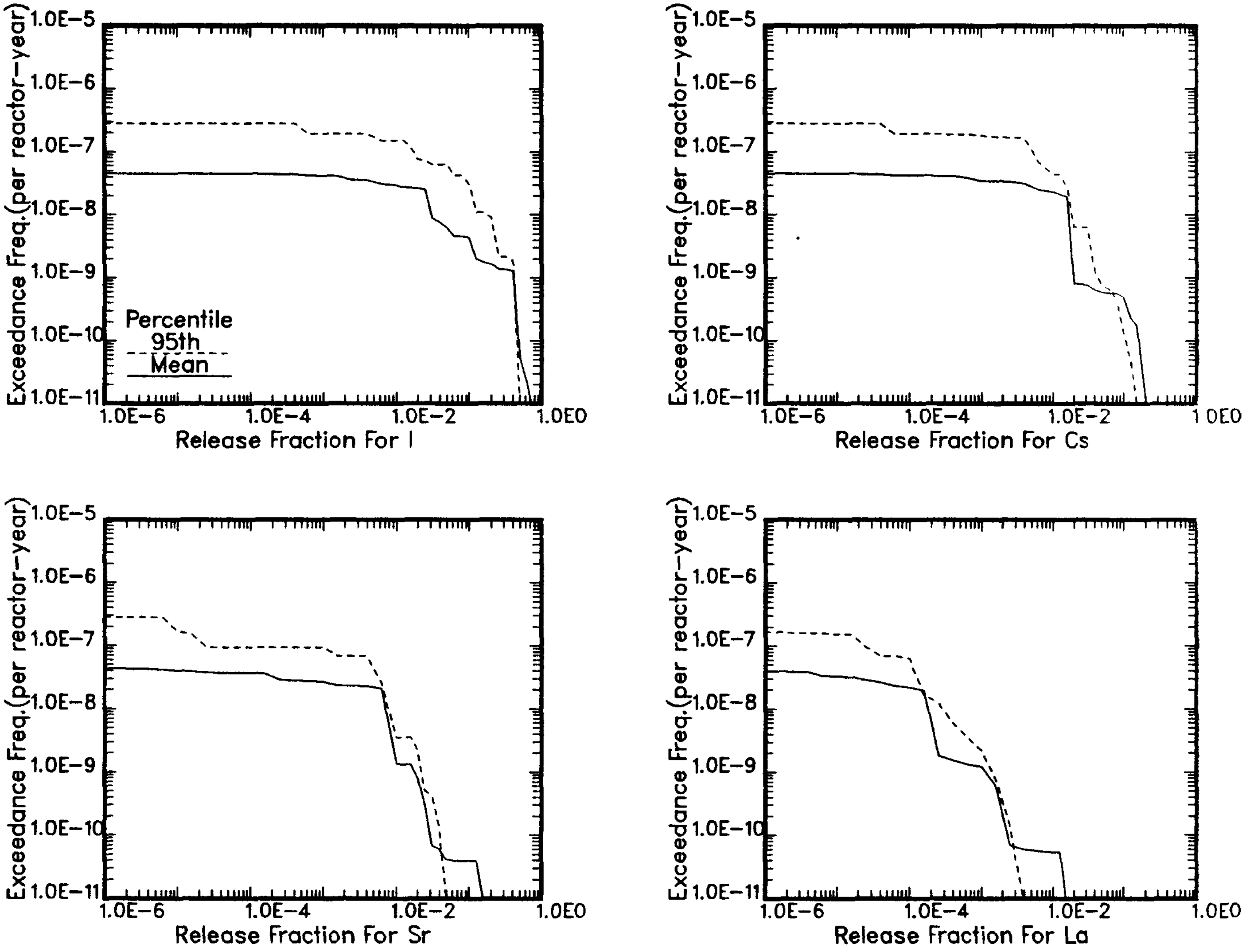

Figure 3.3-10
Peach Bottom: Generalized APB 1
Source Term CCDF: Core Damage, VB>200 Psi, Early Wetwell Failure

Figure 3.3-11 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel fails at low pressure and early containment failure in the wetwell occurs. This generalized bin is similar to the generalized bin used in Figure 3.3-13 except that in these accidents the RPV is at low pressure. These APBs will not have DCH but may have ex-vessel steam explosions. All releases are directed to the suppression pool before going to the reactor building.

Figure 3.3-12 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel fails at high pressure and early containment failure occurs in the drywell. These releases are significantly higher than the corresponding releases for the wetwell failure case since the ex-vessel release is not scrubbed in the suppression pool. These releases may occur with a DCH event.

Figure 3.3-13 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel fails at low pressure and early containment failure occurs in the drywell. Since the vessel is at low pressure, DCH will not occur but ex-vessel steam explosions are possible. These releases are significantly higher than the corresponding releases for the wetwell failure case since the ex-vessel release is not scrubbed in the suppression pool.

Figure 3.3-14 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel fails either at high or low pressure but containment failure does not occur until late in the accident and then in the wetwell. Both in-vessel and ex-vessel release are scrubbed by the suppression pool. The releases are similar in size to or lower than the corresponding early failures in the wetwell depending upon the radionuclide species.

Figure 3.3-15 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel fails either at high or low pressure but containment failure does not occur until late in the accident and then in the drywell. Since the releases are not scrubbed in the suppression pool, they are correspondingly higher than the wetwell failure case in Figure 3.3-14.

Figure 3.3-16 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel fails either at high or low pressure and containment failure occurs by venting either early or late in the accident. All releases are scrubbed by the suppression pool.

Figure 3.3-17 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel failed but the containment remain intact throughout the accident. Because in these APBs there is only nominal leakage from the containment, the release fractions tend to be quite low. It should be pointed out that some of the APBs in this group involve accidents in which the containment fails even though vessel breach is averted.

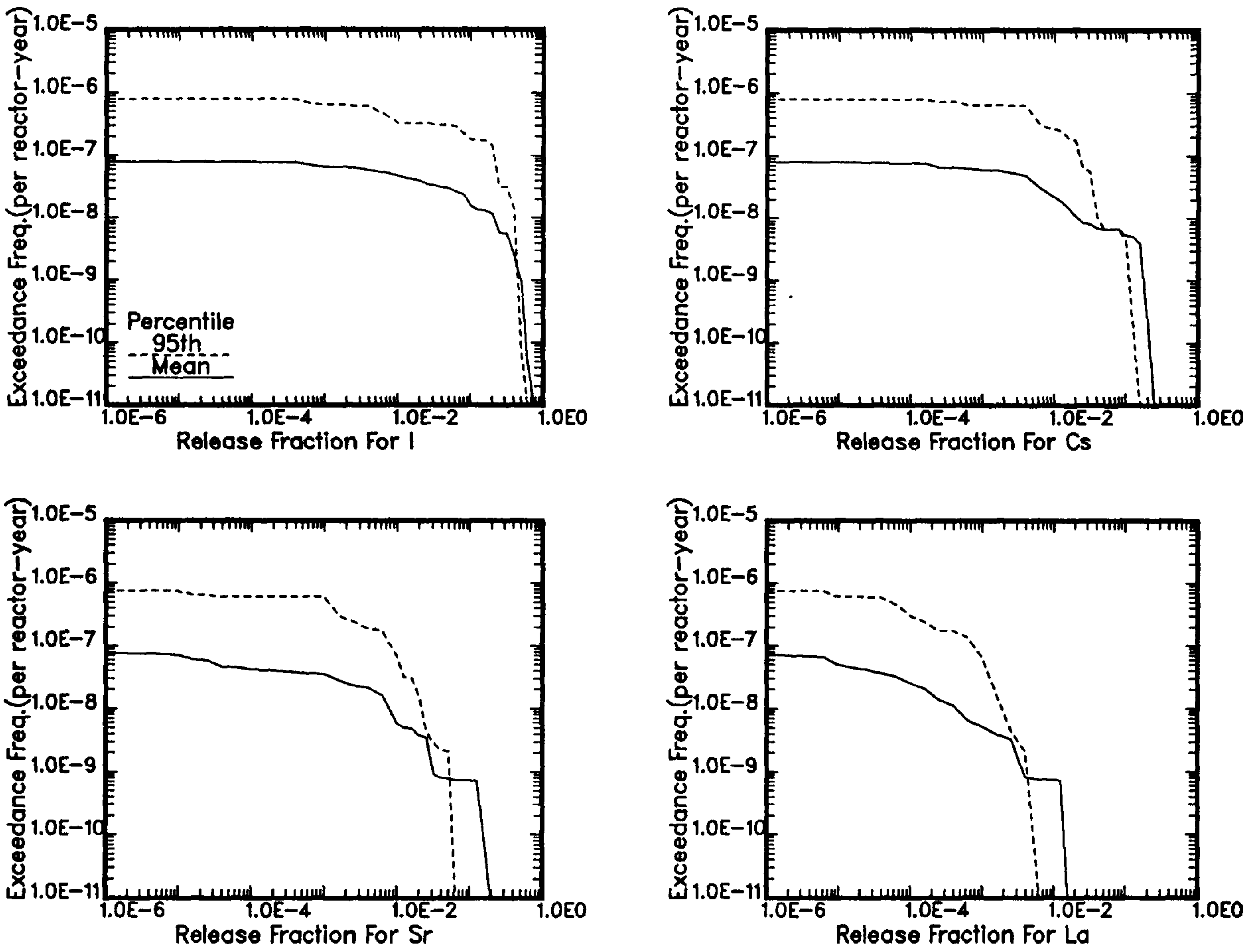

Figure 3.3-11
Peach Bottom: Generalized APB 2
Source Term CCDF: Core Damage, VB<200 Psi, Early Wetwell Failure

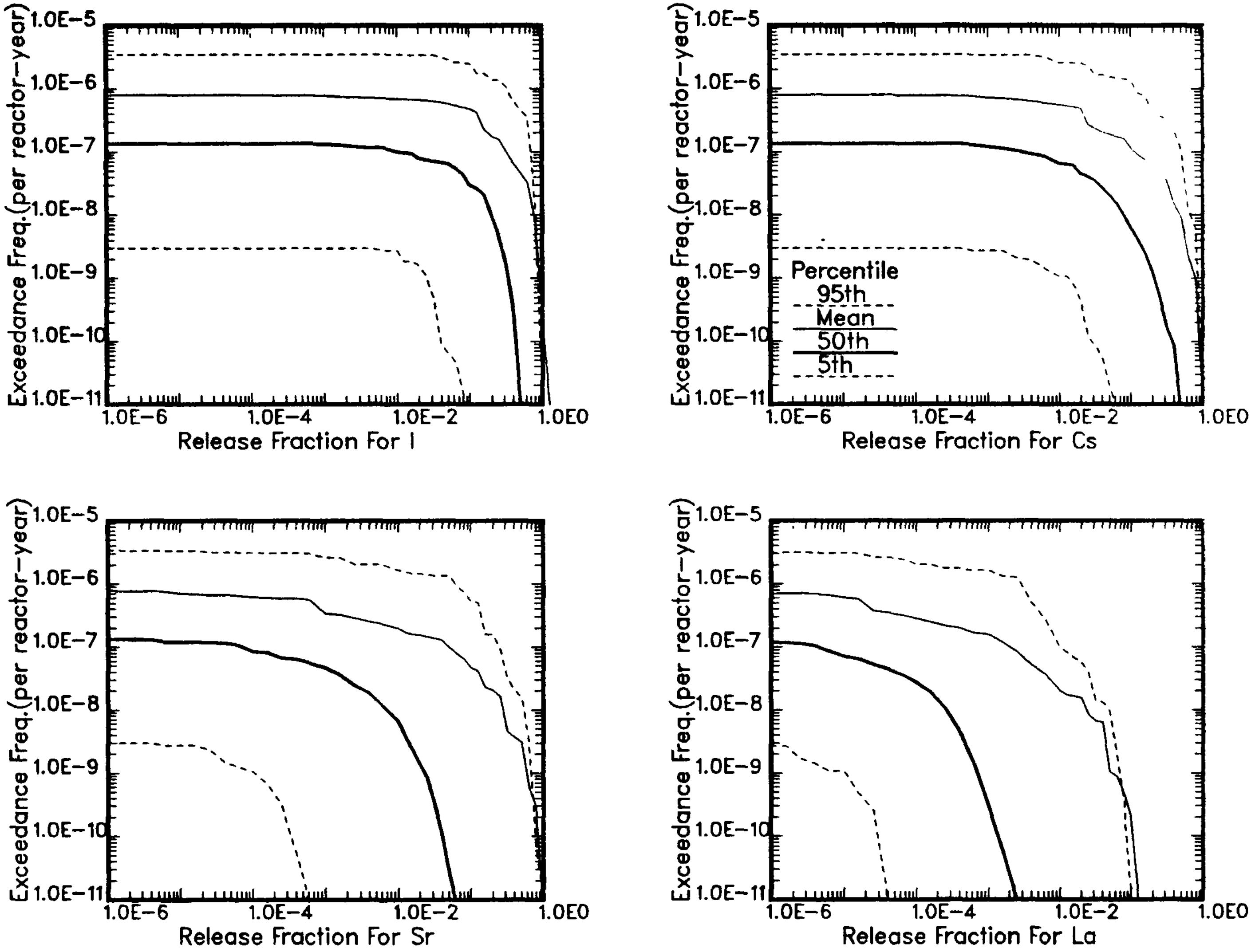

Figure 3.3-12
Peach Bottom: Generalized APB 3
Source Term CCDF: Core Damage, VB>200 Psi, Early Drywell Failure

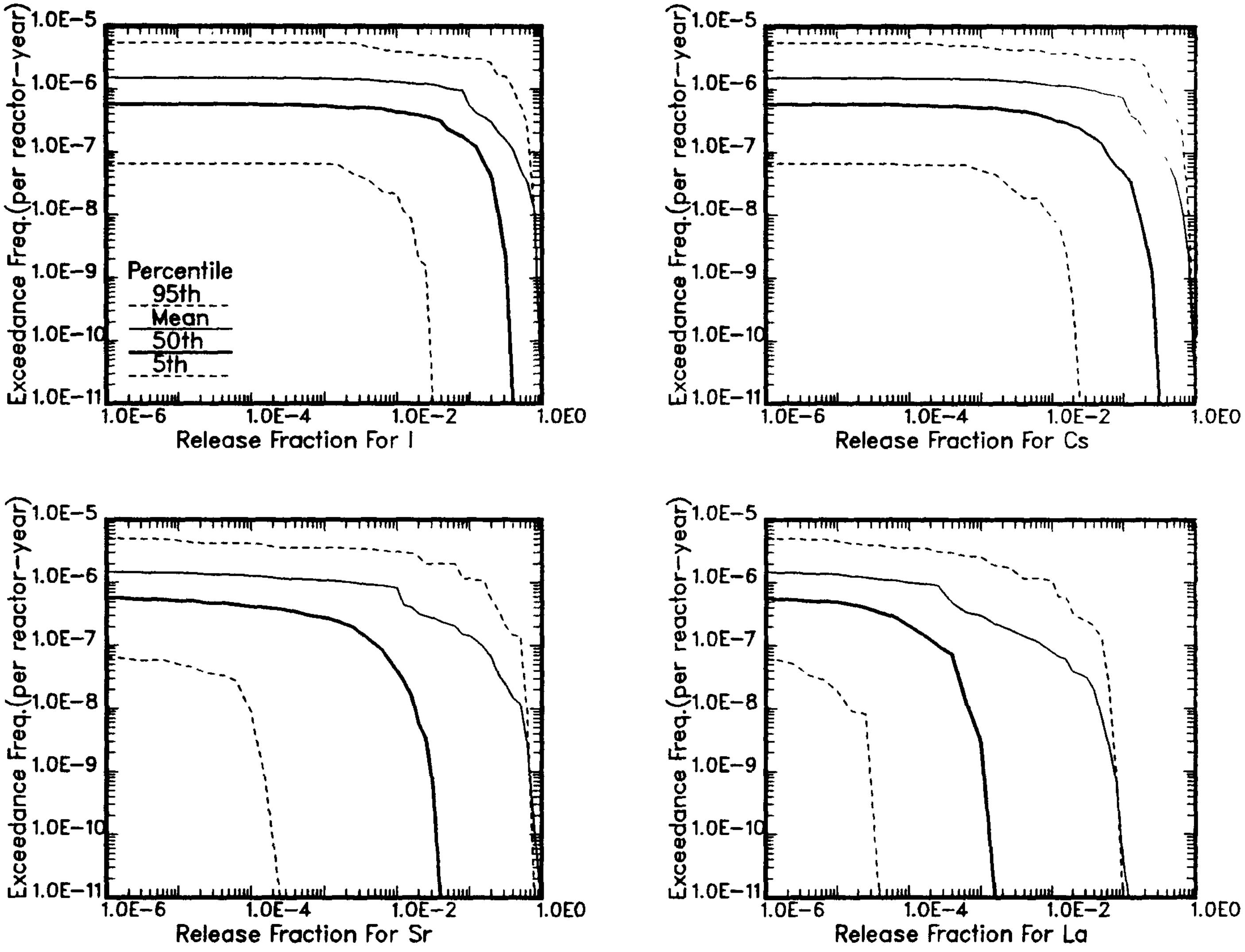

Figure 3.3-13
Peach Bottom: Generalized APB 4
Source Term CCDF: Core Damage, VB<200 Psi, Early Drywell Failure

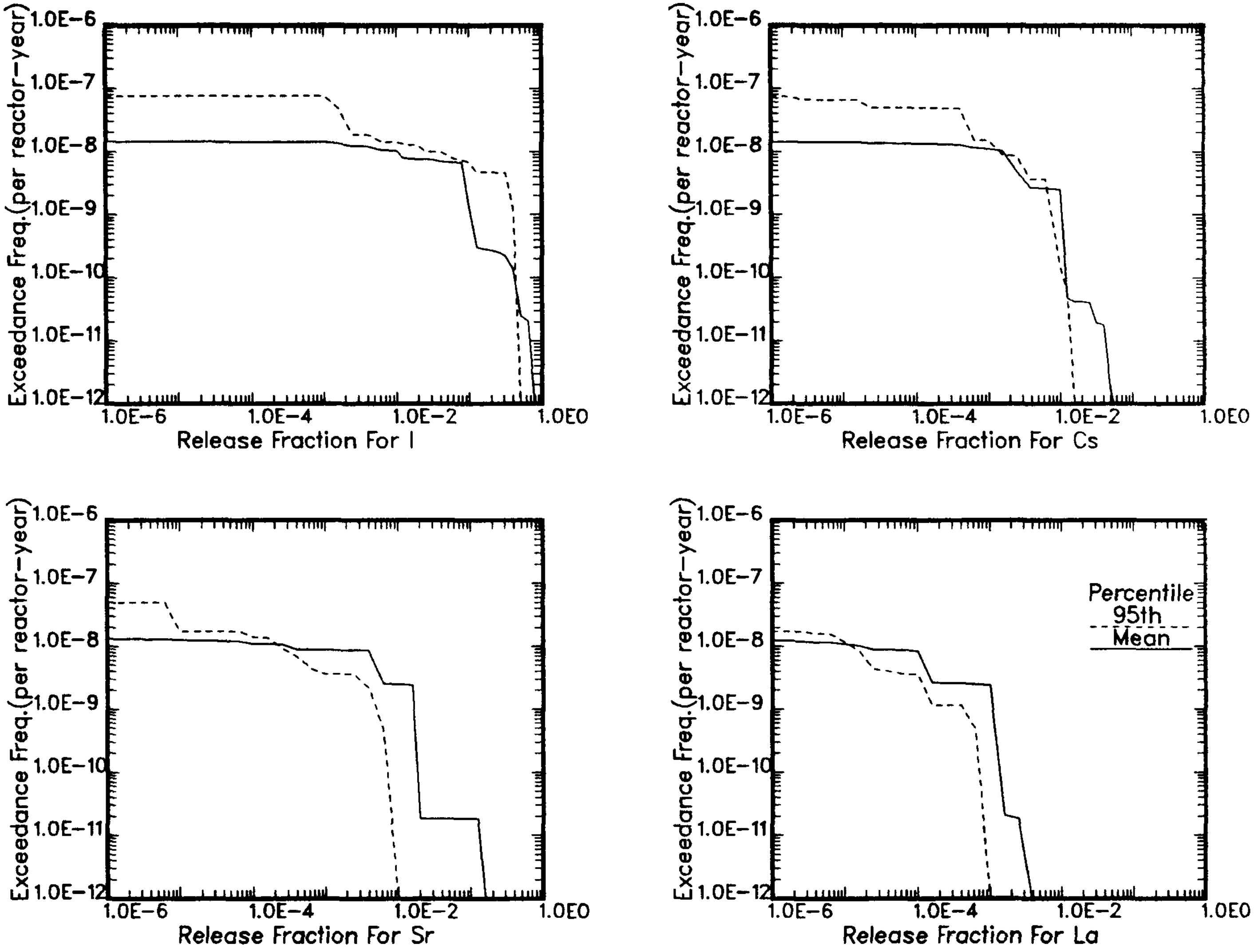

Figure 3.3-14
Peach Bottom: Generalized APB 5
Source Term CCDF: Core Damage, VB, Late Wetwell Failure

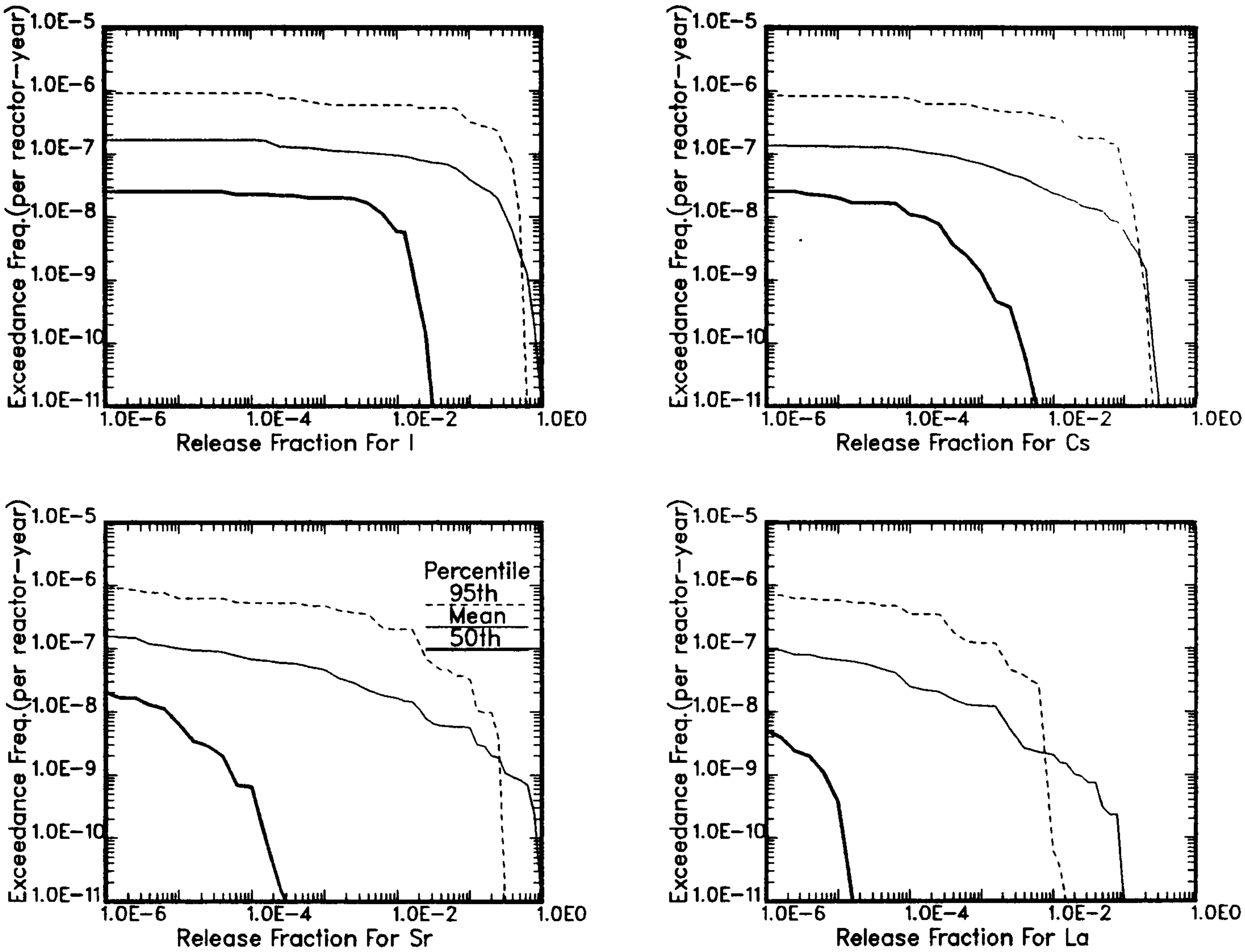

Figure 3.3-15
Peach Bottom: Generalized APB 6
Source Term CCDF: Core Damage, VB, Late Drywell Failure

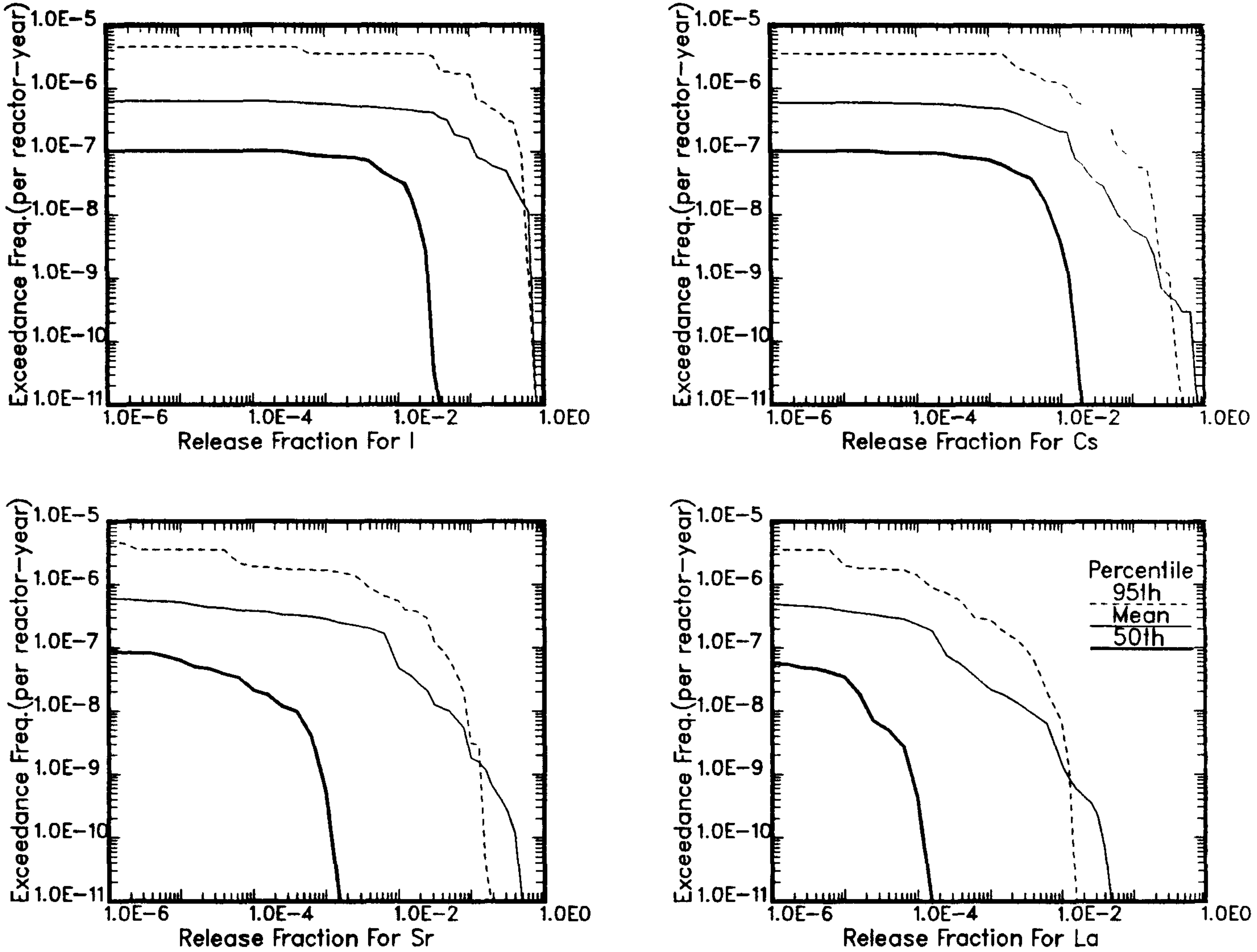

Figure 3.3-16
Peach Bottom: Generalized APB 7
Source Term CCDF: Core Damage, VB, Venting

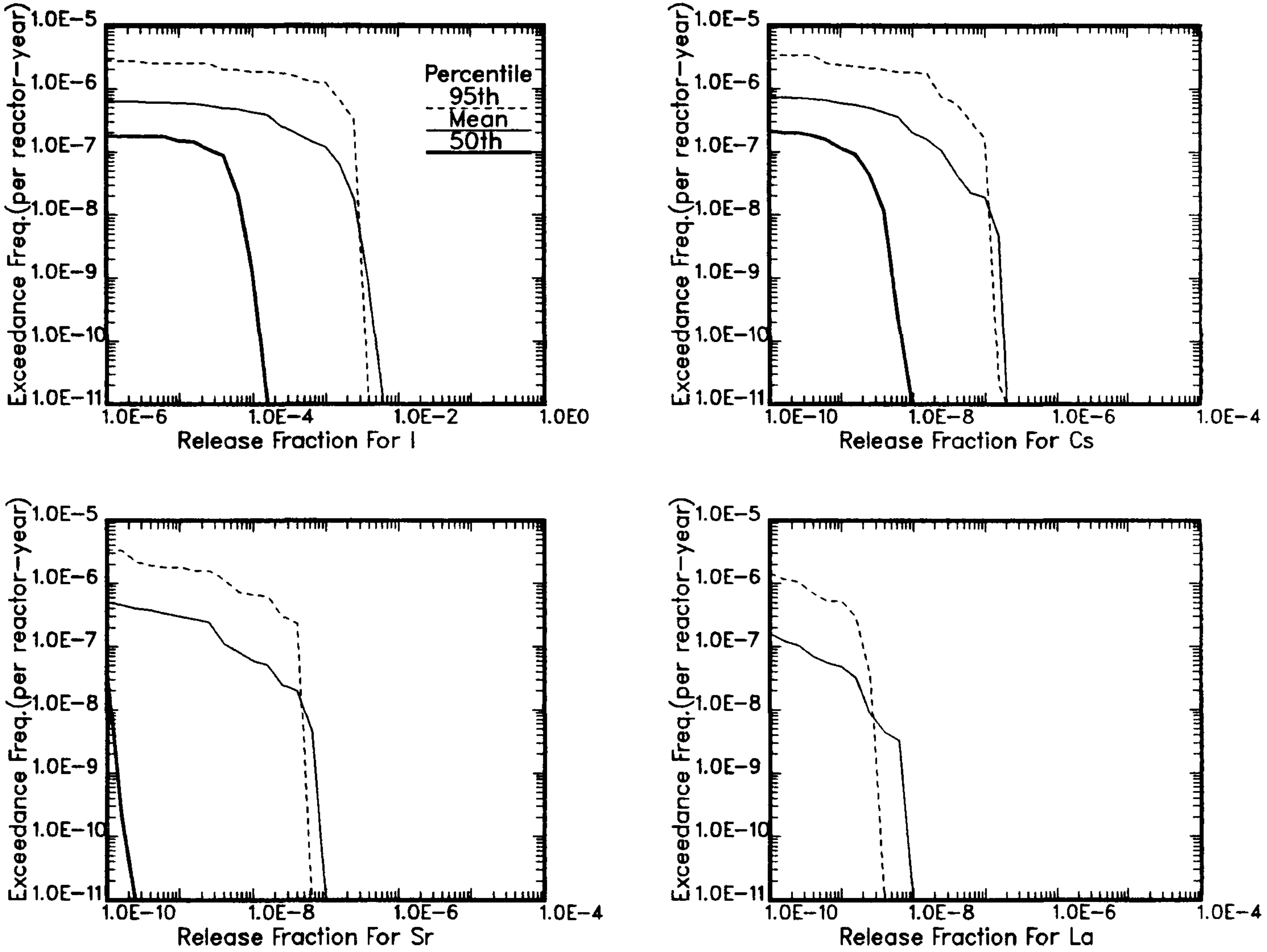

Figure 3.3-17
Peach Bottom: Generalized APB 8
Source Term CCDF: Core Damage, VB, No Containment Failure

Figure 3.3-18 shows the variation of the exceedance frequency with release fraction for all the APBs in which the vessel breach is averted. Although the vessel does not fail in these APBs, some of these bins involve early containment failure. Thus, the release fractions for these APBs are typically larger than the release fraction presented in the previous figure.

There is no figure presented for the last bin, no core damage. Since no core damage has occurred, the releases are negligibly small.

3.3.1.11 Summary

When all the types of internally initiated accidents at Peach Bottom are considered together, the exceedance frequency plots shown in Figure 3.3-19 are obtained. A plot is not shown for the noble gases since almost all of the noble gases (Xe and Kr) in the core are eventually released to the environment whether the containment fails or not. The mean frequency of exceeding a release fraction of 0.10 for I and Cs is on the order of 1E-06/year and for Te and Sr it is on the order of 2E-07/year. The second sheet of Figure 3.3-19 shows the release fractions for Ru, La, Ce, and Ba, which are often treated together as aerosol species. The mean frequency of exceeding a release fraction of 0.01 for Ru, La, and Ce is on the order of 1E-07/year. The releases for the barium class are slightly higher than those for the other three aerosol radionuclide classes.

3.3.1.12 Sensitivity Analysis Results

No sensitivities were carried through to the source term results for the internal analysis. Only the effects of no drywell shell meltthrough were investigated and that analysis was stopped after the APET evaluation.

3.3.2 Results for Fire Initiators

In a manner analogous to Section 2.5.3, the results of the source term analysis for fire initiators are presented for each PDS group. The tables in this section only provide a sample of APBs and their associated mean source terms for the various PDSs.

3.3.2.1 Results for PDS 1: Fast Transient

This PDS is composed of three fire scenarios, two in the control room and one in the cable spreading room. Power is available but remote control of the systems has been lost and auto actuation has failed due to the fire. The operator fails to manually control the plant from the remote shutdown panel in time to prevent core damage. No injection is available and early core damage ensues with the RPV at high pressure. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.33. The probability of recovering injection and averting VB is 0.22.

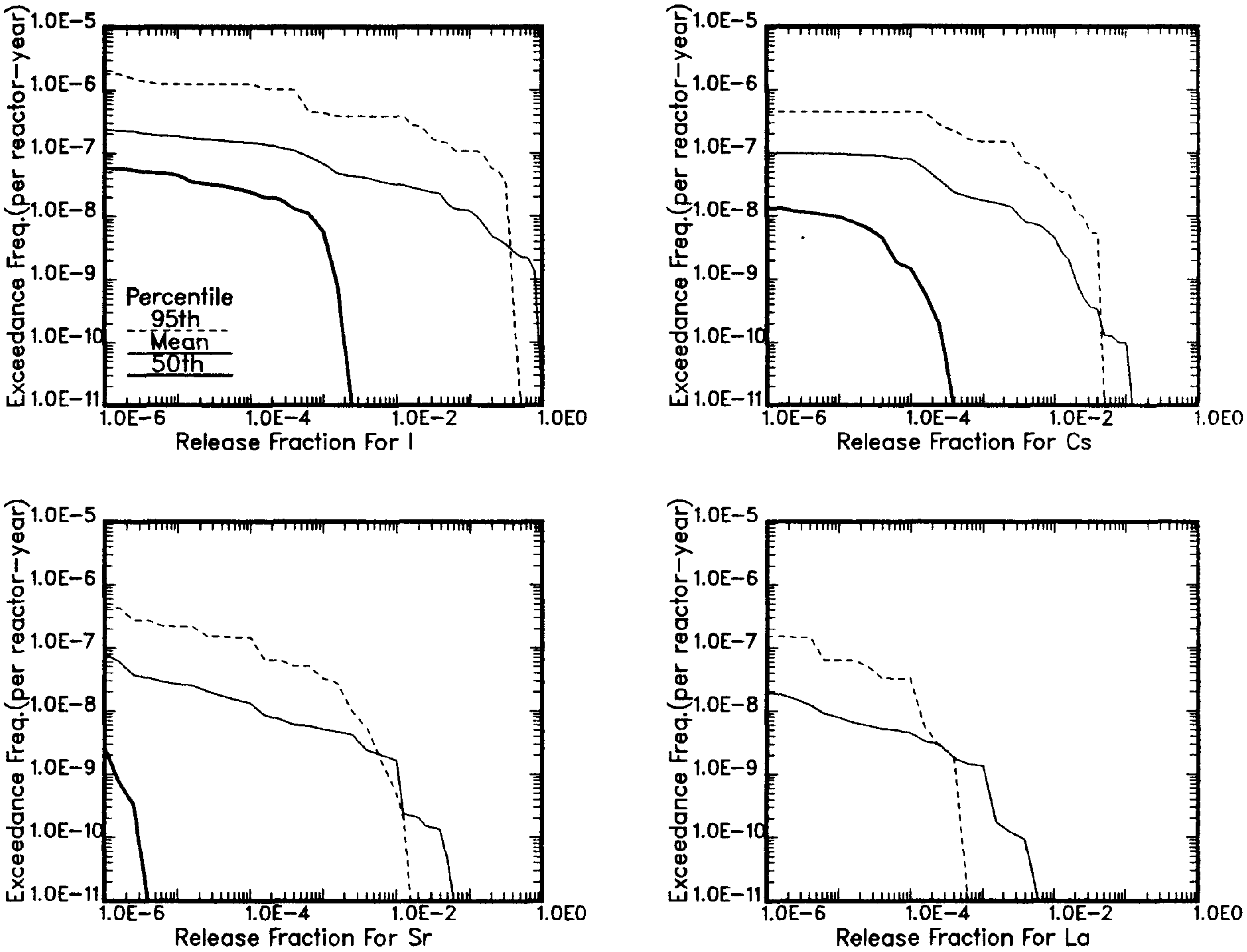

Figure 3.3-18
Peach Bottom: Generalized APB 9
Source Term CCDF: No Vessel Breach

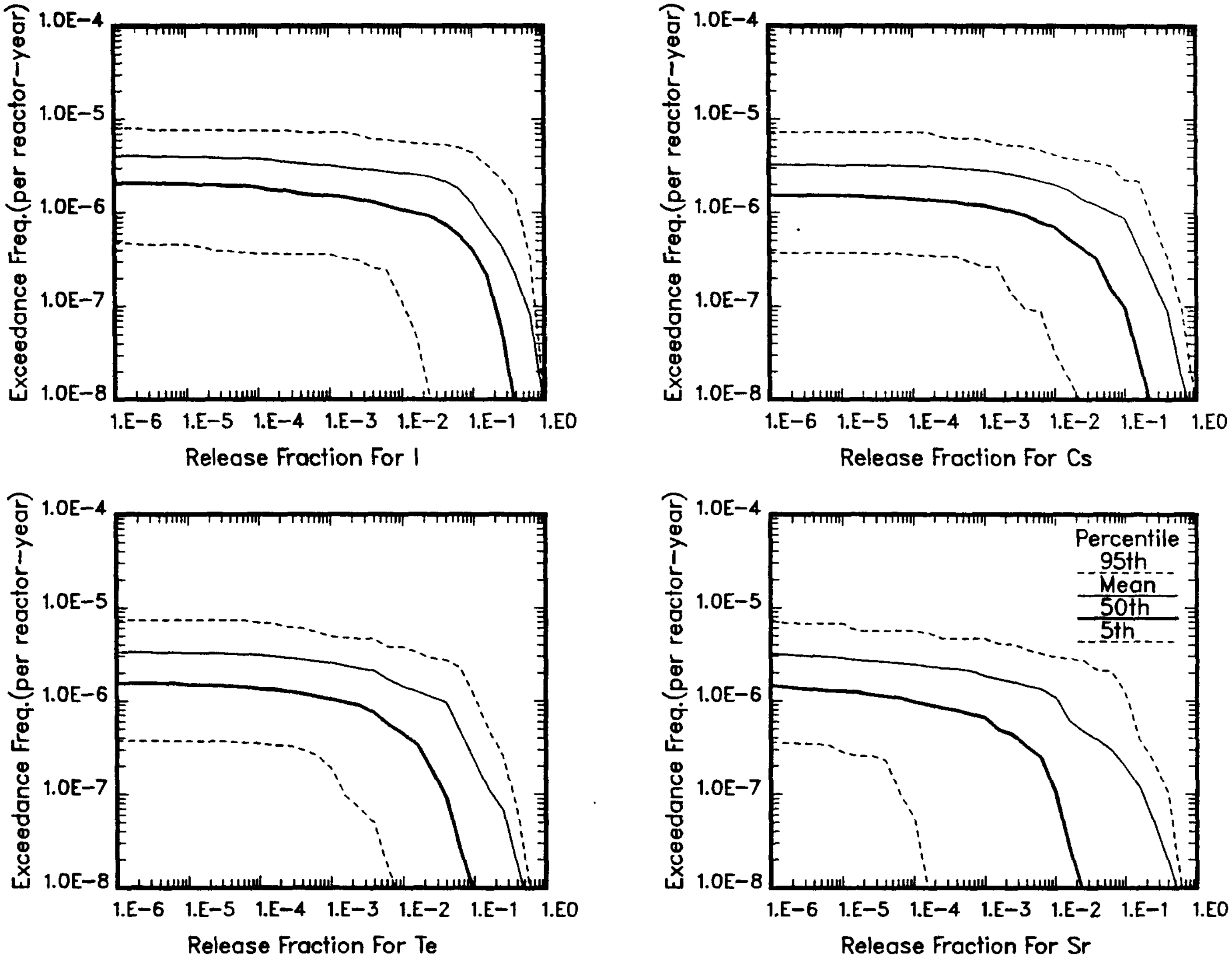

Figure 3.3-19a
Peach Bottom: Total Internal
Source Term CCDF

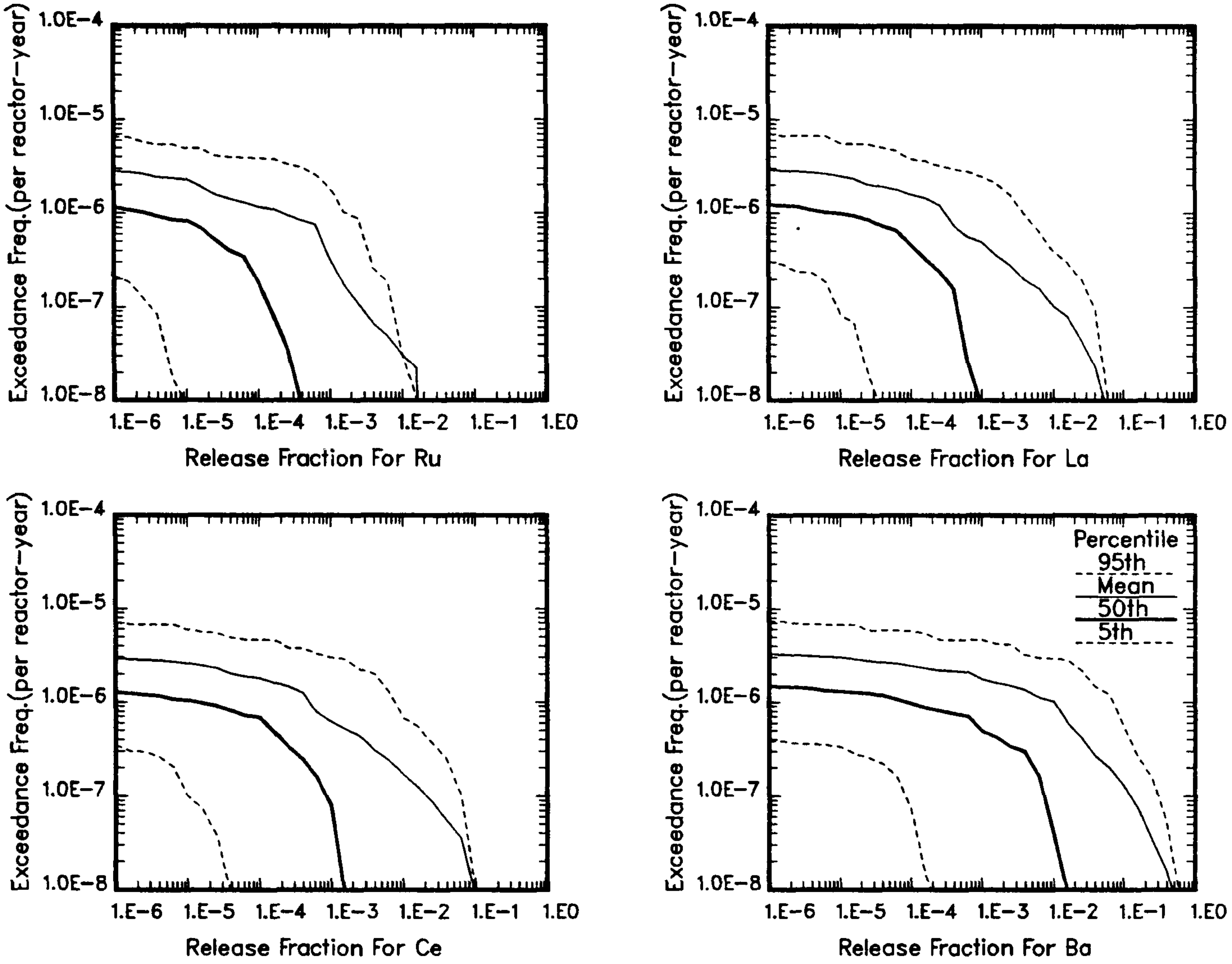

Figure 3.3-19b
Peach Bottom: Total Internal
Source Term CCDF

Table 2.5-12 lists the five most probable APBs, the five most probable APBs that have VB, and the five most probable APBs that have early containment failure (CF). A discussion of the accident characteristics for these APBs is presented in Section 2.5.3.1. Table 3.3-10 lists the mean source terms for these same APBs. For this PDS, containment sprays are available and used after the start of core damage. It is possible for the operator to recover injection during core damage and in the five most probable APBs this is done. The source terms for the cases with core damage arrest are lower than source terms for APBs with no containment failure. All of the APBs have containment sprays and the CCI release occurs with continuous water except in APB # 15 where the sprays fail at vessel breach.

Figure 3.3-20 summarizes the release fraction CCDFs for PDS 1.

3.3.2.2 Results for PDS 2: Slow SBO

This PDS is composed of eight fire scenarios in different emergency switchgear rooms (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D). All lead to a fire induced LOSP followed by a random loss of emergency service water due to valve failure resulting in an early loss of all AC power and station blackout. HPCI will work until it fails on battery depletion or high suppression pool temperature and late core damage will ensue. In 64% of the cases, DC power will be lost and the core degradation will proceed at high RPV pressure. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.86. The probability of recovering AC and averting VB is 0.00.

Table 2.5-13 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.3.2. Table 3.3-11 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For fire initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons (none of which occurred for this PDS). Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection.

Figure 3.3-21 summarizes the release fraction CCDFs for PDS 2.

3.3.2.3 Results for PDS 3: Slow SBO

This PDS is composed of eight fire scenarios in different switchgear rooms (2A, 2B, 2C, 2D, 3A,3B, 3C, and 3D). All lead to fire induced LOSP followed by a random loss of emergency service water from DG failure to run resulting in a delayed station blackout. HPCI will work until failure on high suppression pool temperature and late core damage will ensue. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.88. The probability of recovering AC and averting VB is 0.00.

Table 3.3-10
Mean Source Terms for Peach Bottom
Fire Initiators - PDS 1 - Fast Transient

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Five Most Probable Bins*															
1	BBEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.6E-03	1.6E-05	8.5E-10	4.2E-10	1.3E-10	1.9E-11	6.8E-12	3.0E-11	1.3E-10
				4.8E+04	3.1E+04	2.2E+04	1.6E-03	1.6E-05	8.5E-10	4.2E-10	1.3E-10	1.9E-11	6.8E-12	3.0E-11	1.3E-10
2	BADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.4E-04	1.5E-08	5.2E-09	4.3E-09	1.3E-10	2.4E-10	5.2E-10	3.5E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.4E-04	1.5E-08	5.2E-09	4.3E-09	1.3E-10	2.4E-10	5.2E-10	3.5E-09
3	BAEEICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	1.9E-03	1.5E-05	2.1E-09	1.3E-09	3.3E-10	8.4E-11	2.7E-11	1.6E-10	3.5E-10
				4.8E+04	3.1E+04	2.2E+04	1.9E-03	1.5E-05	2.1E-09	1.3E-09	3.3E-10	8.4E-11	2.7E-11	1.6E-10	3.5E-10
4	BBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.7E-04	8.1E-09	3.4E-09	3.3E-09	2.0E-11	2.1E-10	4.3E-10	2.8E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.7E-04	8.1E-09	3.4E-09	3.3E-09	2.0E-11	2.1E-10	4.3E-10	2.8E-09
5	BBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	8.2E-09	3.5E-09	3.4E-09	9.4E-11	2.3E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	8.2E-09	3.5E-09	3.4E-09	9.4E-11	2.3E-10	4.4E-10	2.9E-09
Mean Source Terms for Five Most Probable Bins that have VB*															
2	BADEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	2.4E-04	1.5E-08	5.2E-09	4.3E-09	1.3E-10	2.4E-10	5.2E-10	3.5E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	2.4E-04	1.5E-08	5.2E-09	4.3E-09	1.3E-10	2.4E-10	5.2E-10	3.5E-09
4	BBDEICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.7E-04	8.1E-09	3.4E-09	3.3E-09	2.0E-11	2.1E-10	4.3E-10	2.8E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.7E-04	8.1E-09	3.4E-09	3.3E-09	2.0E-11	2.1E-10	4.3E-10	2.8E-09
5	BBDDICDBAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.5E-03	3.6E-04	8.2E-09	3.5E-09	3.4E-09	9.4E-11	2.3E-10	4.4E-10	2.9E-09
				4.8E+04	3.1E+04	2.2E+04	2.5E-03	3.6E-04	8.2E-09	3.5E-09	3.4E-09	9.4E-11	2.3E-10	4.4E-10	2.9E-09
6	BBDEFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.8E-01	3.9E-03	3.6E-03	2.0E-03	1.0E-03	1.4E-04	8.6E-05	4.3E-04	1.0E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.3E-01	5.0E-02	1.5E-02	1.2E-02	1.4E-05	8.5E-04	1.6E-03	1.0E-02
7	BACBICDCAA	4.0E+03	3.0E+01	2.5E+05	2.2E+04	9.0E+03	2.0E-03	1.8E-05	2.3E-09	7.9E-10	1.9E-10	1.3E-10	3.5E-11	7.2E-11	2.2E-10
				4.8E+04	3.1E+04	2.2E+04	2.0E-03	1.8E-05	2.3E-09	7.9E-10	1.9E-10	1.3E-10	3.5E-11	7.2E-11	2.2E-10
Mean Source Terms for Five Most Probable Bins that have VB and Early CF*															
6	BBDEFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.8E-01	3.9E-03	3.6E-03	2.0E-03	1.0E-03	1.4E-04	8.6E-05	4.3E-04	1.0E-03
				3.7E+05	1.3E+04	1.4E+04	3.2E-01	2.3E-01	5.0E-02	1.5E-02	1.2E-02	1.4E-05	8.5E-04	1.6E-03	1.0E-02
9	BBDEFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	6.7E-01	3.0E-03	2.7E-03	1.7E-03	1.0E-03	1.4E-04	9.0E-05	4.5E-04	1.1E-03
				7.2E+04	1.3E+04	1.4E+04	3.3E-01	2.0E-01	9.0E-03	2.8E-03	2.7E-03	2.6E-06	1.8E-04	3.4E-04	2.2E-03
11	BBDDFBBBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.1E-01	5.4E-03	5.2E-03	2.3E-03	1.1E-03	4.2E-04	1.5E-04	4.9E-04	1.2E-03
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	2.1E-01	4.0E-02	1.3E-02	1.2E-02	1.3E-05	8.2E-04	1.6E-03	9.8E-03
14	BADEFBDBAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.6E-01	2.2E-03	1.9E-03	1.2E-03	3.9E-04	9.3E-05	2.8E-05	1.9E-04	4.1E-04
				7.2E+04	1.3E+04	1.4E+04	2.4E-01	1.2E-01	4.1E-03	1.2E-03	1.5E-03	1.1E-08	4.4E-05	7.6E-05	1.1E-03
15	BAABFBBAAA	4.0E+03	3.0E+01	1.3E+07	1.3E+04	1.8E+02	7.7E-01	4.5E-03	4.1E-03	1.2E-03	3.0E-04	2.3E-04	5.8E-05	7.9E-05	3.5E-04
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	7.6E-02	7.3E-02	3.0E-02	3.4E-02	1.2E-04	2.6E-03	5.2E-03	2.5E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-11
Mean Source Terms for Peach Bottom
Fire Initiators - PDS 2 - Slow SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	GAABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.7E-01	3.1E-03	3.0E-03	1.4E-03	3.4E-04	2.3E-04	6.3E-05	1.1E-04	3.9E-04
				1.9E+06	4.2E+04	1.4E+04	2.3E-01	8.9E-02	6.9E-02	3.5E-02	3.7E-02	4.1E-04	2.5E-03	4.9E-03	2.8E-02
2	GBABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	5.6E-03	5.7E-03	4.4E-03	3.4E-03	8.1E-04	3.7E-04	1.5E-03	3.5E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	1.6E-01	1.0E-01	5.4E-02	4.6E-02	9.9E-04	5.4E-03	8.0E-03	3.9E-02
3	GAABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.8E-01	4.7E-03	4.8E-03	2.3E-03	5.7E-04	4.7E-04	1.2E-04	1.7E-04	6.9E-04
				1.9E+06	4.2E+04	1.4E+04	2.2E-01	1.2E-01	1.1E-01	6.0E-02	5.5E-02	4.1E-04	3.3E-03	6.6E-03	4.2E-02
4	GAABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.3E-02	1.2E-02	6.4E-03	2.1E-03	1.6E-03	4.0E-04	5.8E-04	2.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	3.0E-01	2.9E-01	1.6E-01	1.5E-01	2.4E-03	9.6E-03	1.9E-02	1.2E-01
5	FAABFBAAAA	1.4E+04	3.0E+01	7.7E+06	2.7E+04	9.0E+02	7.6E-01	3.4E-03	3.4E-03	1.7E-03	3.6E-04	2.5E-04	8.0E-05	1.3E-04	4.3E-04
				1.9E+06	2.8E+04	1.4E+04	2.4E-01	9.0E-02	7.0E-02	3.6E-02	4.0E-02	4.4E-04	2.6E-03	5.2E-03	3.0E-02
6	GAADFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.5E-01	8.3E-03	7.0E-03	4.2E-03	4.5E-04	3.4E-04	9.4E-05	2.5E-04	5.7E-04
				1.9E+06	4.2E+04	1.4E+04	1.5E-01	1.2E-01	6.1E-02	3.1E-02	2.6E-02	1.1E-06	1.0E-03	2.1E-03	1.8E-02
7	GBABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	6.6E-03	6.7E-03	5.3E-03	4.1E-03	1.1E-03	4.6E-04	1.8E-03	4.2E-03
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.8E-01	1.2E-01	7.0E-02	6.1E-02	1.1E-03	6.2E-03	9.4E-03	5.0E-02
8	FBABFBAAAA	1.4E+04	3.0E+01	7.7E+06	2.7E+04	9.0E+02	7.9E-01	5.7E-03	5.8E-03	4.4E-03	3.4E-03	8.1E-04	3.7E-04	1.5E-03	3.5E-03
				1.9E+06	2.8E+04	1.4E+04	2.1E-01	1.6E-01	1.0E-01	5.4E-02	4.7E-02	9.9E-04	5.4E-03	8.0E-03	3.9E-02
9	GBAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.1E-02	1.2E-02	4.4E-03	1.0E-03	1.4E-03	4.3E-04	4.3E-04	1.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	1.1E-01	9.7E-02	5.2E-02	3.6E-02	3.1E-04	2.6E-03	4.0E-03	2.8E-02
10	GAAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	1.0E-02	1.1E-02	1.4E-03	1.8E-04	3.3E-04	1.8E-04	1.8E-04	2.7E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.3E-01	7.6E-02	2.0E-02	2.0E-02	7.0E-06	9.4E-04	1.8E-03	1.3E-02
11	GAABACAAAB	2.9E+04	3.0E+01	7.7E+05	4.7E+04	9.0E+03	5.0E-01	2.4E-02	2.3E-02	3.0E-02	2.8E-02	2.7E-04	1.8E-03	3.9E-03	2.4E-02
				1.3E+06	5.6E+04	2.2E+04	5.0E-01	2.4E-02	2.3E-02	3.0E-02	2.8E-02	2.7E-04	1.8E-03	3.9E-03	2.4E-02
12	GBABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	1.7E-02	1.7E-02	1.2E-02	8.8E-03	2.0E-03	9.2E-04	3.7E-03	9.0E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	3.5E-01	3.0E-01	1.6E-01	1.5E-01	2.0E-03	1.5E-02	2.3E-02	1.2E-01
13	GAABHBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	5.3E-03	5.7E-03	2.2E-03	5.2E-04	5.5E-04	1.3E-04	1.3E-04	6.7E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.2E-01	3.7E-02	2.5E-02	2.2E-02	1.9E-06	8.2E-04	1.7E-03	1.5E-02
14	GBADACAAAB	2.9E+04	3.0E+01	7.7E+05	4.7E+04	9.0E+03	5.0E-01	3.0E-02	3.1E-02	8.2E-03	1.6E-03	1.3E-05	4.7E-05	8.1E-05	1.0E-03
				1.3E+06	5.6E+04	2.2E+04	5.0E-01	3.0E-02	3.1E-02	8.2E-03	1.6E-03	1.3E-05	4.7E-05	8.1E-05	1.0E-03
15	GAADEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	8.7E-03	7.3E-03	4.2E-03	6.7E-04	5.5E-04	1.2E-04	2.8E-04	8.8E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.5E-01	1.2E-01	8.5E-02	8.6E-02	1.2E-03	5.4E-03	1.1E-02	7.0E-02

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* A listing of source terms for all bins is available on computer media

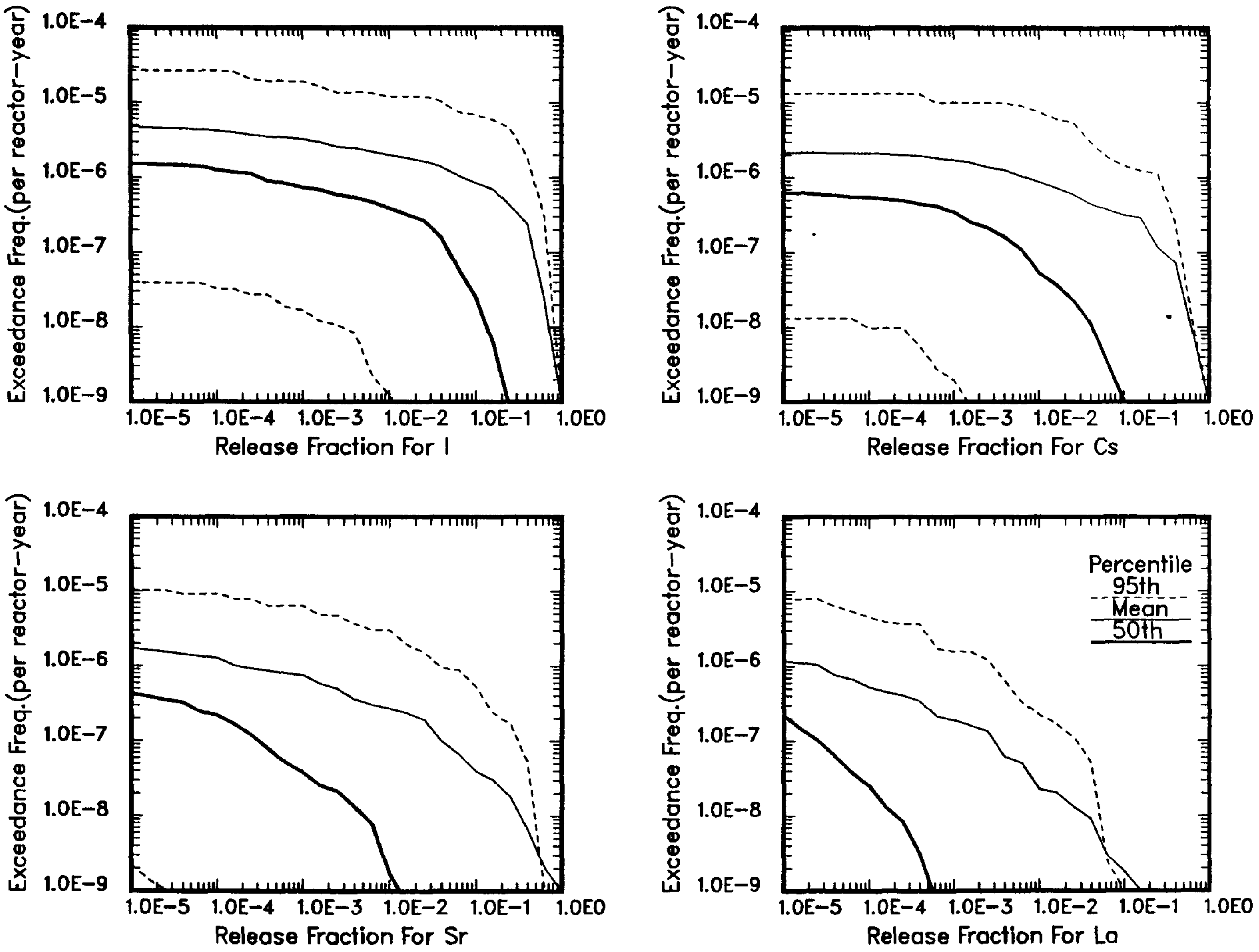

Figure 3.3-20
Peach Bottom: Fire PDS 1 - Fast Transient
Source Term CCDF

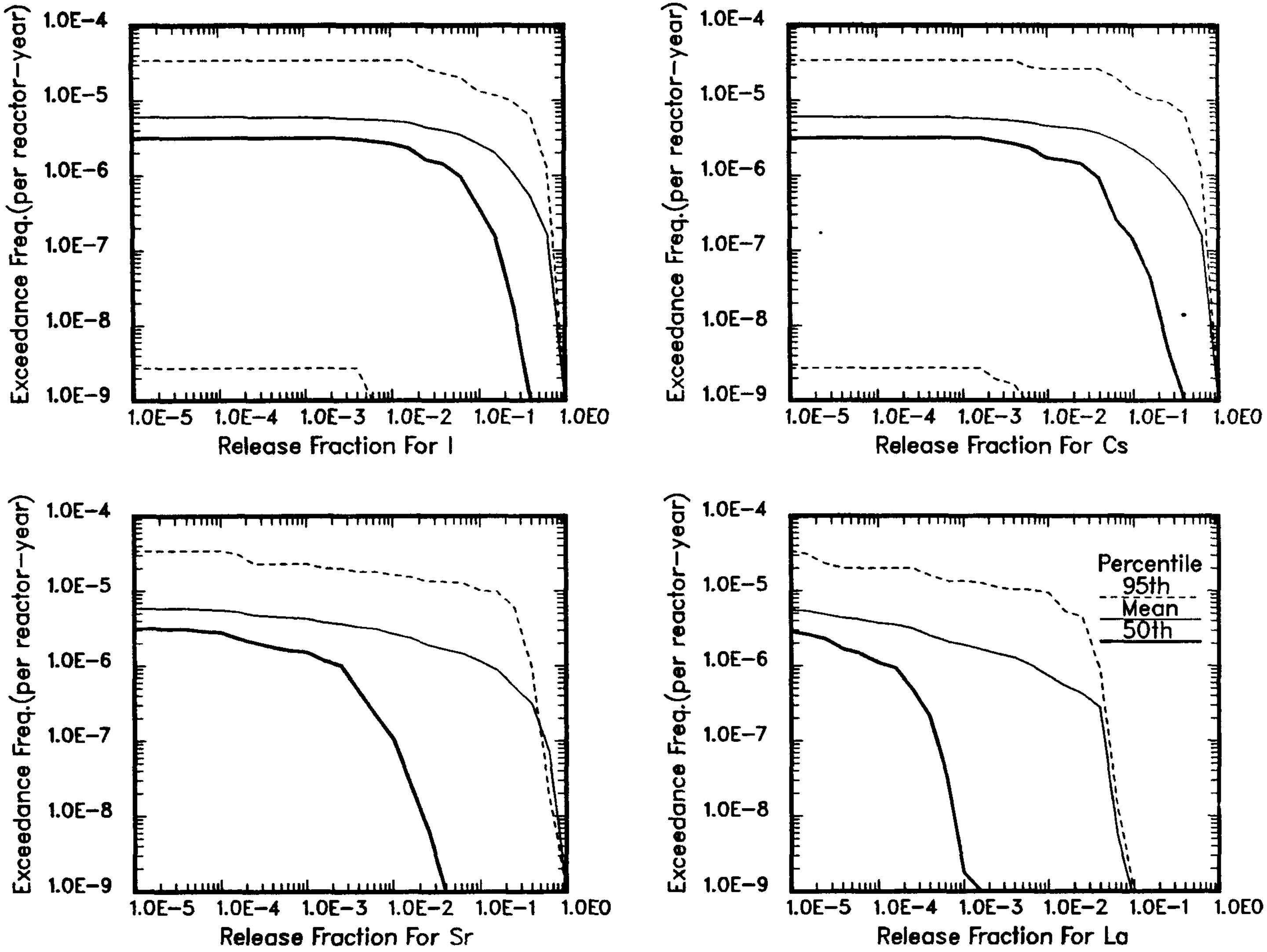

Figure 3.3-21
Peach Bottom: Fire PDS 2 - Slow SBO
Source Term CCDF

Table 2.5-14 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.3.3. Table 3.3-12 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For fire initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons (none of which occurred for this PDS). Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection.

Figure 3.3-22 summarizes the release fraction CCDFs for PDS 3.

3.3.2.4 Results for PDS 4: Transient CV

This PDS is composed of two fire scenarios in emergency switchgear room 2C. The fires result in LOSP with failure of PCS, venting, and failure of most RHR trains. Random failures complete the failure of containment heat removal. The HPCI and LPCI systems succeed but core damage results when HPCI fails on high suppression pool temperature and LPCI fails when the SRVs reclose on high containment pressure. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.997. The probability of recovering AC and averting VB is 0.00.

Table 2.5-15 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.3.4. Table 3.3-13 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For fire initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons (none of which occurred for this PDS). Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection.

Figure 3.3-23 summarizes the release fraction CCDFs for PDS 4.

3.3.2.5 Results for Generalized Accident Progression Bins

The preceding four subsections presented the source term results by PDS group. It is also possible to group the source terms in other ways. These other groupings are called generalized APBs. These generalized APBs are generated by sorting all of the bins from the ten PDSs on attributes of the accident. The generalized bins are composed of essentially five characteristics: the occurrence of core damage, the occurrence of vessel breach, the pressure at vessel breach, the location of containment failure, and the timing of containment failure with respect to vessel breach. A description of these reduced bins is presented in section 2.4.3.

Table 3.3-12
Mean Source Terms for Peach Bottom
Fire Initiators - PDS 3 - Slow SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	GAABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.7E-01	3.1E-03	3.0E-03	1.4E-03	3.4E-04	2.3E-04	6.3E-05	1.1E-04	3.9E-04
				1.9E+06	4.2E+04	1.4E+04	2.3E-01	8.9E-02	6.9E-02	3.5E-02	3.7E-02	4.1E-04	2.5E-03	4.9E-03	2.8E-02
2	GBABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	5.6E-03	5.7E-03	4.4E-03	3.4E-03	8.1E-04	3.7E-04	1.5E-03	3.5E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	1.6E-01	1.0E-01	5.4E-02	4.6E-02	9.9E-04	5.4E-03	8.0E-03	3.9E-02
3	GAABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.8E-01	4.7E-03	4.8E-03	2.3E-03	5.7E-04	4.7E-04	1.2E-04	1.7E-04	6.9E-04
				1.9E+06	4.2E+04	1.4E+04	2.2E-01	1.2E-01	1.1E-01	6.0E-02	5.5E-02	4.1E-04	3.3E-03	6.6E-03	4.2E-02
4	GAABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.3E-02	1.2E-02	6.4E-03	2.1E-03	1.6E-03	4.0E-04	5.8E-04	2.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	3.0E-01	2.9E-01	1.6E-01	1.5E-01	2.4E-03	9.6E-03	1.9E-02	1.2E-01
5	GAADFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.5E-01	8.3E-03	7.0E-03	4.2E-03	4.5E-04	3.4E-04	9.4E-05	2.5E-04	5.7E-04
				1.9E+06	4.2E+04	1.4E+04	1.5E-01	1.2E-01	6.1E-02	3.1E-02	2.6E-02	1.1E-06	1.0E-03	2.1E-03	1.8E-02
6	GBABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	6.6E-03	6.7E-03	5.3E-03	4.1E-03	1.1E-03	4.6E-04	1.8E-03	4.2E-03
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.8E-01	1.2E-01	7.0E-02	6.1E-02	1.1E-03	6.2E-03	9.4E-03	5.0E-02
7	GBAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.1E-02	1.2E-02	4.4E-03	1.0E-03	1.4E-03	4.3E-04	4.3E-04	1.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	1.1E-01	9.7E-02	5.2E-02	3.6E-02	3.1E-04	2.6E-03	4.0E-03	2.8E-02
8	GAAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	1.0E-02	1.1E-02	1.4E-03	1.8E-04	3.3E-04	1.8E-04	1.8E-04	2.7E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.3E-01	7.6E-02	2.0E-02	2.0E-02	7.0E-06	9.4E-04	1.8E-03	1.3E-02
9	GAABACAAAB	2.9E+04	3.0E+01	7.7E+05	4.7E+04	9.0E+03	5.0E-01	2.4E-02	2.3E-02	3.0E-02	2.8E-02	2.7E-04	1.8E-03	3.9E-03	2.4E-02
				1.3E+06	5.6E+04	2.2E+04	5.0E-01	2.4E-02	2.3E-02	3.0E-02	2.8E-02	2.7E-04	1.8E-03	3.9E-03	2.4E-02
10	GBABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	1.7E-02	1.7E-02	1.2E-02	8.8E-03	2.0E-03	9.2E-04	3.7E-03	9.0E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	3.5E-01	3.0E-01	1.6E-01	1.5E-01	2.0E-03	1.5E-02	2.3E-02	1.2E-01
11	GAABHBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	5.3E-03	5.7E-03	2.2E-03	5.2E-04	5.5E-04	1.3E-04	1.3E-04	6.7E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.2E-01	3.7E-02	2.5E-02	2.2E-02	1.9E-06	8.2E-04	1.7E-03	1.5E-02
12	GBADACAAAB	2.9E+04	3.0E+01	7.7E+05	4.7E+04	9.0E+03	5.0E-01	3.0E-02	3.1E-02	8.2E-03	1.6E-03	1.3E-05	4.7E-05	8.1E-05	1.0E-03
				1.3E+06	5.6E+04	2.2E+04	5.0E-01	3.0E-02	3.1E-02	8.2E-03	1.6E-03	1.3E-05	4.7E-05	8.1E-05	1.0E-03
13	GAADEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	8.7E-03	7.3E-03	4.2E-03	6.7E-04	5.5E-04	1.2E-04	2.8E-04	8.8E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.5E-01	1.2E-01	8.5E-02	8.6E-02	1.2E-03	5.4E-03	1.1E-02	7.0E-02
14	GAADHBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.2E-01	6.2E-03	5.2E-03	2.4E-03	7.8E-04	5.7E-04	9.4E-05	1.2E-04	9.2E-04
				1.9E+06	4.2E+04	1.4E+04	2.8E-01	1.3E-01	3.8E-02	2.8E-02	2.9E-02	4.3E-04	2.5E-03	5.1E-03	2.6E-02
15	GBADFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	5.2E-01	2.7E-03	2.9E-03	7.6E-04	3.8E-05	6.9E-05	4.0E-05	4.0E-05	7.6E-05
				1.9E+06	4.2E+04	1.4E+04	4.8E-01	1.5E-01	1.5E-01	1.1E-01	1.1E-01	4.7E-05	8.4E-03	1.4E-02	8.4E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-13
Mean Source Terms for Peach Bottom
Fire Initiators - PDS 4 - Transient CV

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	GAABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.3E-02	1.2E-02	6.4E-03	2.1E-03	1.6E-03	4.0E-04	5.8E-04	2.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	3.0E-01	2.9E-01	1.6E-01	1.5E-01	2.4E-03	9.6E-03	1.9E-02	1.2E-01
2	GBABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	1.7E-02	1.7E-02	1.2E-02	8.8E-03	2.0E-03	9.2E-04	3.7E-03	9.0E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	3.5E-01	3.0E-01	1.6E-01	1.5E-01	2.0E-03	1.5E-02	2.3E-02	1.2E-01
3	GAABEBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.8E-01	1.2E-02	1.1E-02	5.7E-03	2.0E-03	1.5E-03	3.6E-04	5.2E-04	2.2E-03
				1.9E+06	4.2E+04	1.4E+04	2.2E-01	2.9E-01	2.9E-01	1.6E-01	1.5E-01	2.0E-03	9.0E-03	1.8E-02	1.1E-01
4	GAABGBAAAB	2.9E+04	3.0E+01	0.0E+00	4.1E+04	9.0E+02	8.3E-01	1.1E-02	1.1E-02	5.1E-03	1.9E-03	1.9E-03	3.7E-04	3.9E-04	2.3E-03
				0.0E+00	4.2E+04	1.4E+04	1.7E-01	1.2E-01	5.6E-02	3.6E-02	3.2E-02	3.7E-06	1.2E-03	2.5E-03	2.2E-02
5	GAADFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.1E-01	1.3E-02	1.1E-02	6.8E-03	1.3E-03	8.7E-04	2.7E-04	8.1E-04	1.5E-03
				1.9E+06	4.2E+04	1.4E+04	1.9E-01	2.8E-01	2.2E-01	1.2E-01	1.2E-01	2.2E-06	3.6E-03	7.2E-03	7.8E-02
6	GBABEBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	1.6E-02	1.6E-02	1.1E-02	7.6E-03	2.0E-03	8.3E-04	3.1E-03	7.8E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	3.6E-01	3.0E-01	1.7E-01	1.4E-01	1.6E-03	1.3E-02	2.0E-02	1.1E-01
7	GBABGBAAAB	2.9E+04	3.0E+01	0.0E+00	4.1E+04	9.0E+02	7.0E-01	9.1E-03	9.2E-03	4.3E-03	2.1E-03	1.5E-03	3.5E-04	5.3E-04	2.3E-03
				0.0E+00	4.2E+04	1.4E+04	3.0E-01	1.9E-01	5.4E-02	2.2E-02	1.1E-02	8.2E-06	6.6E-04	1.1E-03	8.2E-03
8	GAABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.7E-01	3.1E-03	3.0E-03	1.4E-03	3.4E-04	2.3E-04	6.3E-05	1.1E-04	3.9E-04
				1.9E+06	4.2E+04	1.4E+04	2.3E-01	8.9E-02	6.9E-02	3.5E-02	3.7E-02	4.1E-04	2.5E-03	4.9E-03	2.8E-02
9	GAAAFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	3.2E-02	3.5E-02	6.0E-03	6.4E-04	1.2E-03	6.9E-04	6.9E-04	1.1E-03
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	2.7E-01	2.1E-01	8.2E-02	1.0E-01	7.7E-05	5.8E-03	1.2E-02	7.7E-02
10	GBAAFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	2.9E-02	3.1E-02	1.4E-02	1.0E-02	1.2E-02	2.0E-03	2.1E-03	1.2E-02
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	3.2E-01	2.9E-01	1.7E-01	1.4E-01	8.4E-04	1.0E-02	1.6E-02	1.2E-01
11	GBABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	5.6E-03	5.7E-03	4.4E-03	3.4E-03	8.1E-04	3.7E-04	1.5E-03	3.5E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	1.6E-01	1.0E-01	5.4E-02	4.6E-02	9.9E-04	5.4E-03	8.0E-03	3.9E-02
12	GAABFBAABB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.7E-02	1.6E-02	8.3E-03	2.4E-03	1.6E-03	4.2E-04	6.7E-04	2.7E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	3.0E-01	3.0E-01	1.6E-01	1.5E-01	2.4E-03	9.8E-03	2.0E-02	1.2E-01
13	GBADGBAAAB	2.9E+04	3.0E+01	0.0E+00	4.1E+04	9.0E+02	6.9E-01	5.0E-03	5.2E-03	1.6E-03	1.9E-04	1.9E-04	8.0E-05	8.7E-05	2.7E-04
				0.0E+00	4.2E+04	1.4E+04	3.1E-01	8.6E-02	6.3E-02	1.7E-02	2.3E-03	3.3E-10	4.6E-05	8.2E-05	1.3E-03
14	GAADGBAAAB	2.9E+04	3.0E+01	0.0E+00	4.1E+04	9.0E+02	7.2E-01	1.5E-02	1.3E-02	5.3E-03	1.7E-03	1.4E-03	2.2E-04	2.5E-04	2.0E-03
				0.0E+00	4.2E+04	1.4E+04	2.8E-01	1.8E-01	1.1E-01	6.5E-02	6.5E-02	7.7E-04	5.2E-03	1.1E-02	5.7E-02
15	GAADEBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.7E-01	1.5E-02	1.2E-02	6.5E-03	1.5E-03	1.1E-03	2.6E-04	6.3E-04	1.8E-03
				1.9E+06	4.2E+04	1.4E+04	2.3E-01	3.3E-01	2.9E-01	1.9E-01	2.0E-01	1.4E-03	9.2E-03	1.9E-02	1.4E-01

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* A listing of source terms for all bins is available on computer media

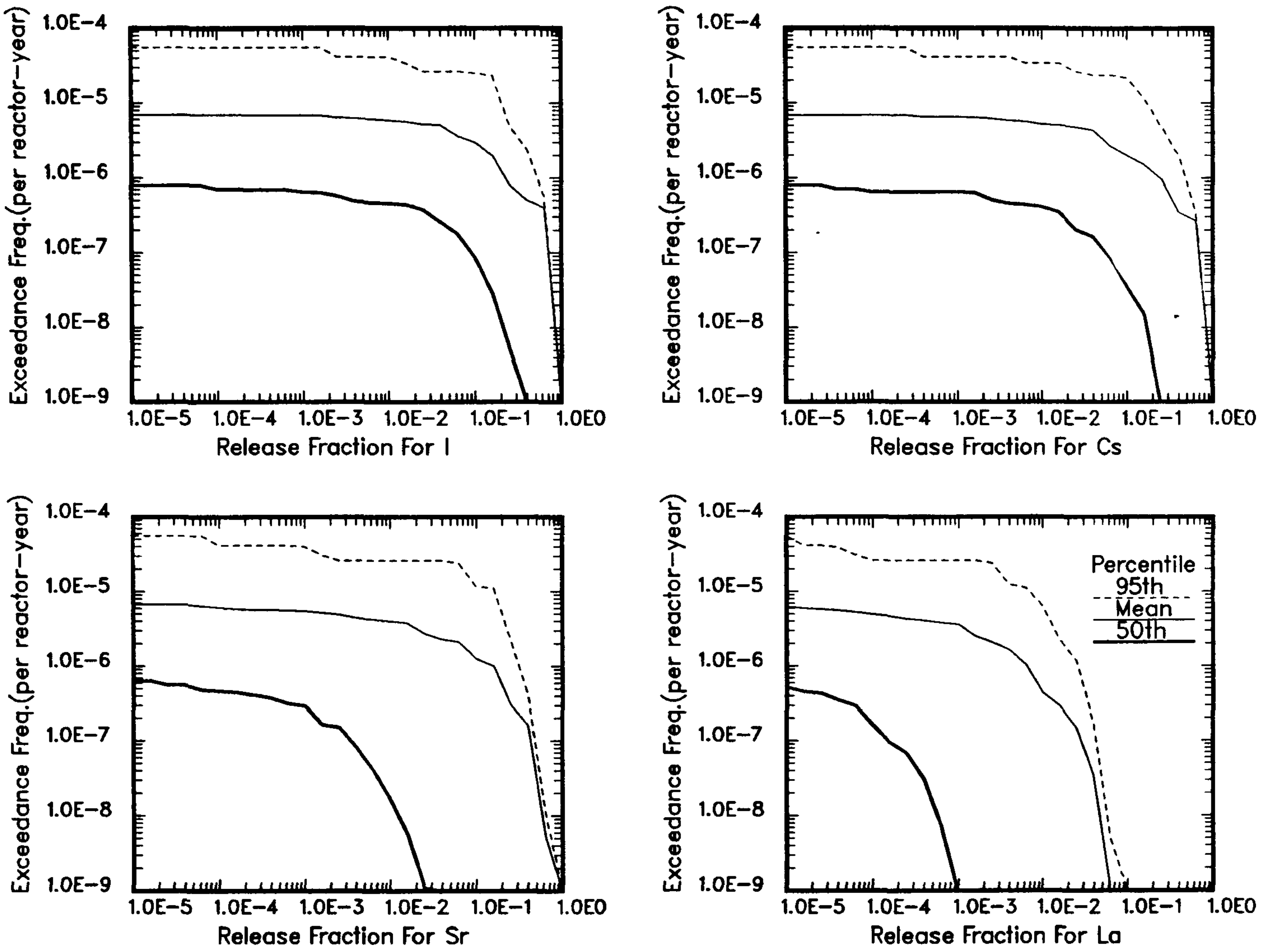

Figure 3.3-22
Peach Bottom: Fire PDS 3 - Slow SBO
Source Term CCDF

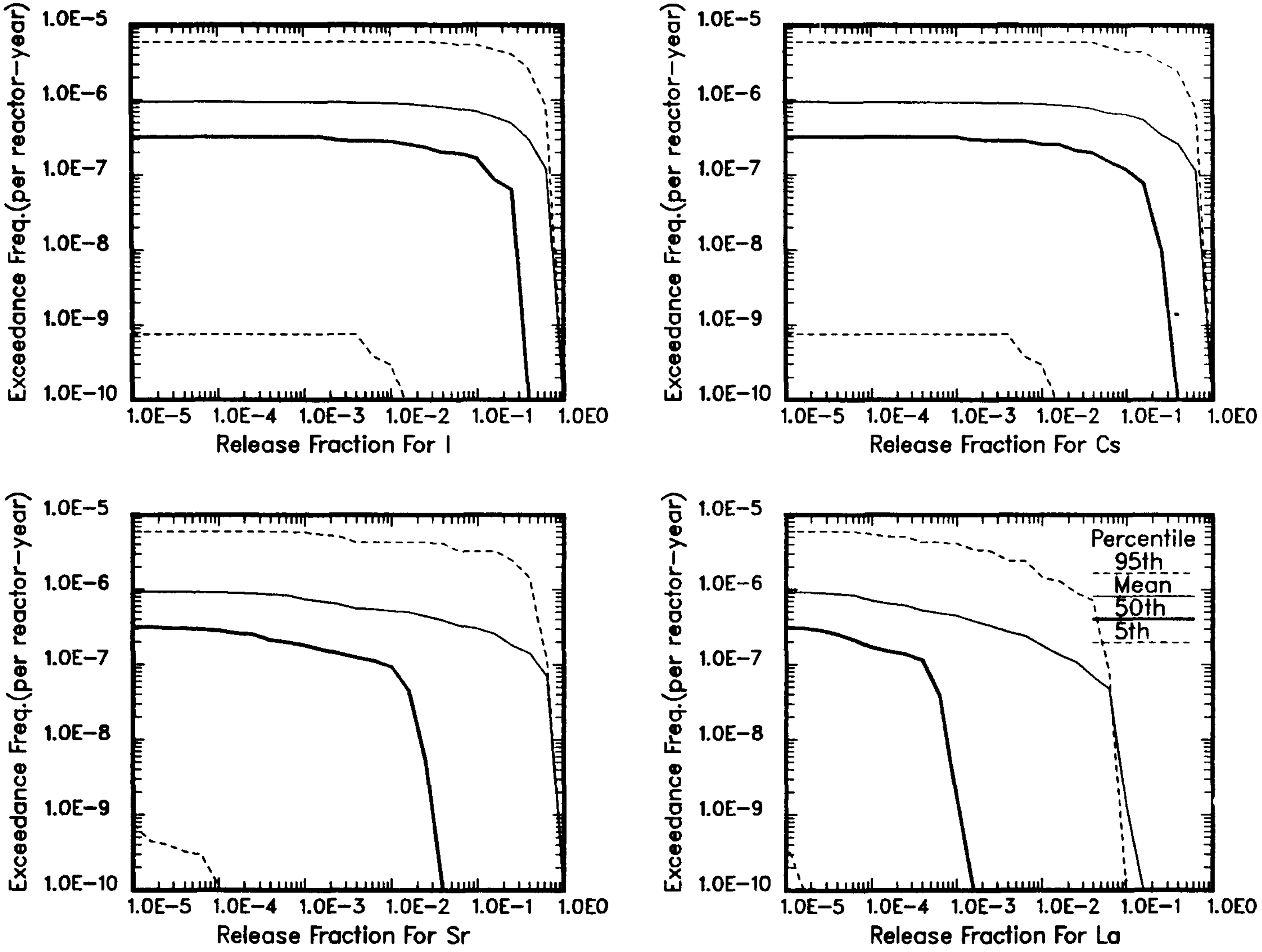

Figure 3.3-23
Peach Bottom: Fire PDS 4 - Transient CV
Source Term CCDF

Figures 3.3-24 to 3.3-32 show the variation of the exceedance frequency with release fraction for the I, Cs, Sr, and La radionuclide classes for the nine generalized APBs that have non-zero releases. The bin descriptions are identical to those in Section 3.3.1.10.

3.3.2.6 Summary

When all the types of fire initiated accidents at Peach Bottom are considered together, the exceedance frequency plots shown in Figure 3.3-33 are obtained. A plot is not shown for the noble gases since almost all of the noble gases (Xe and Kr) in the core are eventually released to the environment whether the containment fails or not. The mean frequency of exceeding a release fraction of 0.10 for I and Cs is on the order of 10^{-6}/year and for Te and Sr it is on the order of 10^{-7}/year. The second sheet of Figure 3.3-33 shows the release fractions for Ru, La, Ce, and Ba, which are often treated together as aerosol species. The mean frequency of exceeding a release fraction of 0.01 for Ru, La, and Ce is on the order of 10^{-7}/year. The releases for the barium class are slightly higher than those for the other three aerosol radionuclide classes.

3.3.2.7 Sensitivity Analysis Results

No sensitivities were carried through to the source term results for the fire analysis. Only the effects of no drywell shell meltthrough were investigated and that analysis was stopped after the APET evaluation.

3.3.3 Results for Seismic Initiators

In a manner analogous to Section 2.5.5, the results of the source term analysis for seismic initiators are presented for each PDS group. The tables in this section only provide a sample of APBs and their associated mean source terms for the various PDSs. As for the APET analysis, there is no significant difference in the results for the LLNL and EPRI hazard curves since the APET results (except for PDS 7) are independent of the PDS frequency and PDS 7 had the same APBs only different conditional probabilities. The low and high PGA cases are also the same. However, while the conditional probabilities of the release fractions are independent of frequency, the results presented in Figures 3.3-34 to 3.3-99 are not. These figures present the CCDFs for the release fractions and they are weighted by the PDS frequencies of occurrence. Since the description of the PDSs is the same for all four cases (LLNL Hi PGA, LLNL Low PGA, EPRI Hi PGA, and EPRI Low PGA), we only describe the PDSs once.

3.3.3.1 Results for PDS 1: FSB RPV

This PDS is composed of one sequence with a seismically induced LOSP followed by RPV vessel rupture. All injection is lost and early core damage ensues. Some onsite AC is available; but, containment heat removal is not available. Early containment failure occurs as a result of the

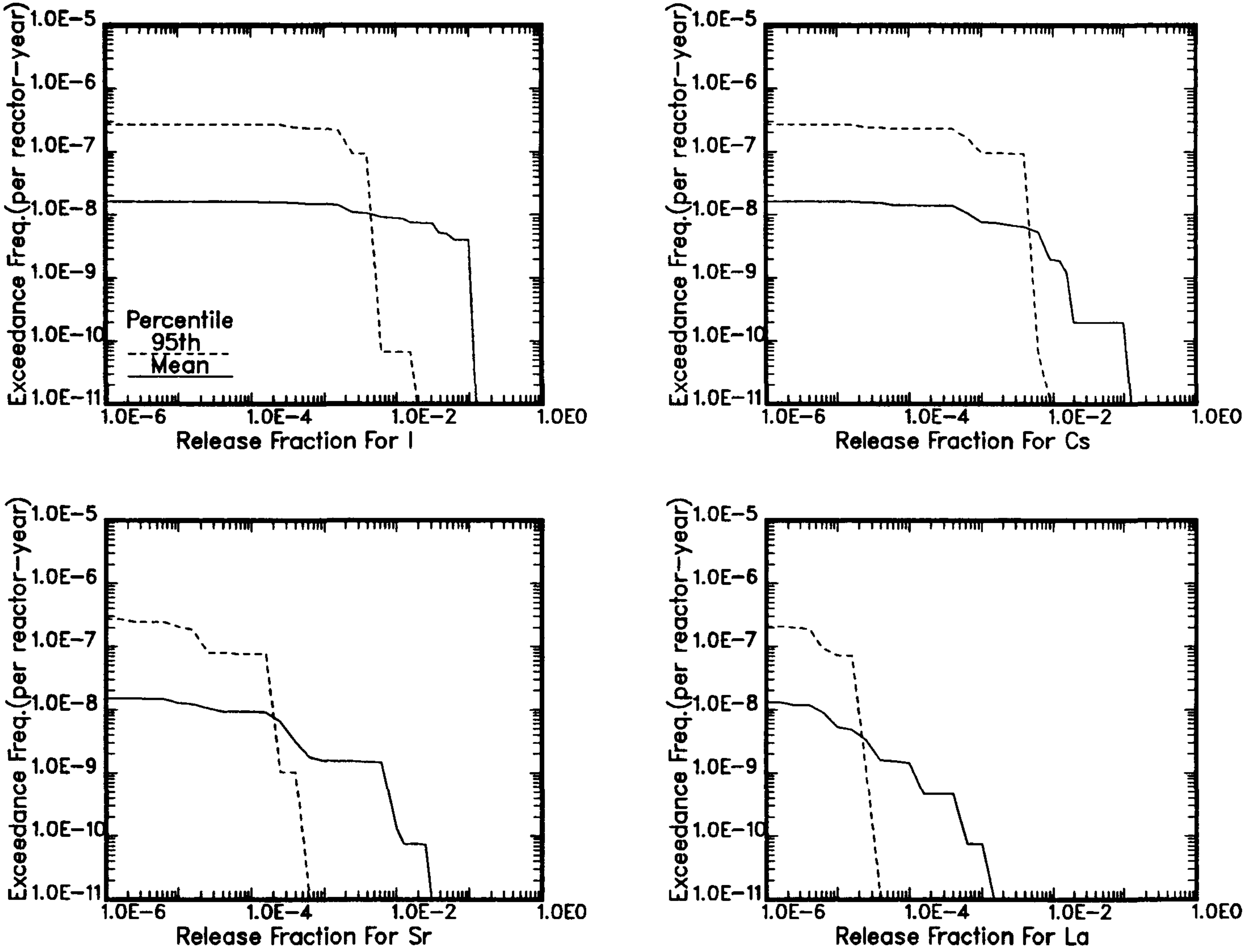

Figure 3.3-24
Peach Bottom: Fire Generalized APB 1
Source Term CCDF: Core Damage, VB>200 Psi, Early Wetwell Failure

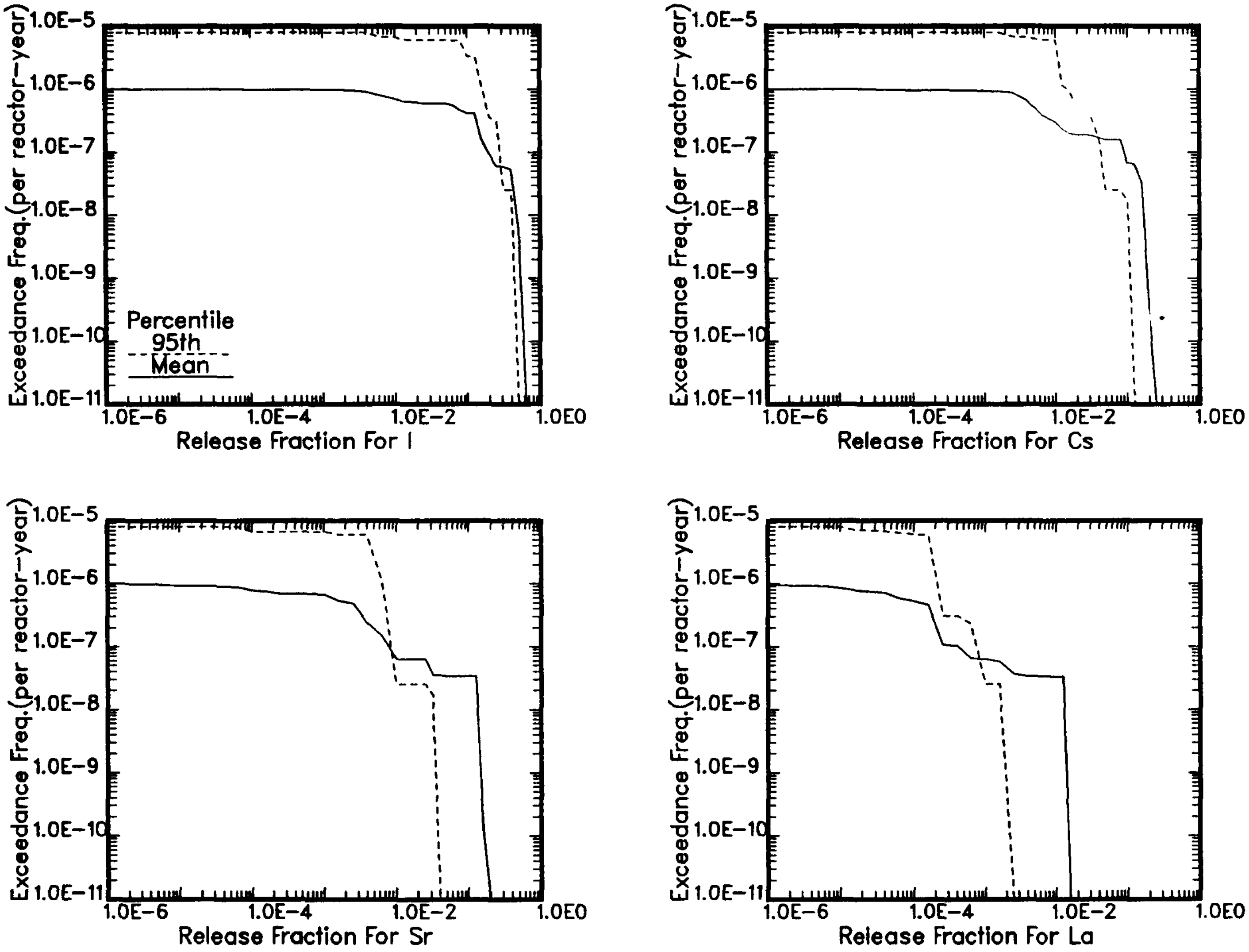

Figure 3.3-25
Peach Bottom: Fire Generalized APB 2
Source Term CCDF: Core Damage, VB<200 Psi, Early Wetwell Failure

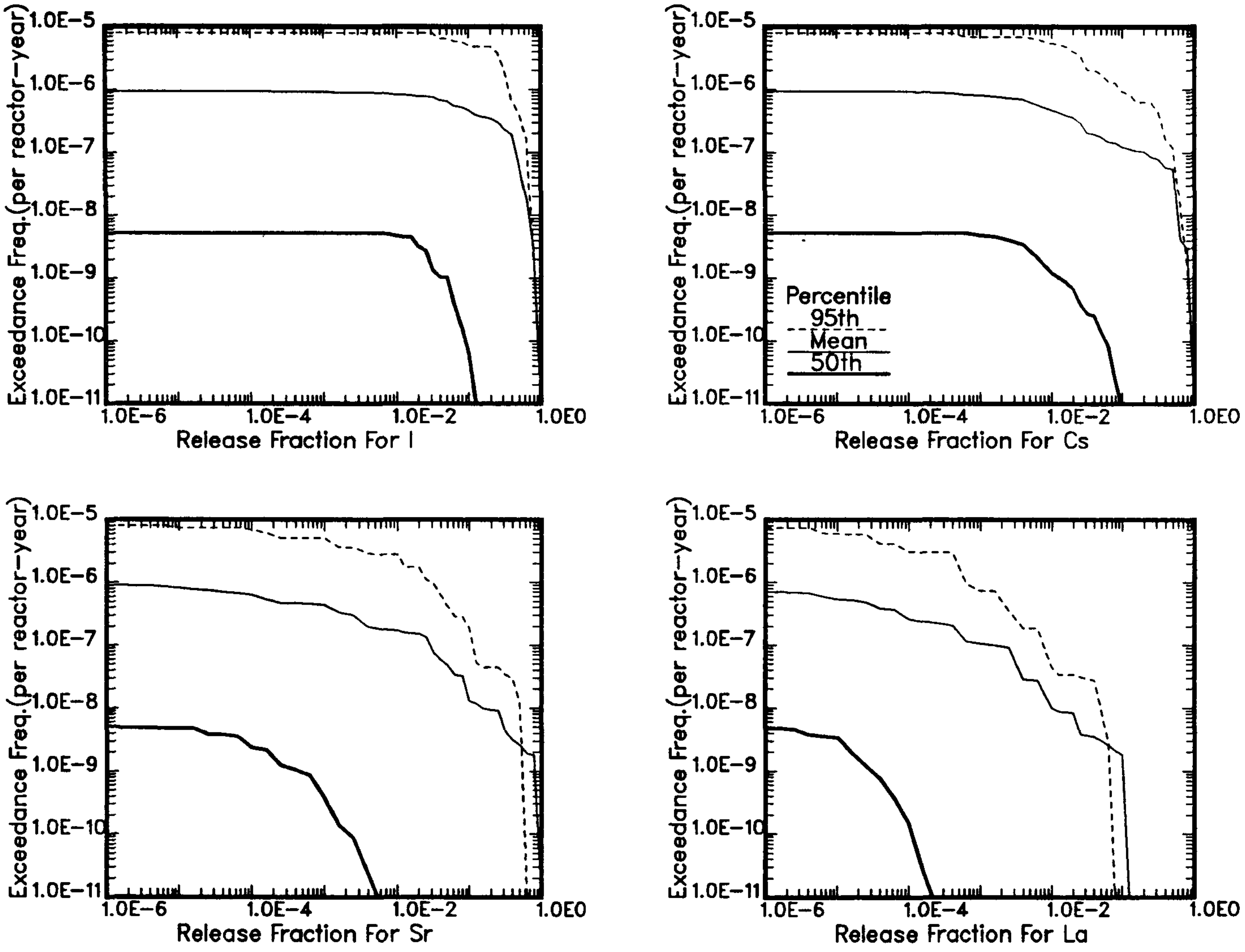

Figure 3.3-26
Peach Bottom: Fire Generalized APB 3
Source Term CCDF: Core Damage, VB>200 Psi, Early Drywell Failure

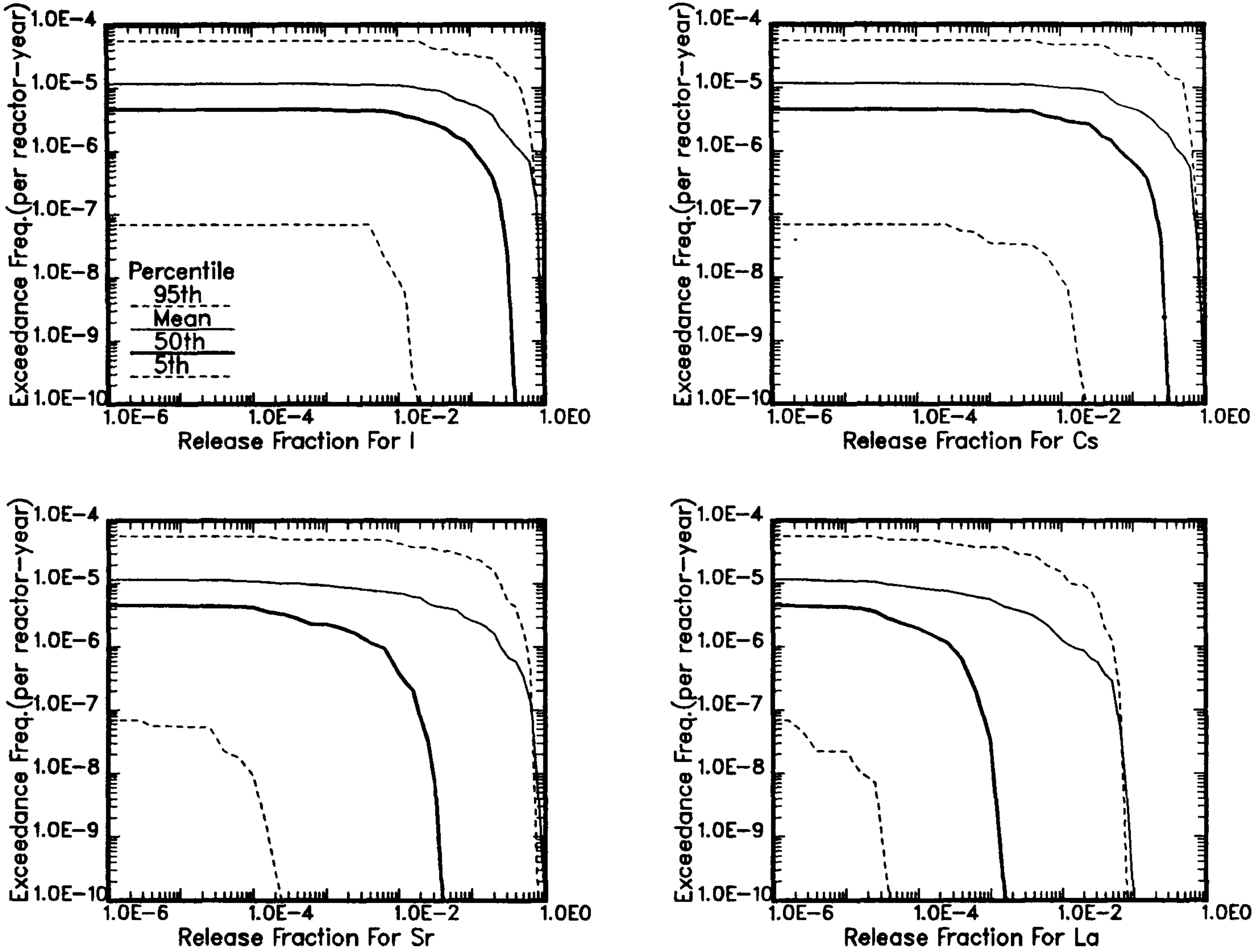

Figure 3.3-27
Peach Bottom: Fire Generalized APB 4
Source Term CCDF: Core Damage, VB<200 Psi, Early Drywell Failure

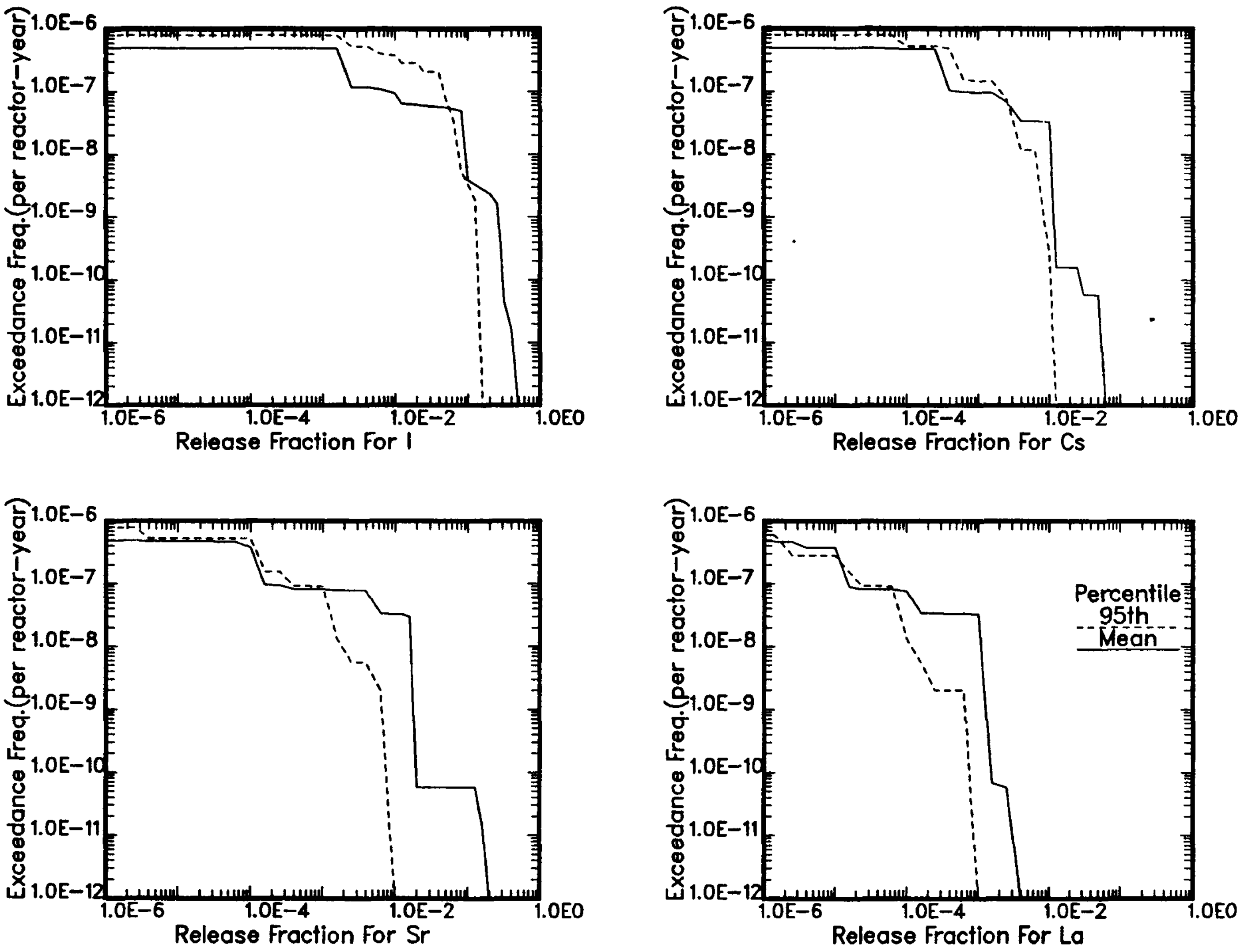

Figure 3.3-28
Peach Bottom: Fire Generalized APB 5
Source Term CCDF: Core Damage, VB, Late Wetwell Failure

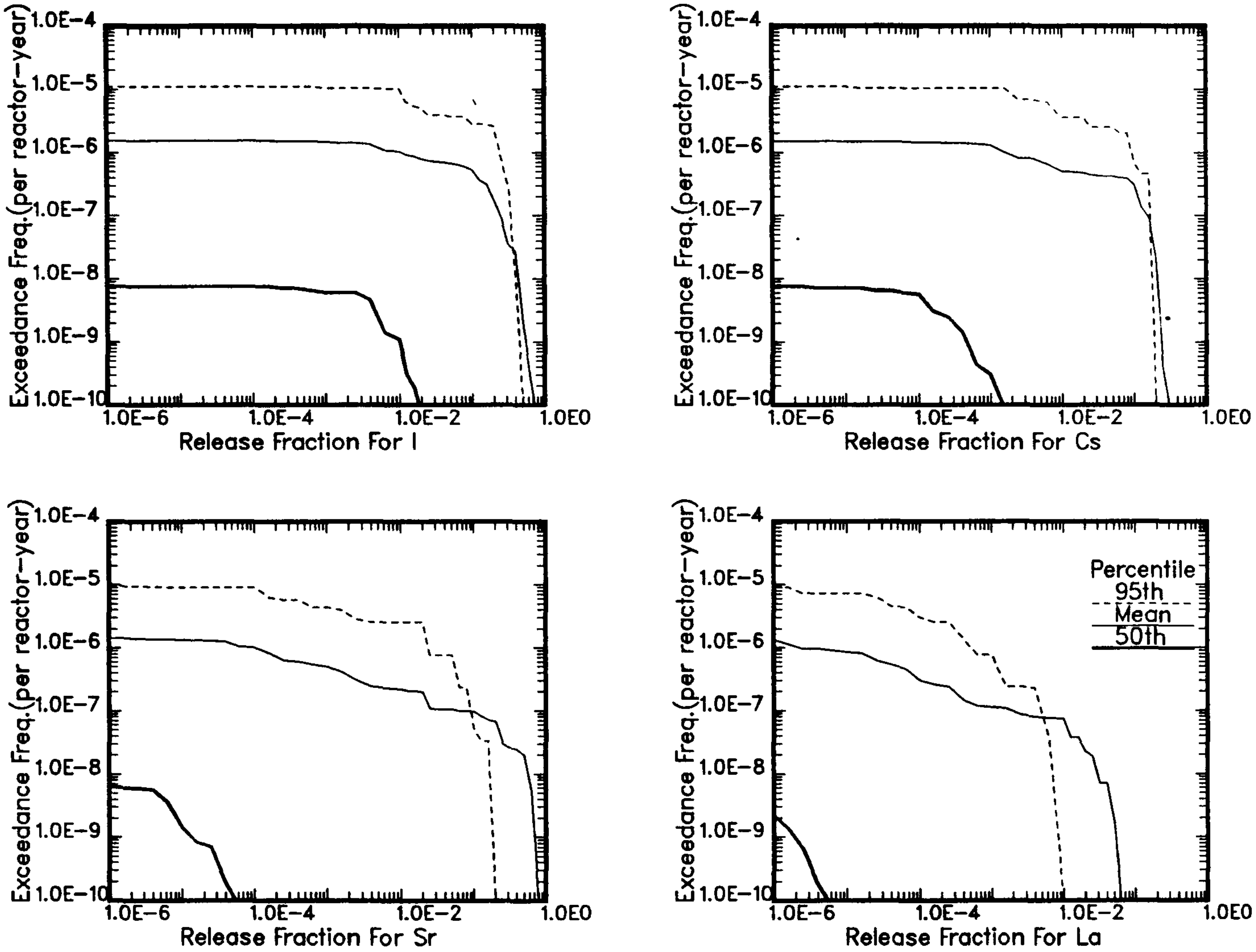

Figure 3.3-29
Peach Bottom: Fire Generalized APB 6
Source Term CCDF: Core Damage, VB, Late Drywell Failure

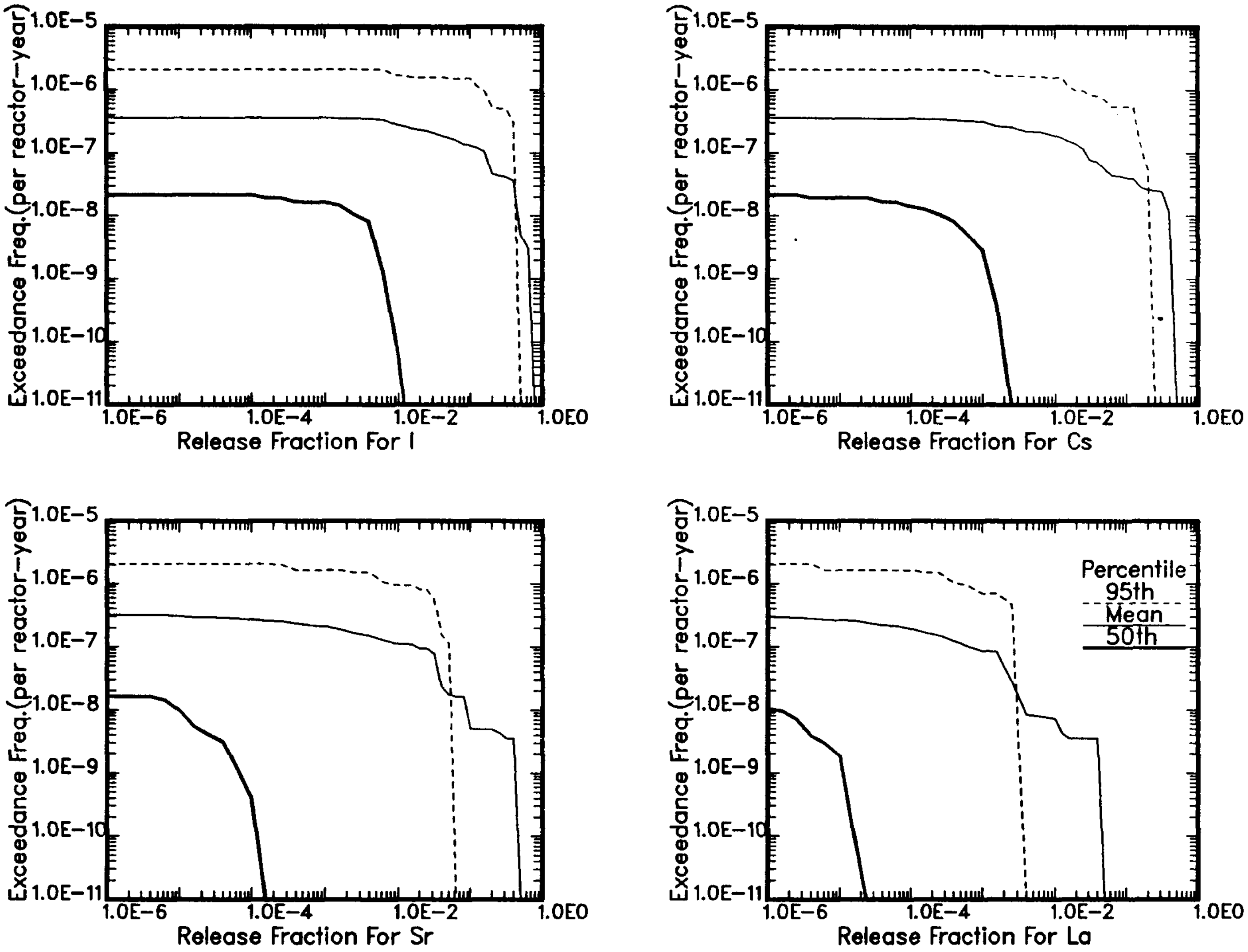

Figure 3.3-30
Peach Bottom: Fire Generalized APB 7
Source Term CCDF: Core Damage, VB, Venting

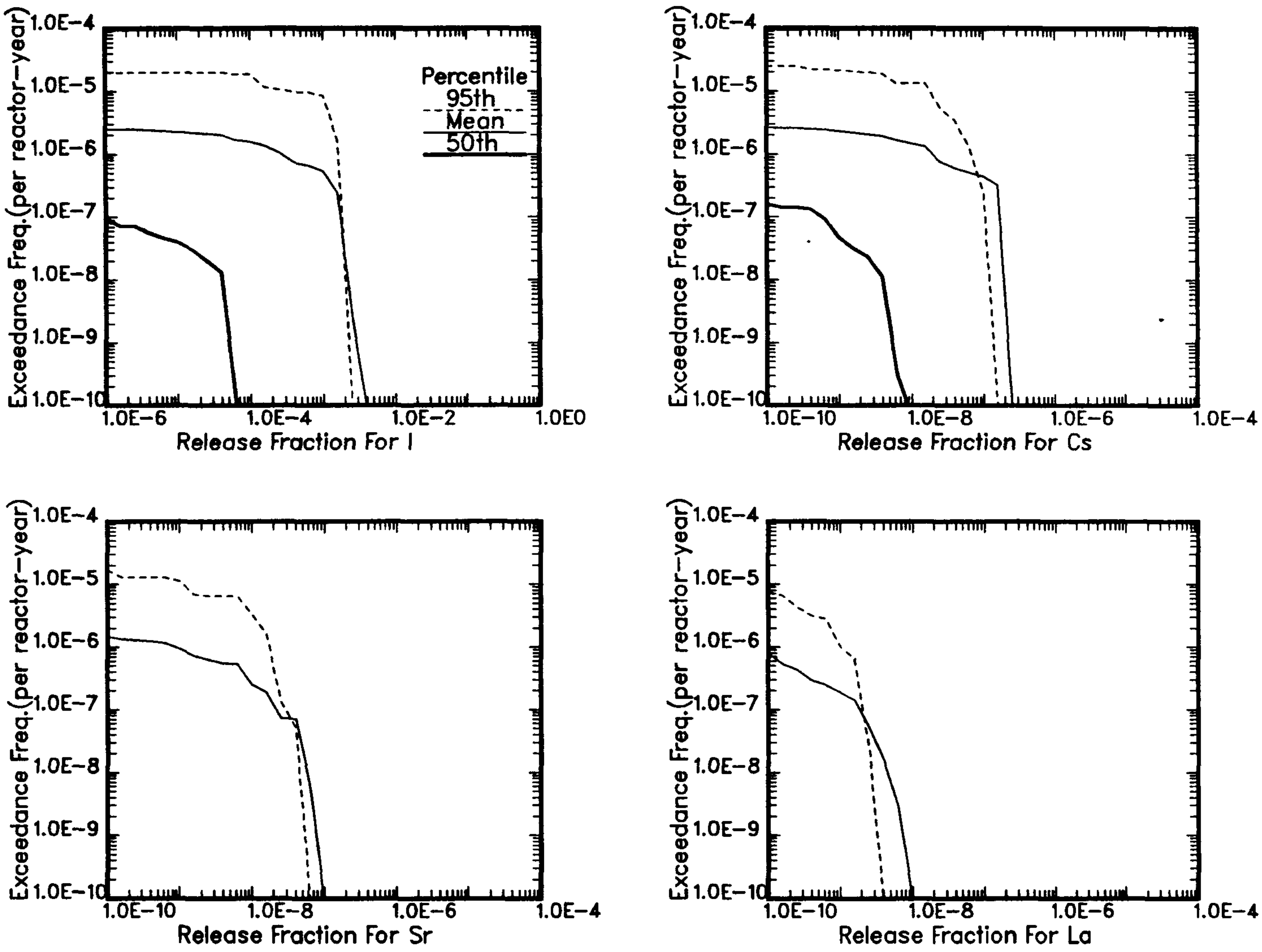

Figure 3.3-31
Peach Bottom: Fire Generalized APB 8
Source Term CCDF: Core Damage, VB, No Containment Failure

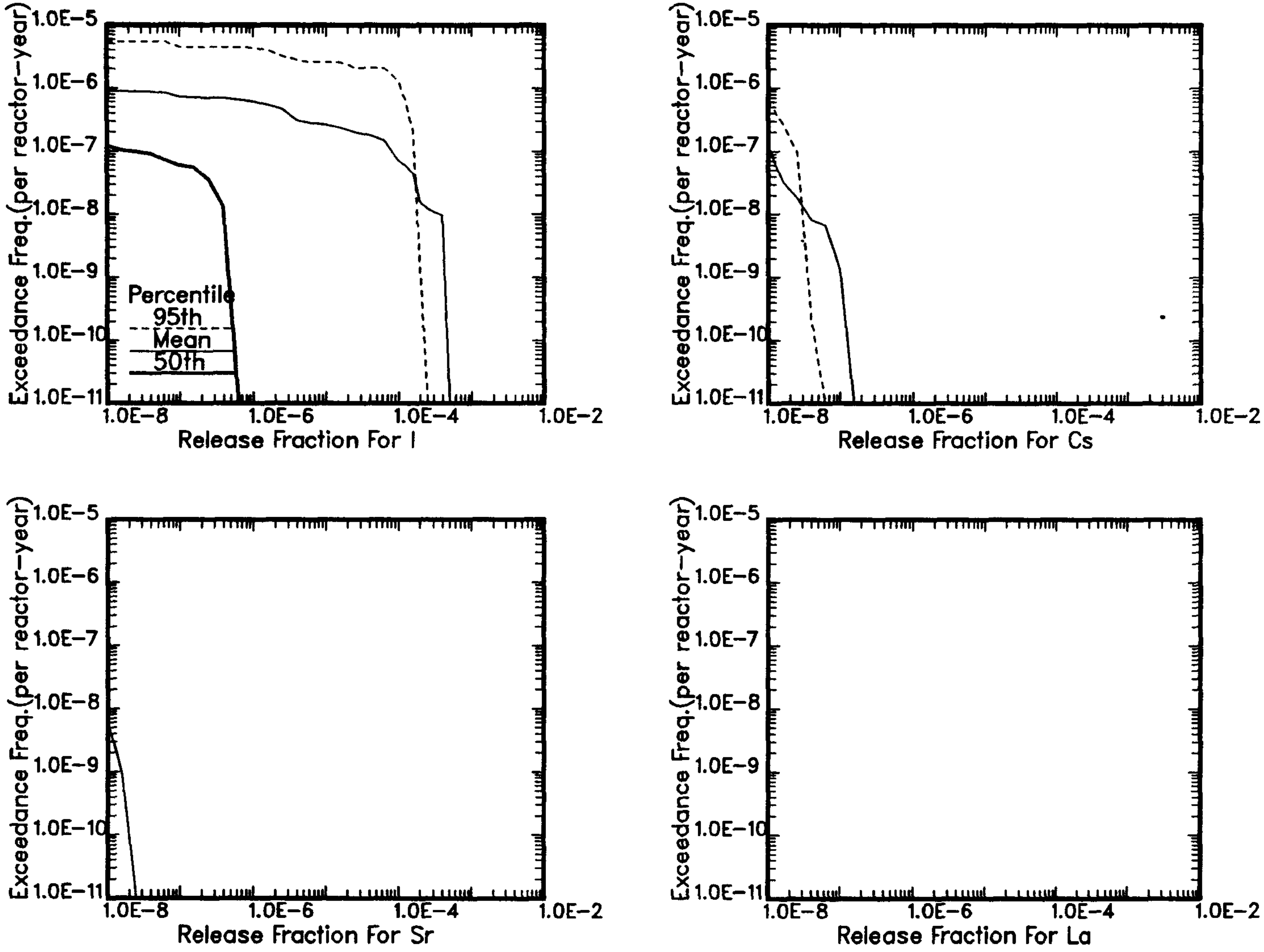

Figure 3.3-32
Peach Bottom: Fire Generalized APB 9
Source Term CCDF: No Vessel Breach

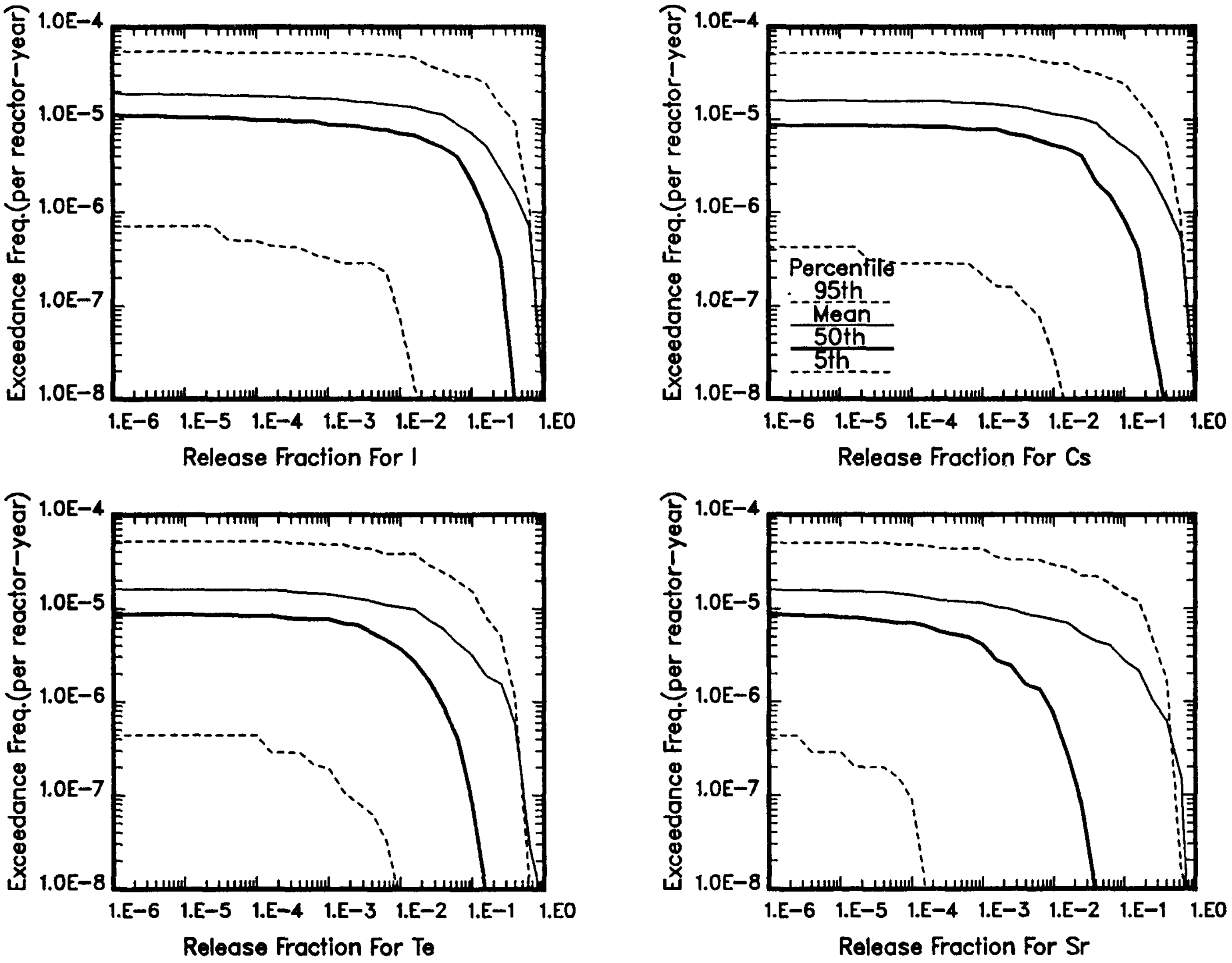

Figure 3.3-33a
Peach Bottom: Total Fire
Source Term CCDF

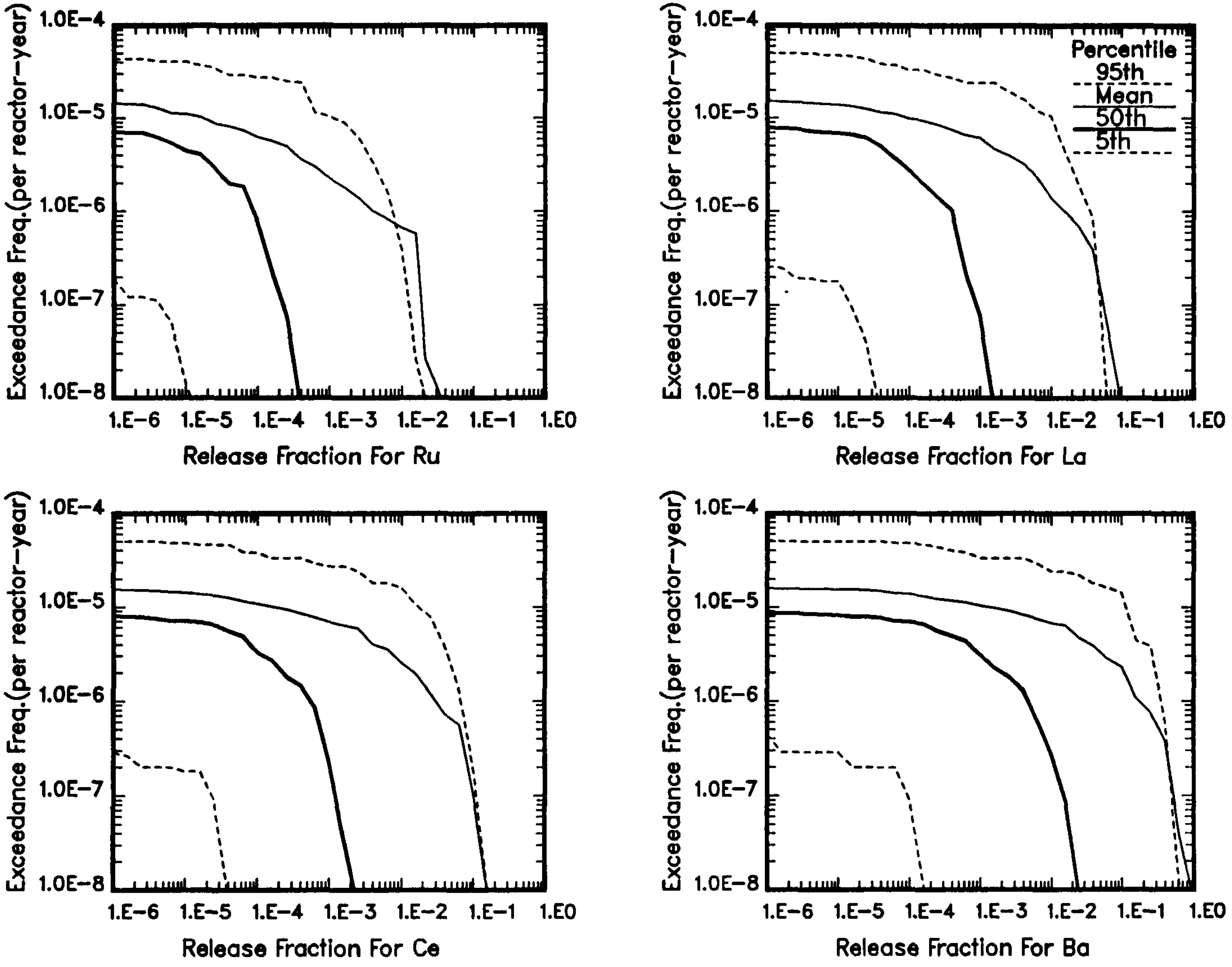

Figure 3.3-33b
Peach Bottom: Total Fire
Source Term CCDF

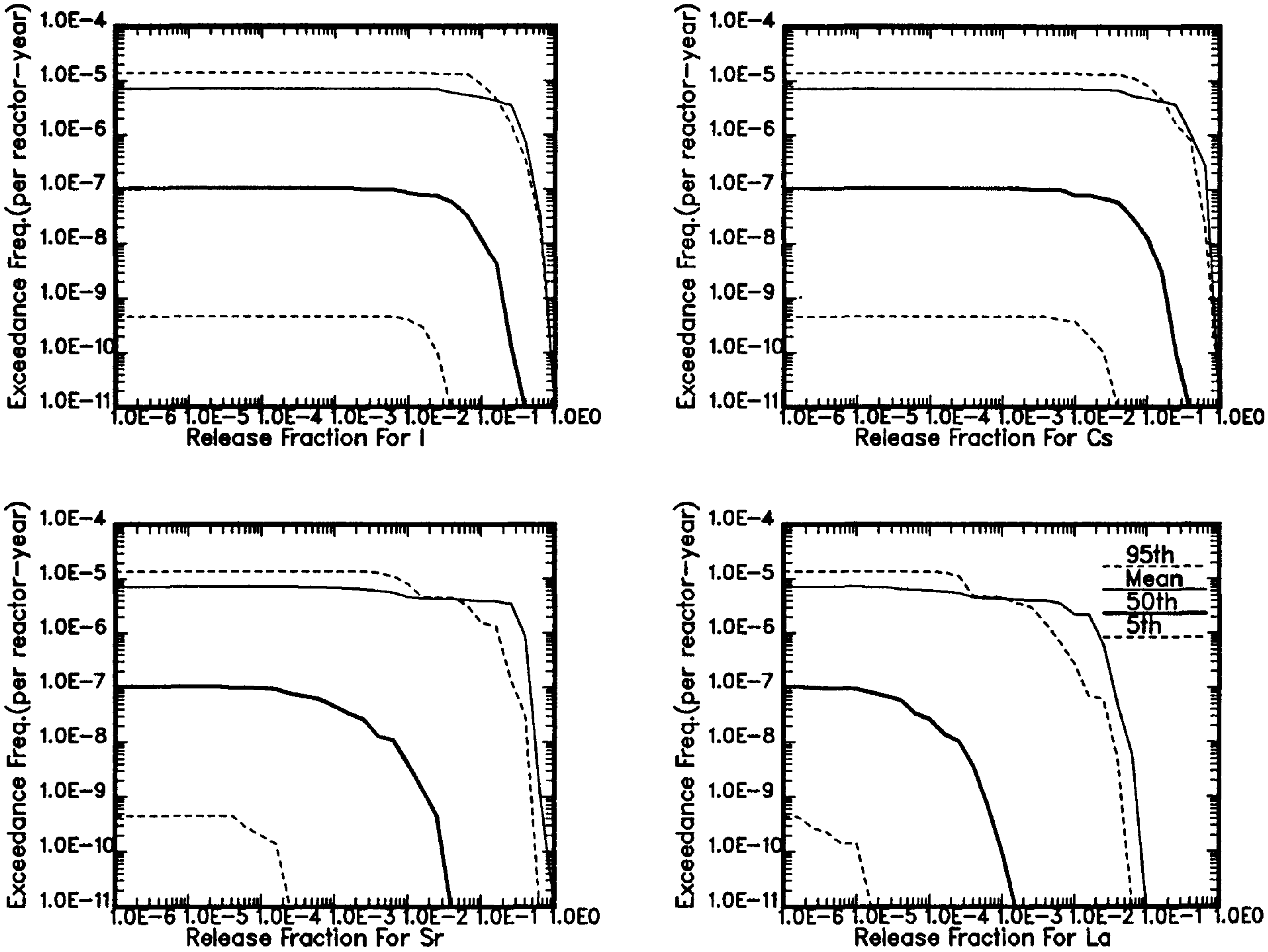

Figure 3.3-34
Peach Bottom: LLNL Seismic PDS 1 - FSB RPV - Hi PGA
Source Term CCDF

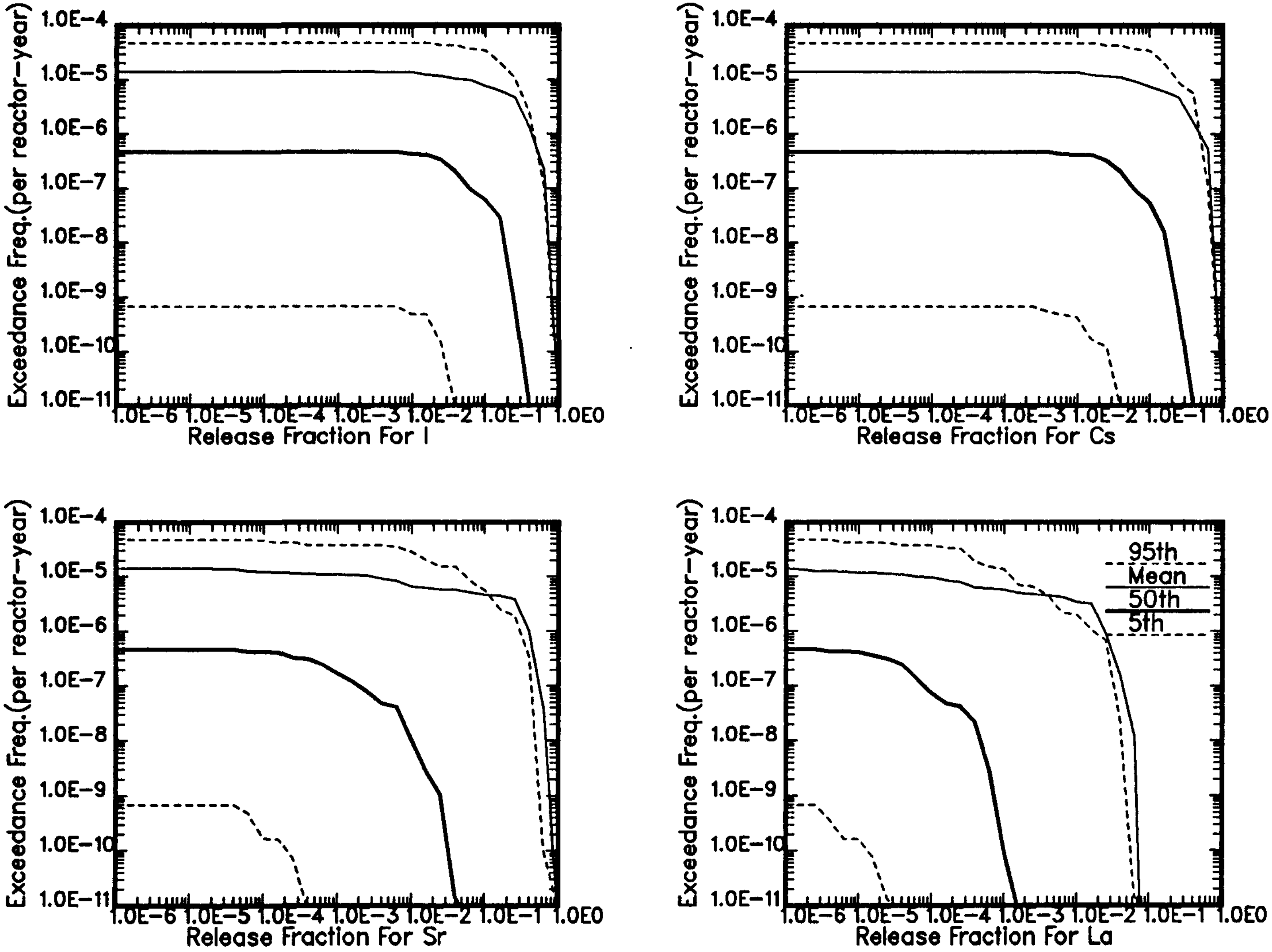

Figure 3.3-35
Peach Bottom: LLNL Seismic PDS 2 - FSB LLOCA - Hi PGA
Source Term CCDF

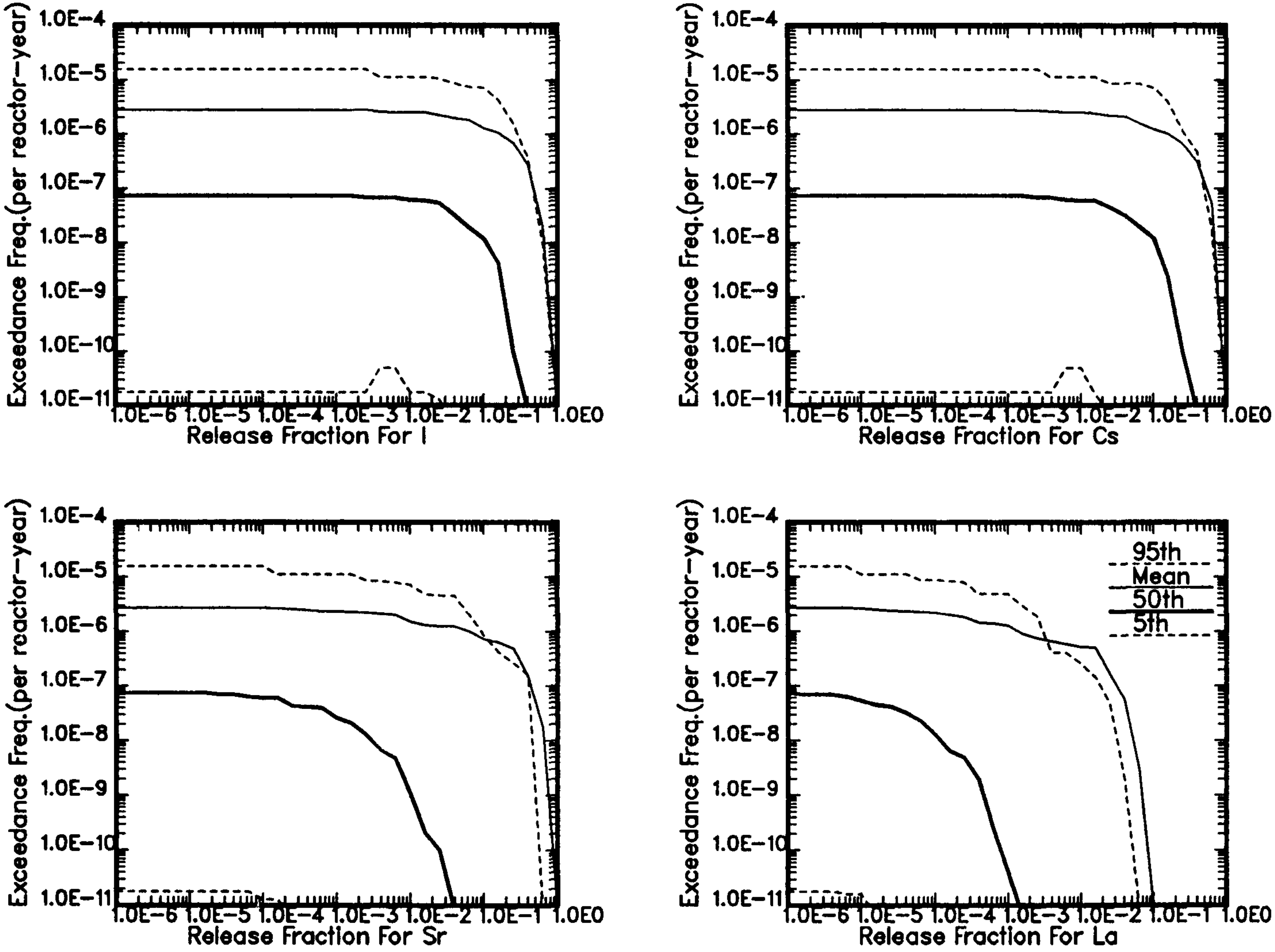

Figure 3.3-36
Peach Bottom: LLNL Seismic PDS 3 - FSB LLOCA - Hi PGA
Source Term CCDF

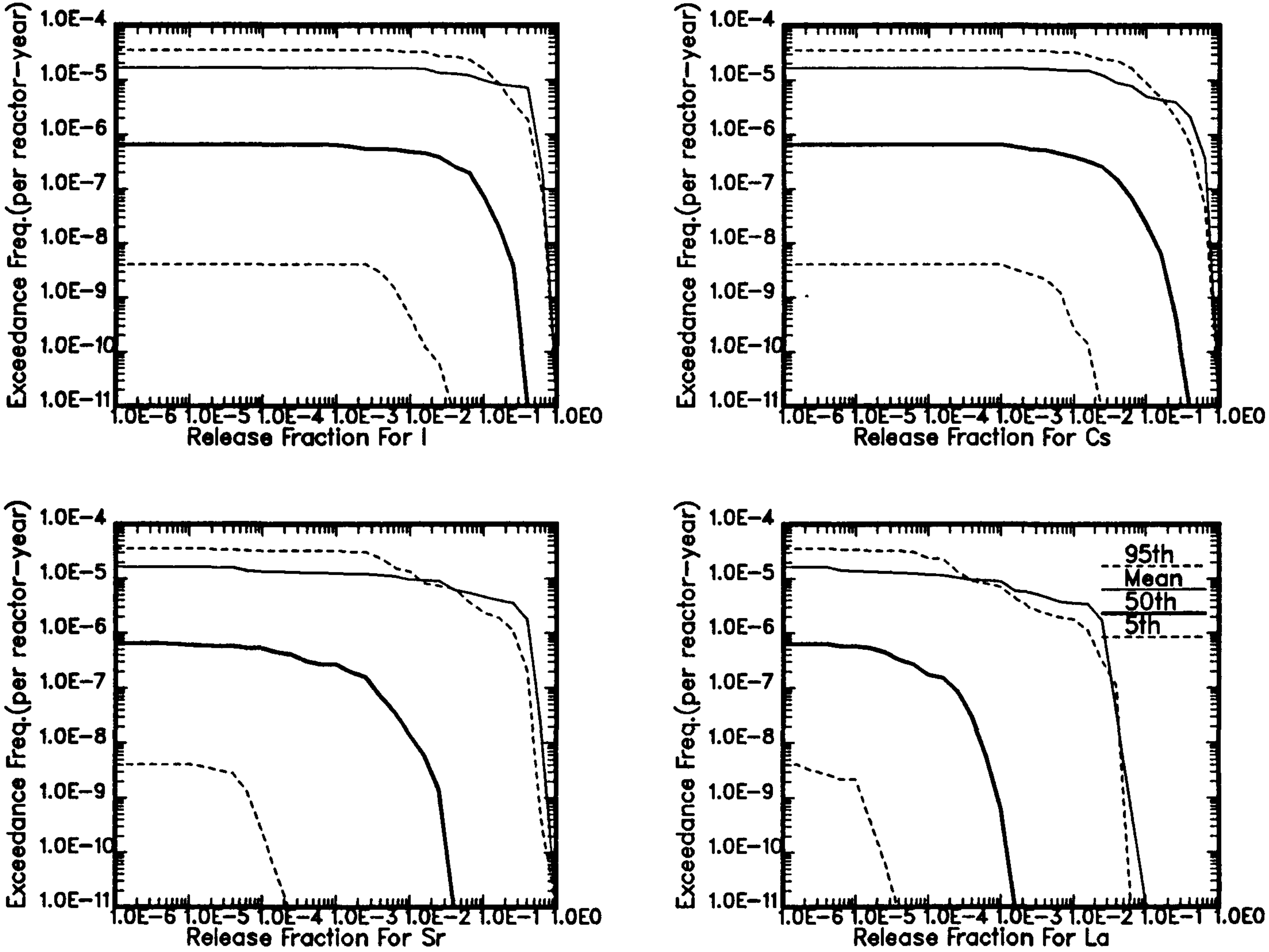

Figure 3.3-37
Peach Bottom: LLNL Seismic PDS 4 - Slow SBO - Hi PGA
Source Term CCDF

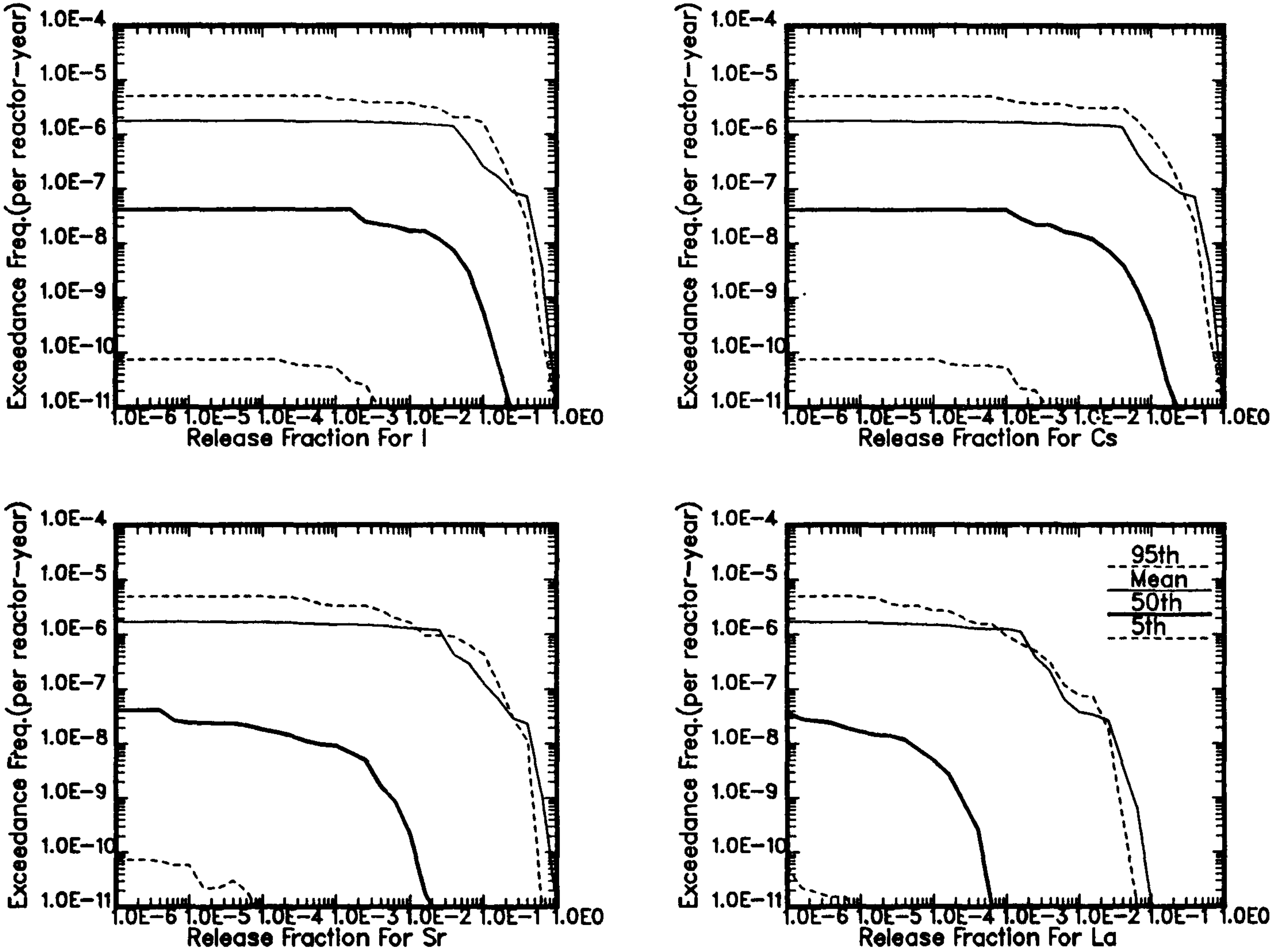

Figure 3.3-38
Peach Bottom: LLNL Seismic PDS 5 - Fast SBO - Hi PGA
Source Term CCDF

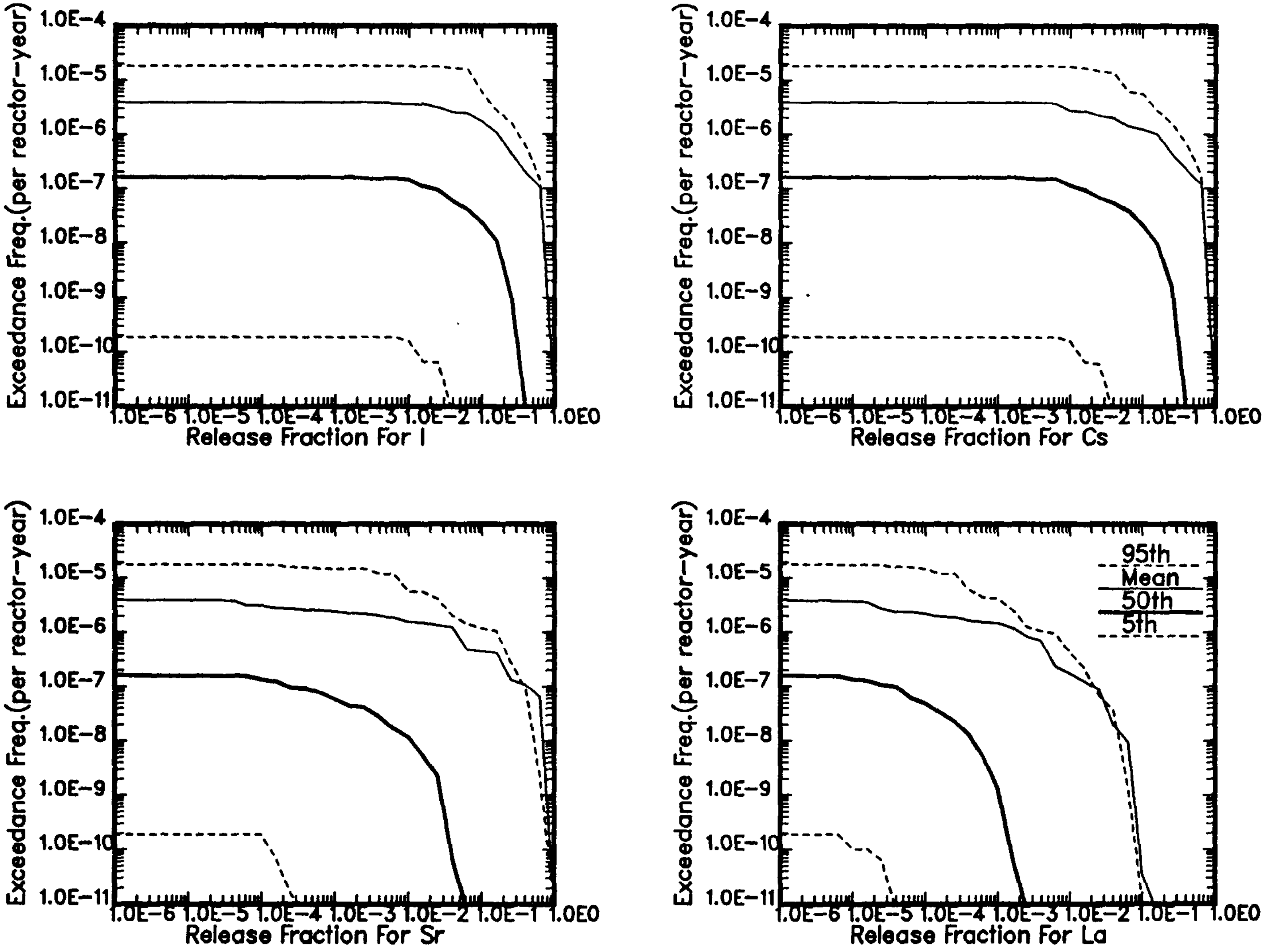

Figure 3.3-39
Peach Bottom: LLNL Seismic PDS 6 - FSB ILOCA - Hi PGA
Source Term CCDF

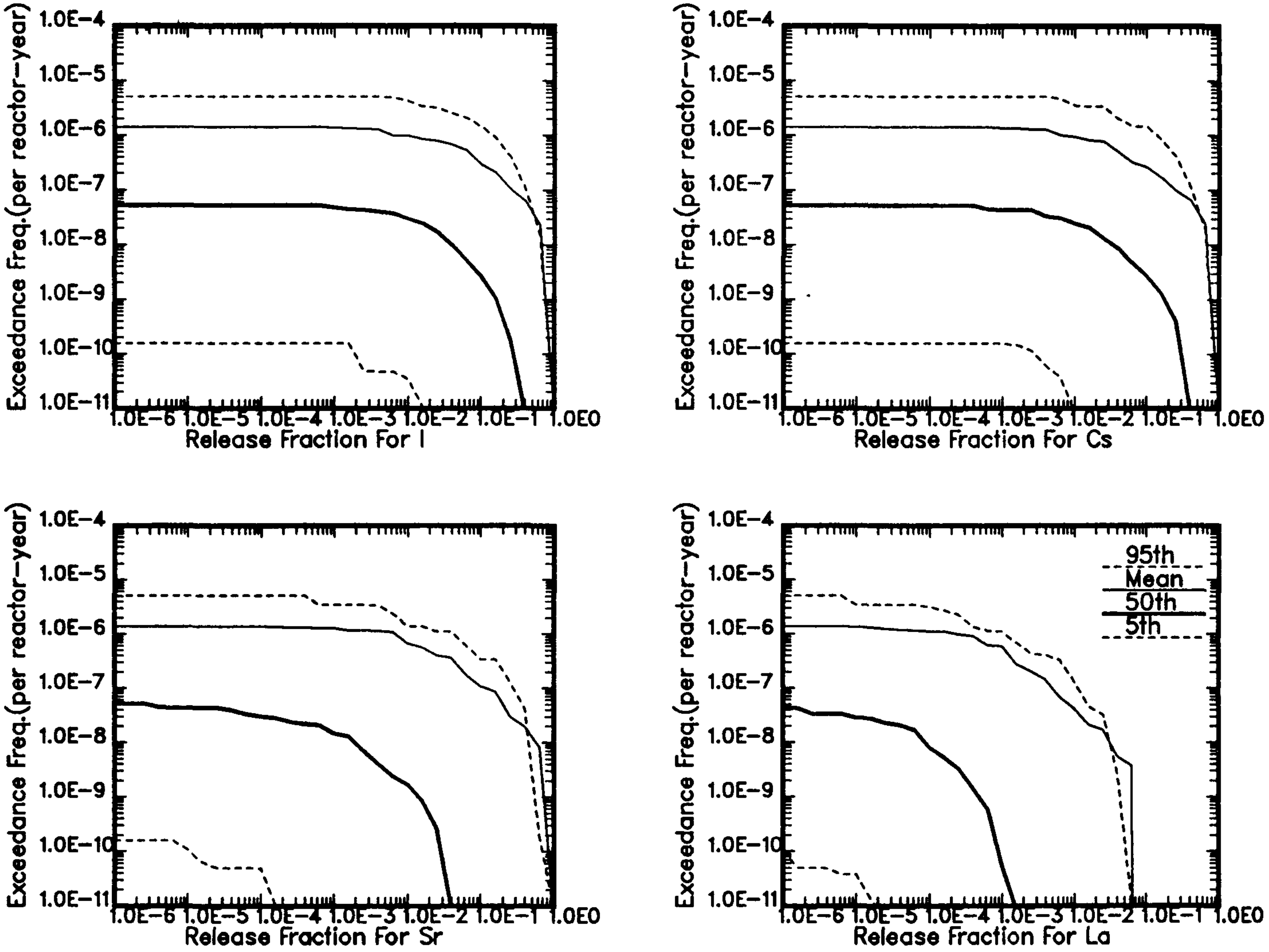

Figure 3.3-40
Peach Bottom: LLNL Seismic PDS 7 - FSB I/SLOCA - Hi PGA
Source Term CCDF

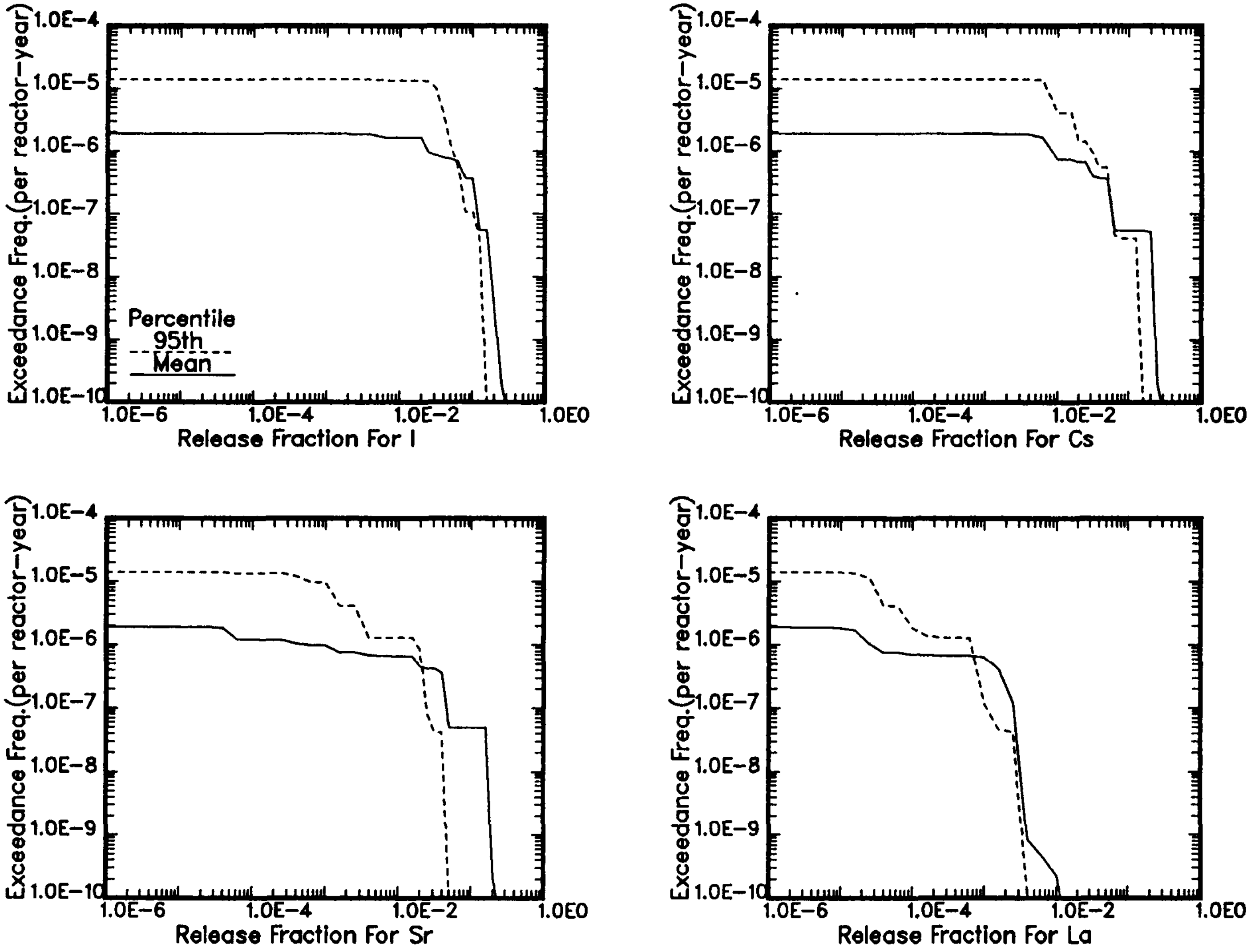

Figure 3.3-41
Peach Bottom: LLNL Seismic Generalized APB 1 - Hi PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Wetwell Failure

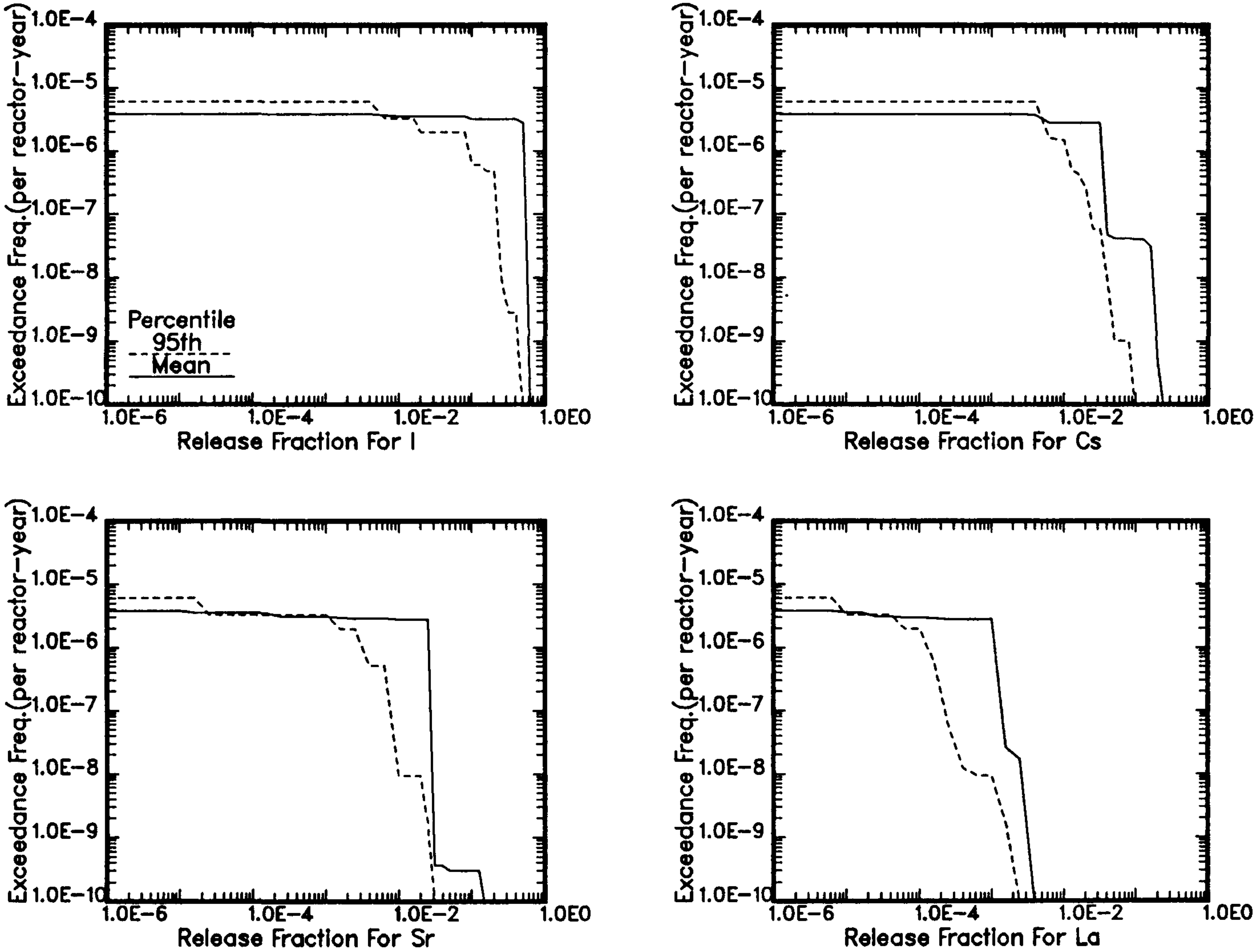

Figure 3.3-42
Peach Bottom: LLNL Seismic Generalized APB 2 - Hi PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Wetwell Failure

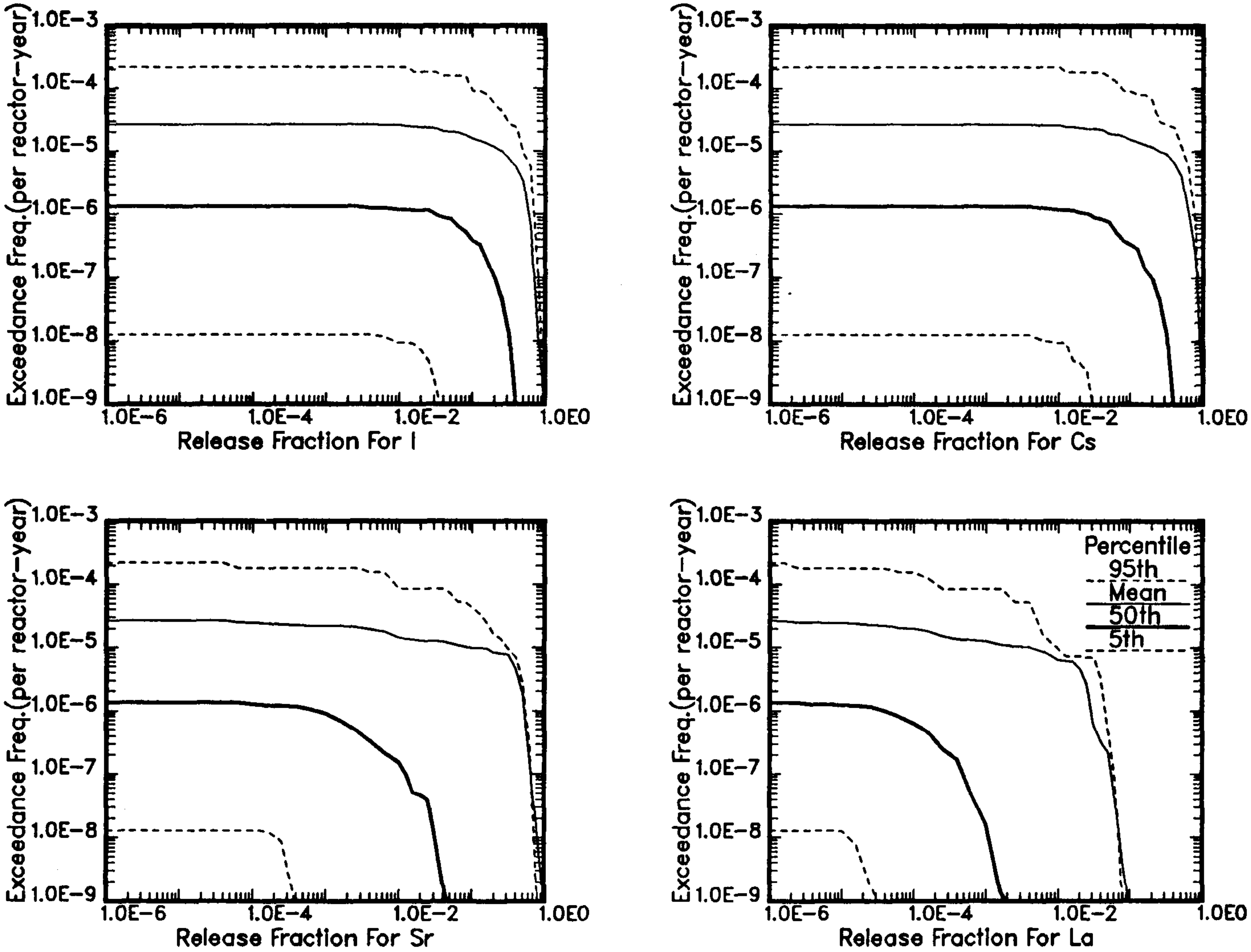

Figure 3.3-43
Peach Bottom: LLNL Seismic Generalized APB 3 - Hi PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Drywell Failure

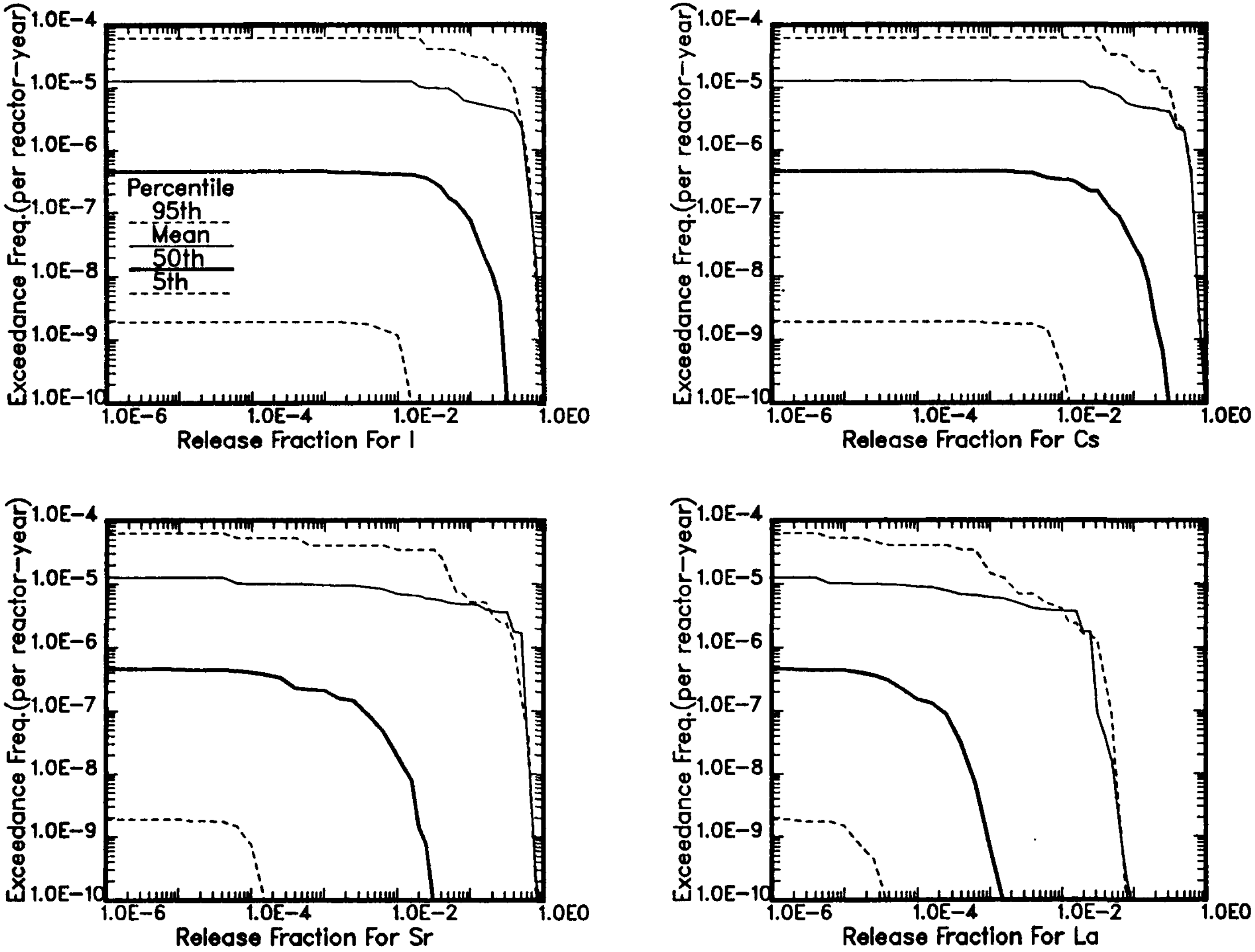

Figure 3.3-44
Peach Bottom: LLNL Seismic Generalized APB 4 - Hi PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Drywell Failure

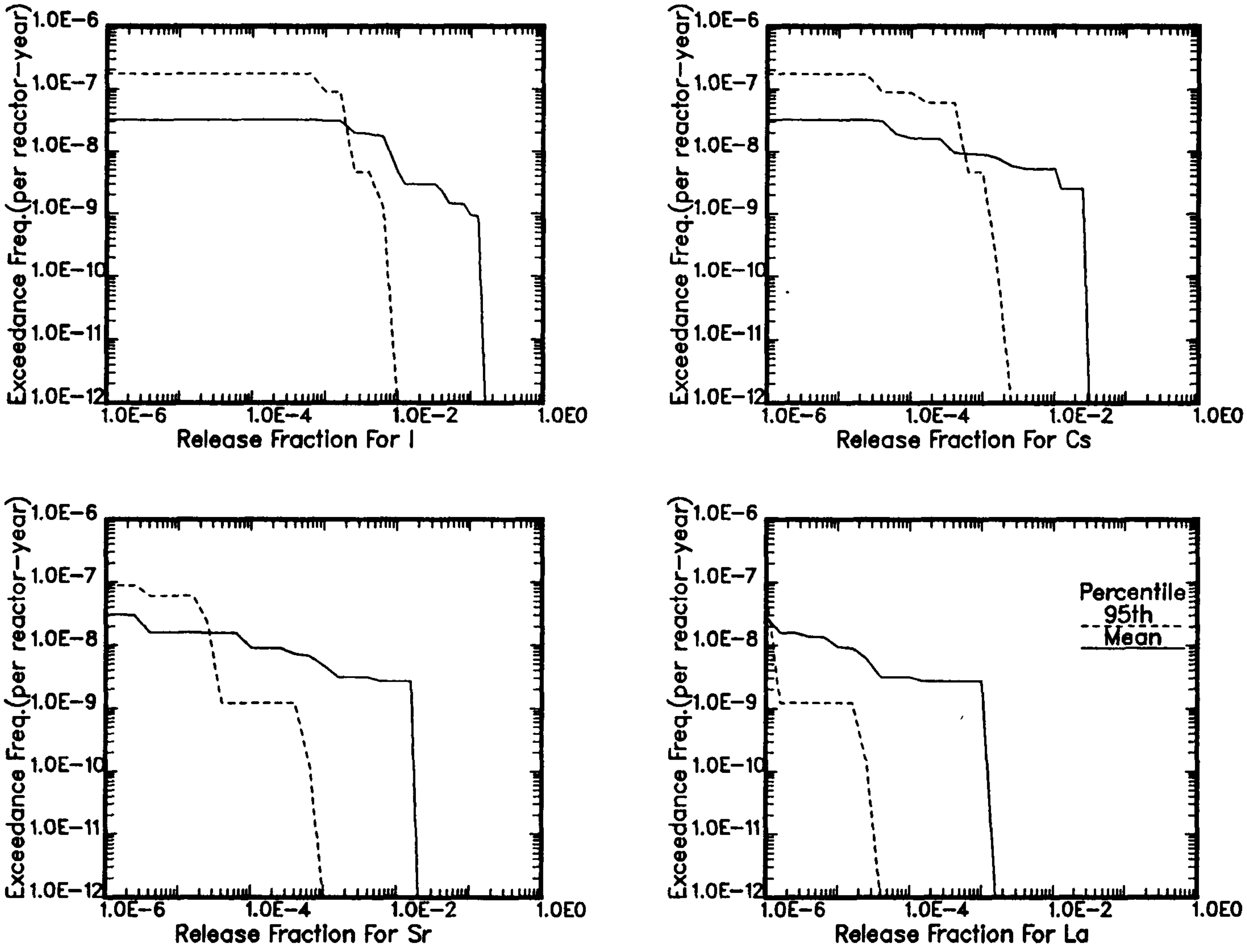

Figure 3.3-45
Peach Bottom: LLNL Seismic Generalized APB 5 - Hi PGA
Source Term CCDF: Core Damage, VB, Late Wetwell Failure

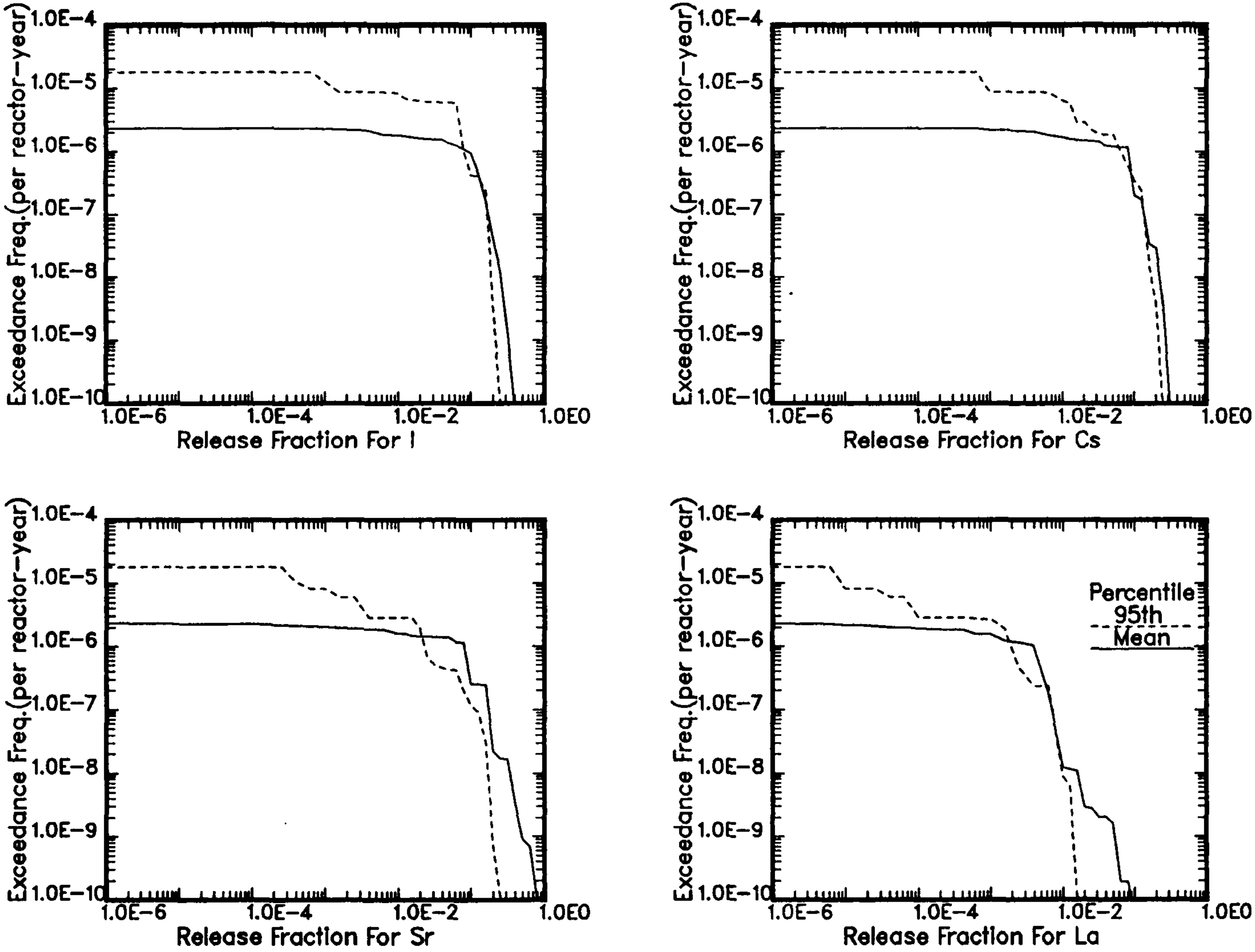

Figure 3.3-46
Peach Bottom: LLNL Seismic Generalized APB 6 - Hi PGA
Source Term CCDF: Core Damage, VB, Late Drywell Failure

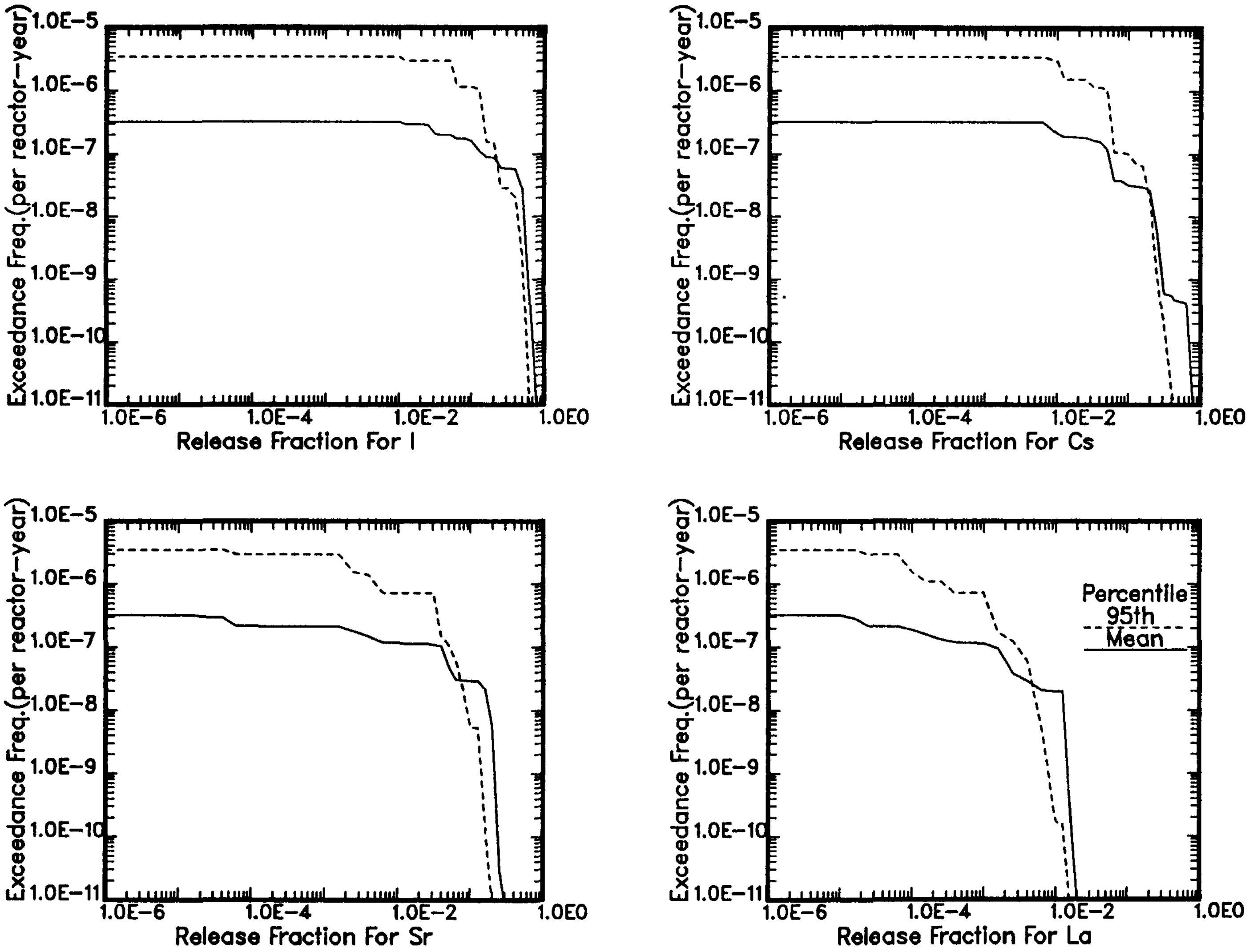

Figure 3.3-47
Peach Bottom: LLNL Seismic Generalized APB 7 - Hi PGA
Source Term CCDF: Core Damage, VB, Venting

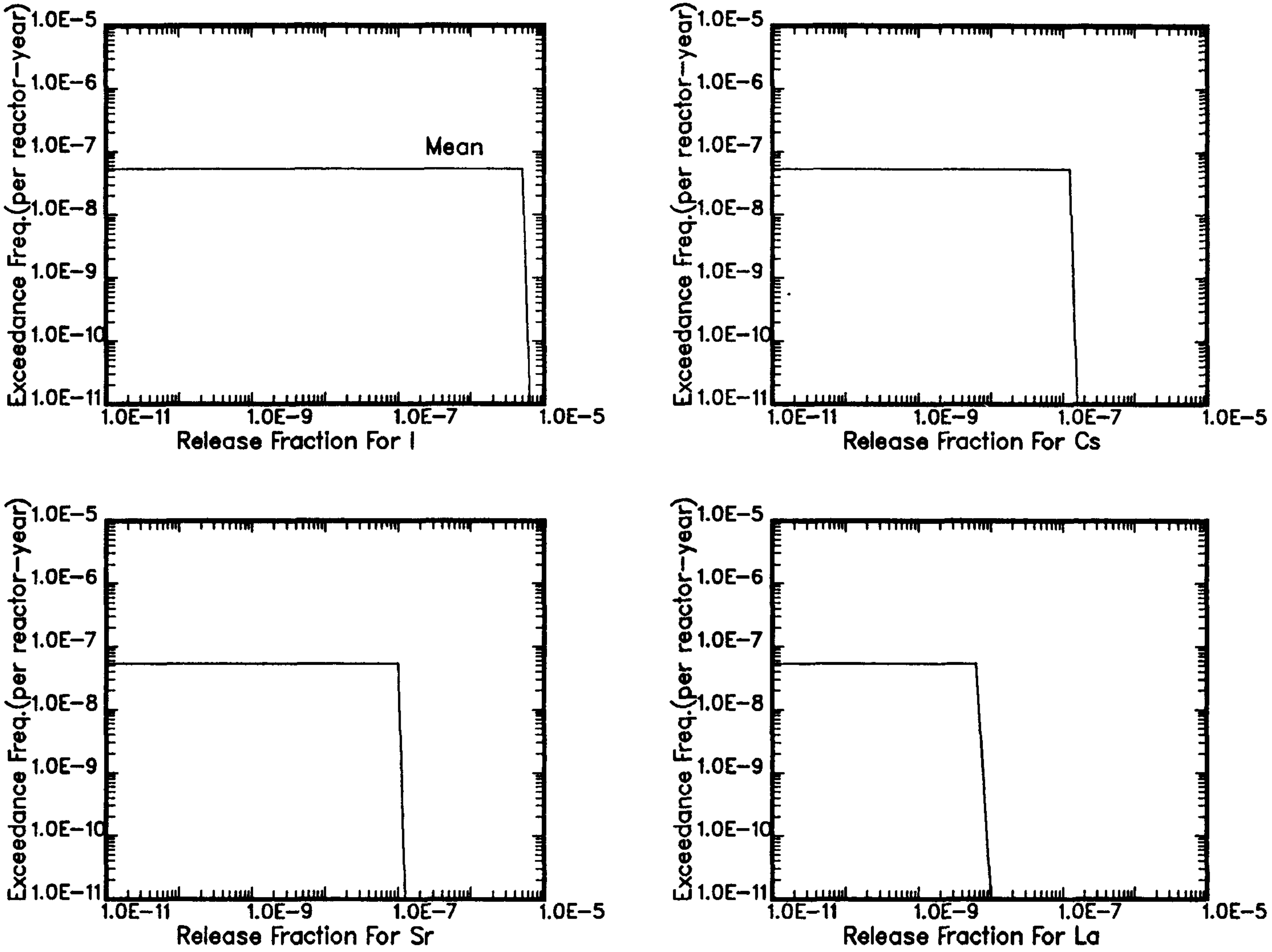

Figure 3.3-48
Peach Bottom: LLNL Seismic Generalized APB 8 - Hi PGA
Source Term CCDF: Core Damage, VB, No Containment Failure

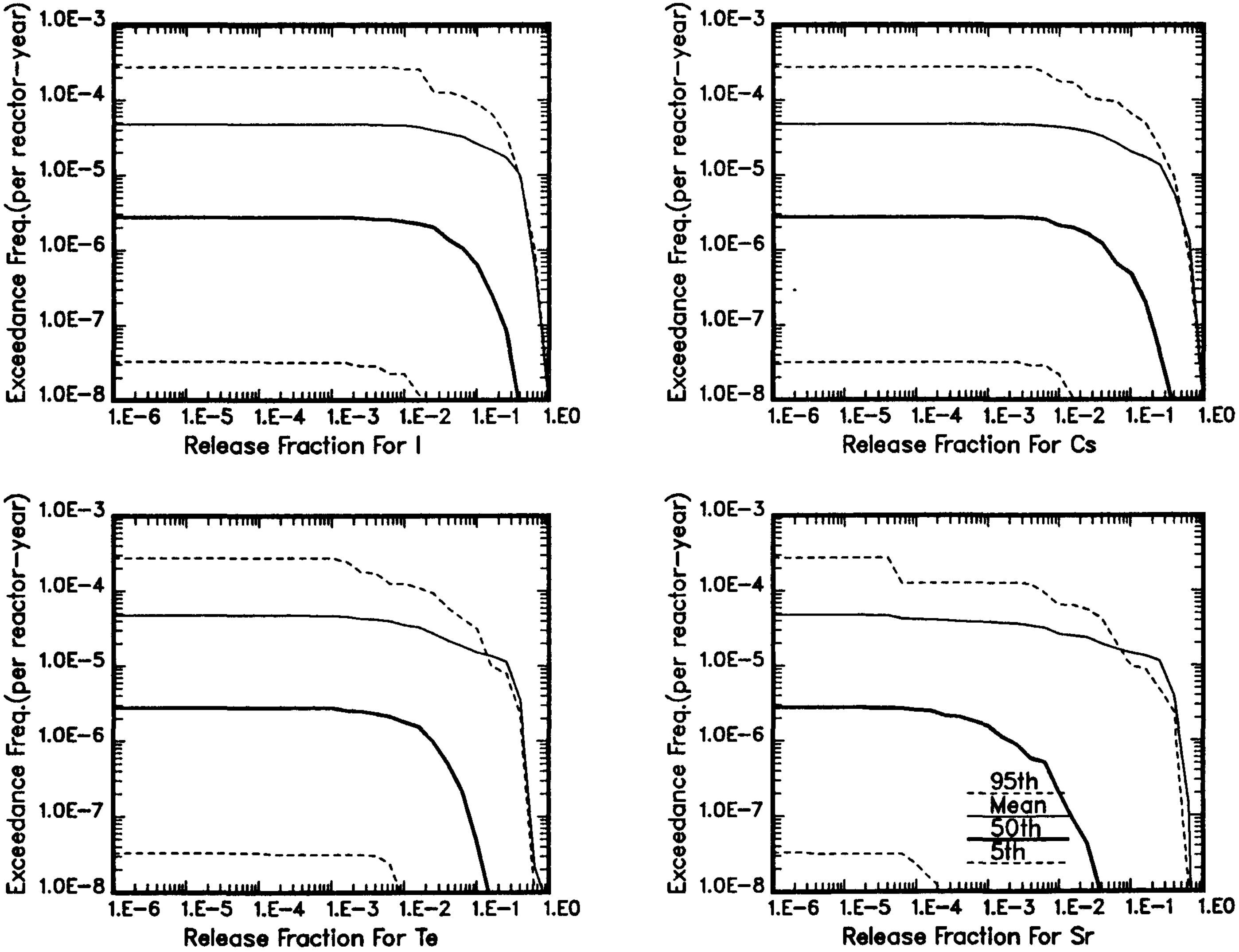

Figure 3.3-49a
Peach Bottom: LLNL Seismic - Hi PGA
Source Term CCDF

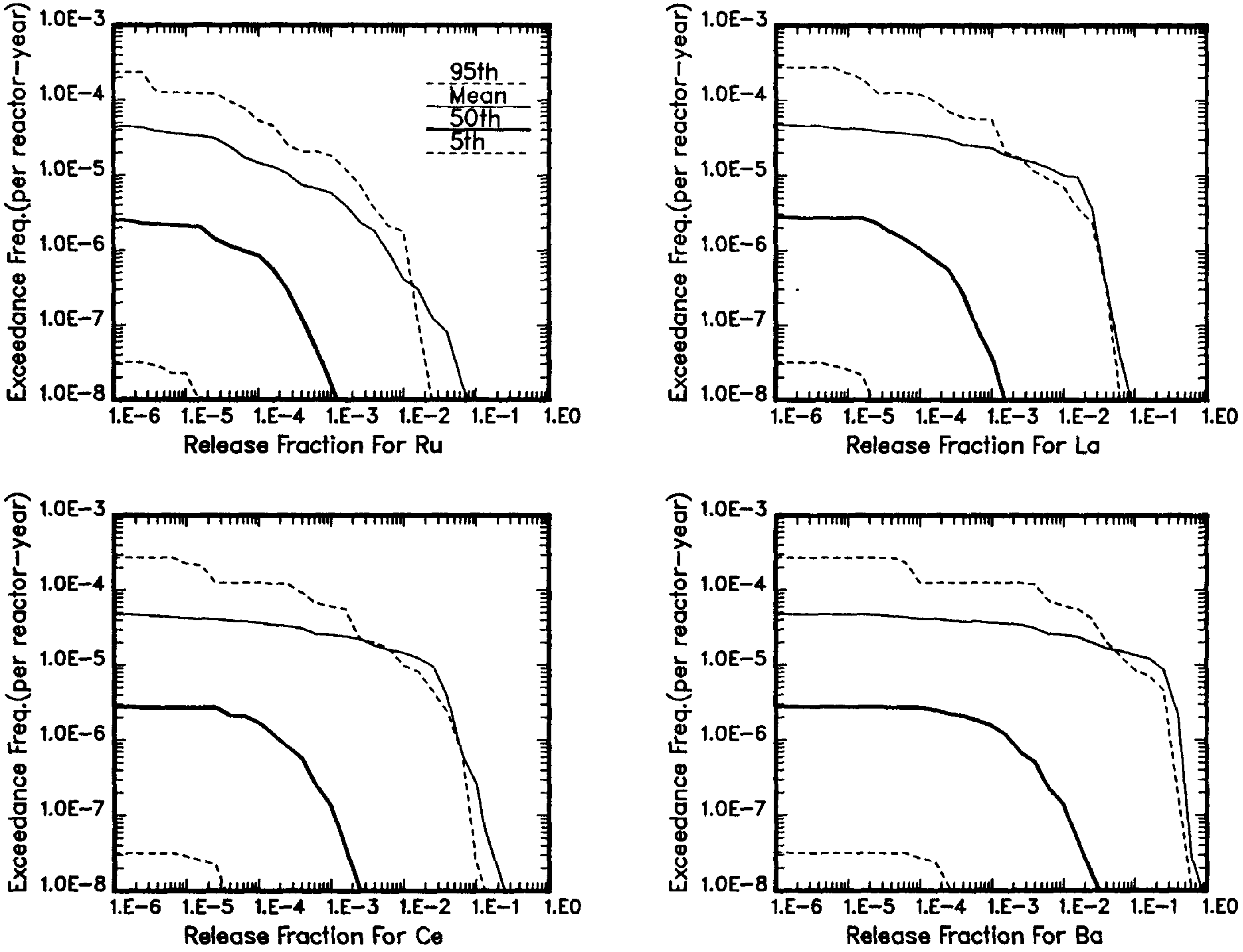

Figure 3.3-49b
Peach Bottom: LLNL Seismic - Hi PGA
Source Term CCDF

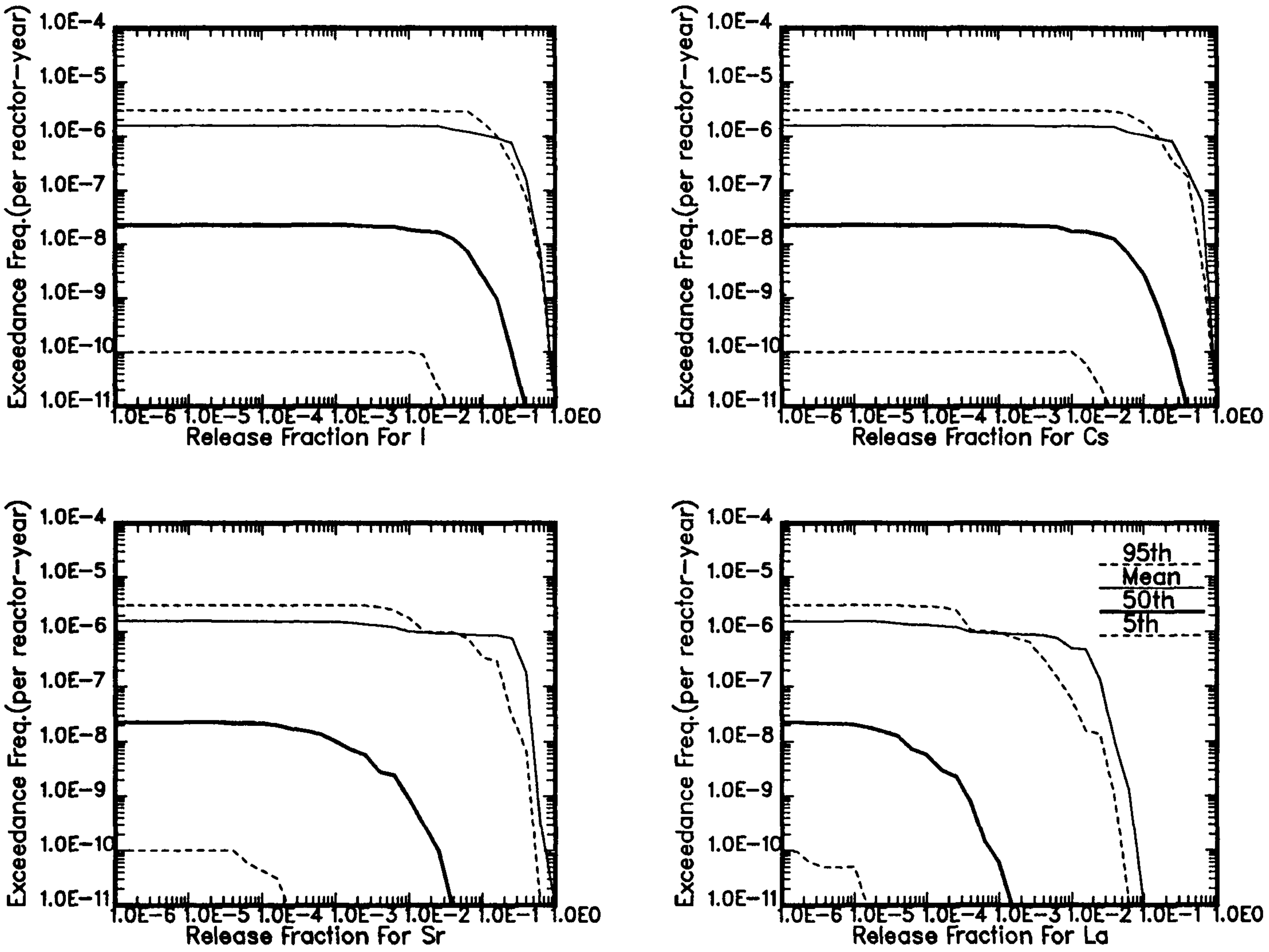

Figure 3.3-50
Peach Bottom: LLNL Seismic PDS 1 - FSB RPV - Low PGA
Source Term CCDF

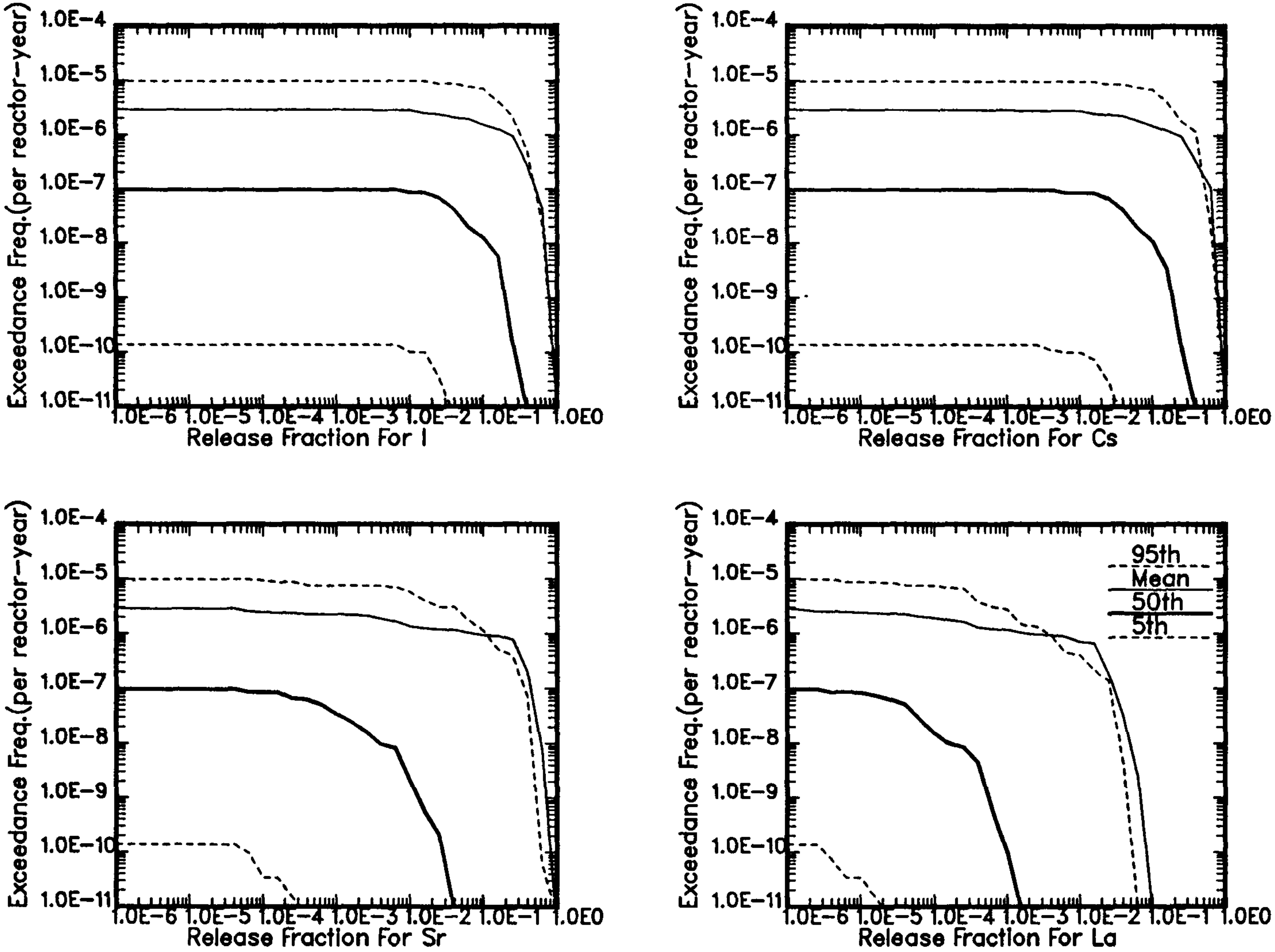

Figure 3.3-51
Peach Bottom: LLNL Seismic PDS 2 - FSB LLOCA - Low PGA
Source Term CCDF

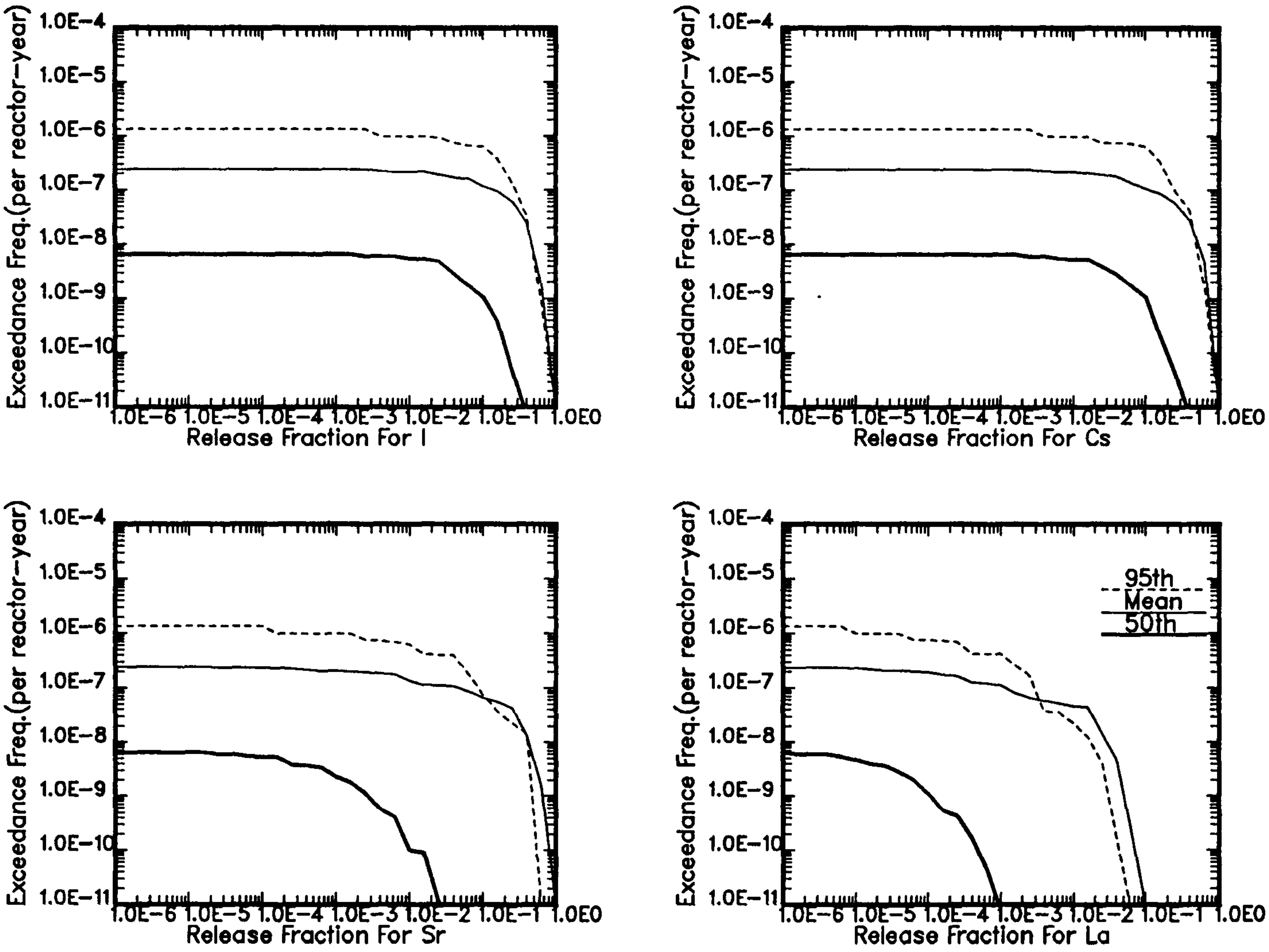

Figure 3.3-52
Peach Bottom: LLNL Seismic PDS 3 - FSB LLOCA - Low PGA
Source Term CCDF

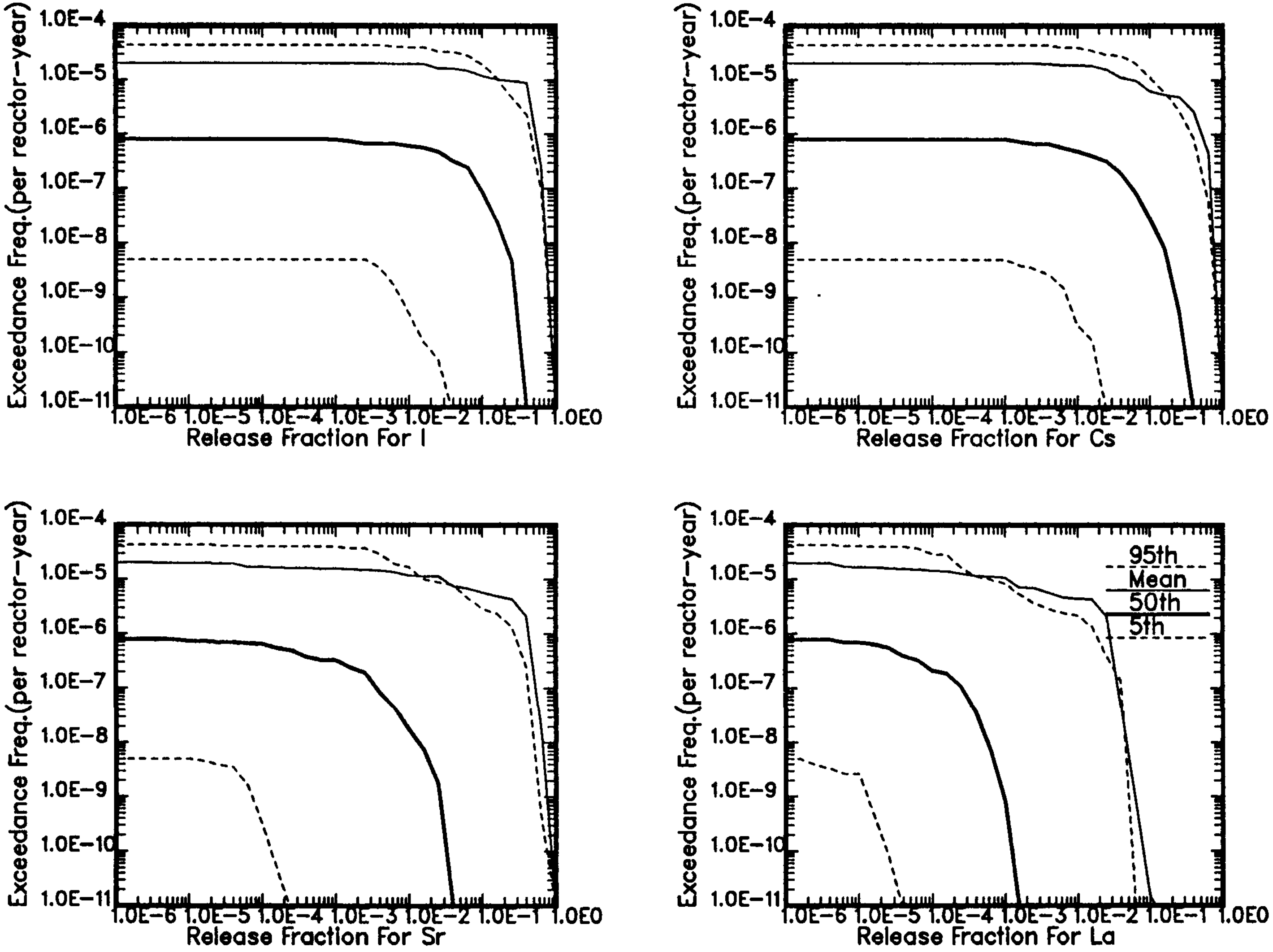

Figure 3.3-53
Peach Bottom: LLNL Seismic PDS 4 - Slow SBO - Low PGA
Source Term CCDF

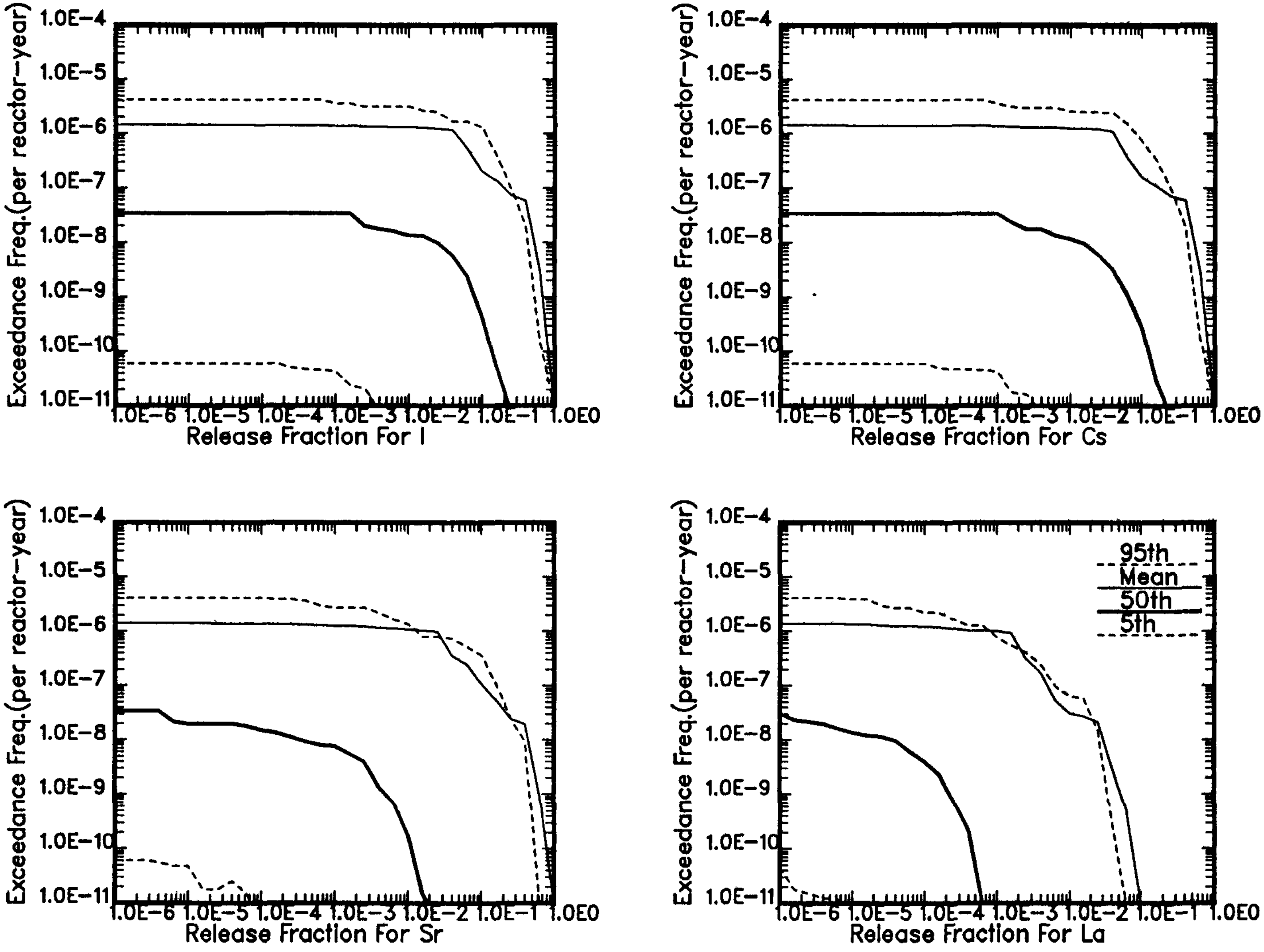

Figure 3.3-54
Peach Bottom: LLNL Seismic PDS 5 - Fast SBO - Low PGA
Source Term CCDF

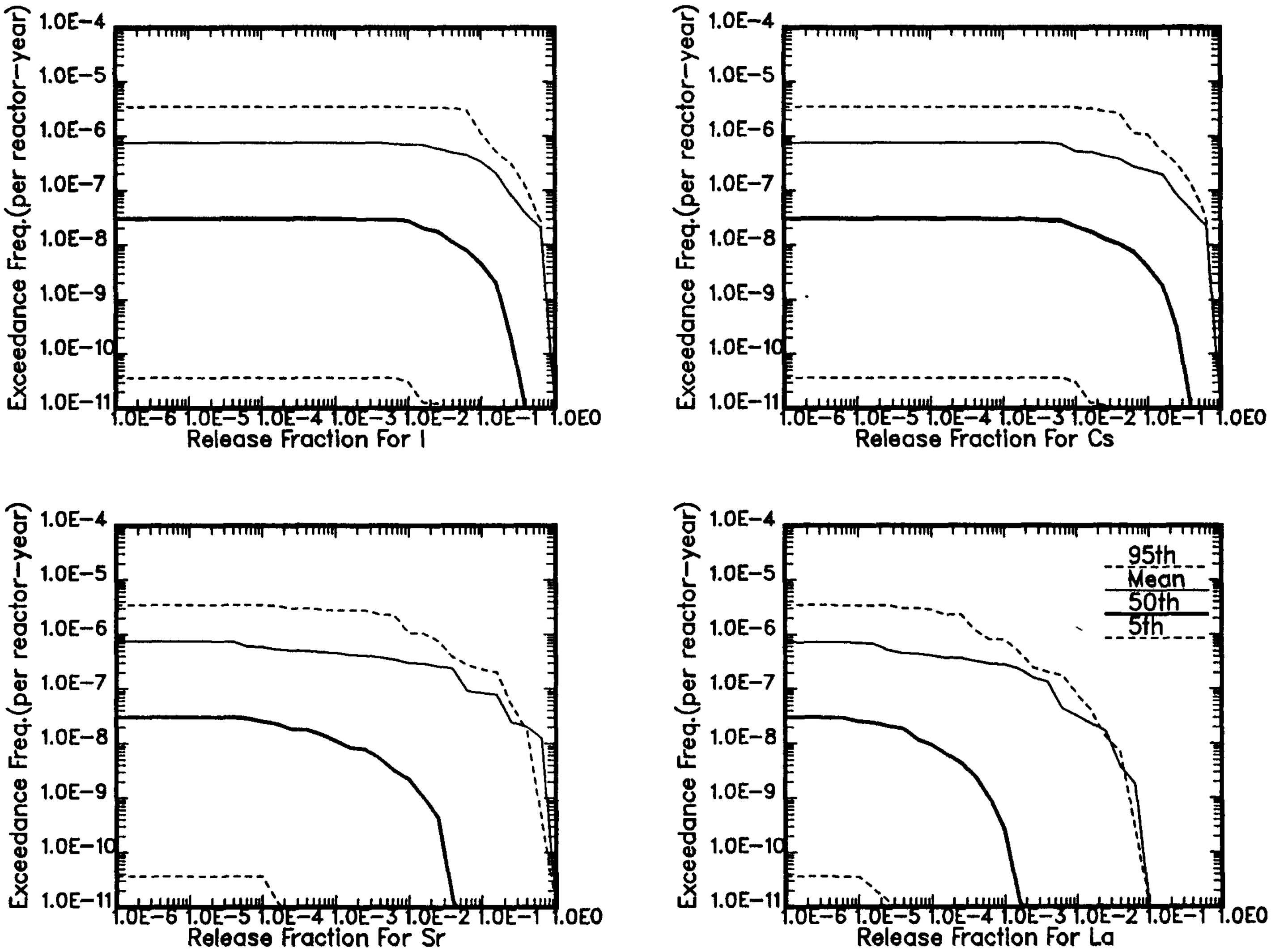

Figure 3.3-55
Peach Bottom: LLNL Seismic PDS 6 - FSB ILOCA - Low PGA
Source Term CCDF

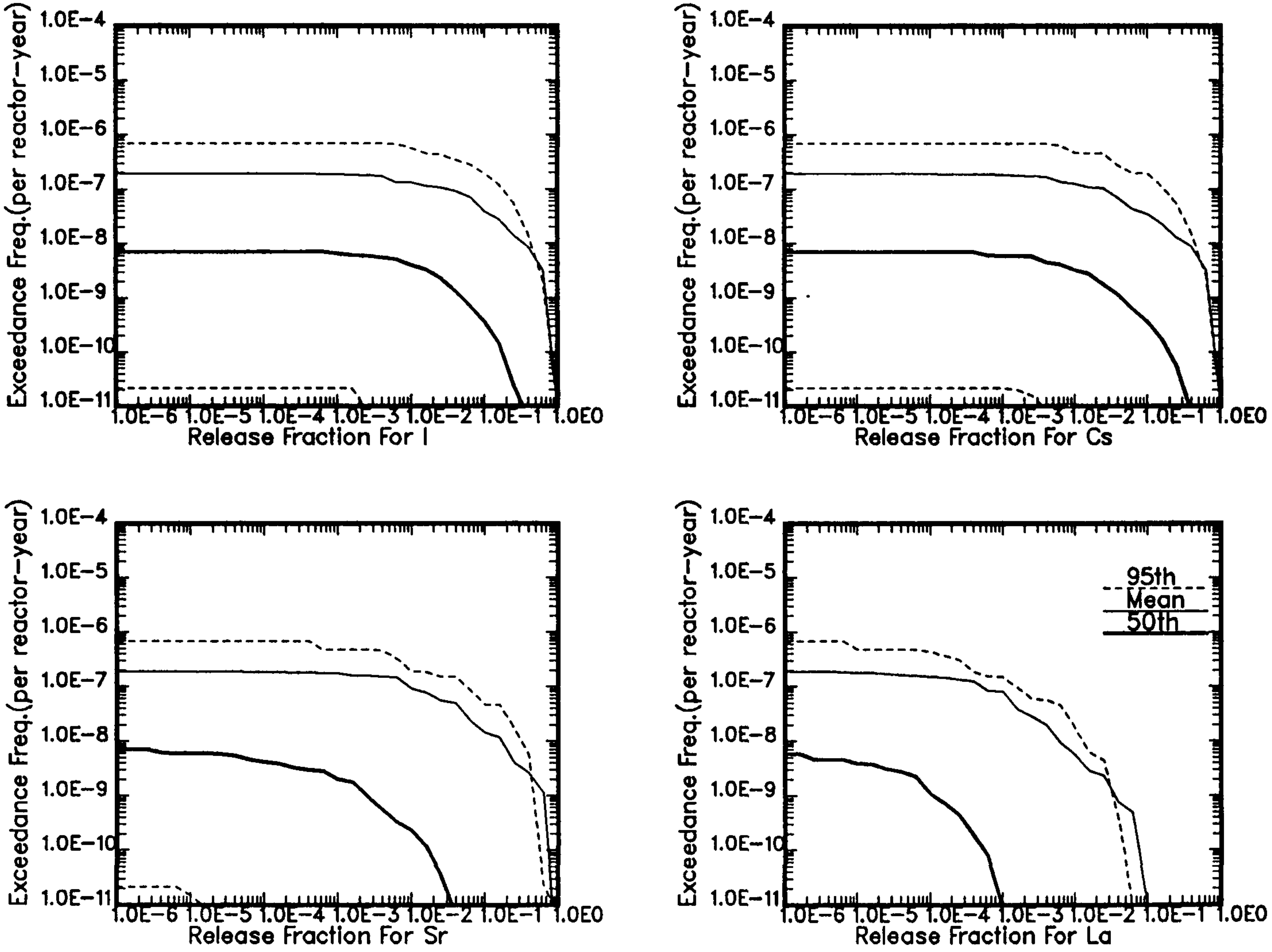

Figure 3.3-56
Peach Bottom: LLNL Seismic PDS 7 - FSB I/SLOCA - Low PGA
Source Term CCDF

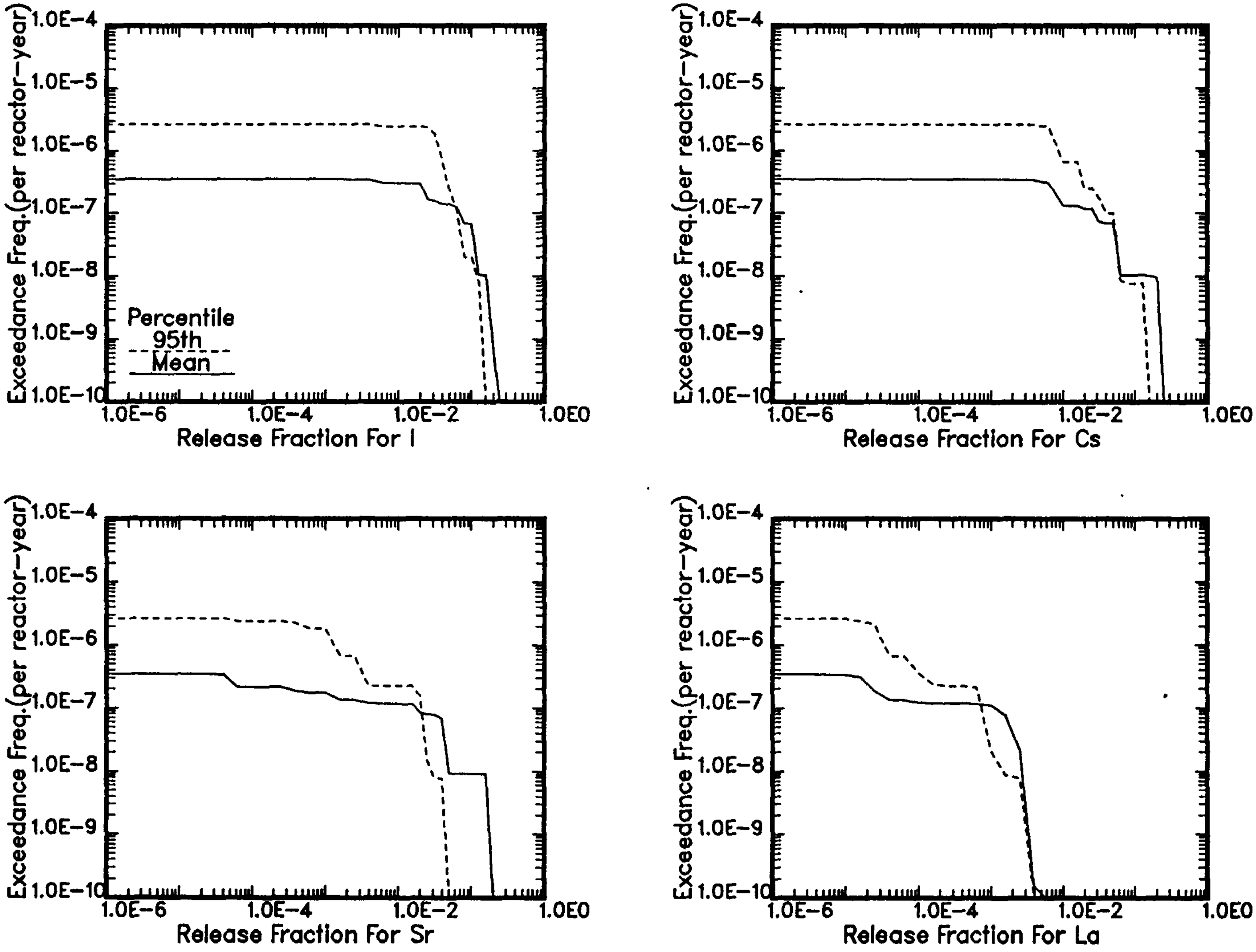

Figure 3.3-57
Peach Bottom: LLNL Seismic Generalized APB 1 - Low PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Wetwell Failure

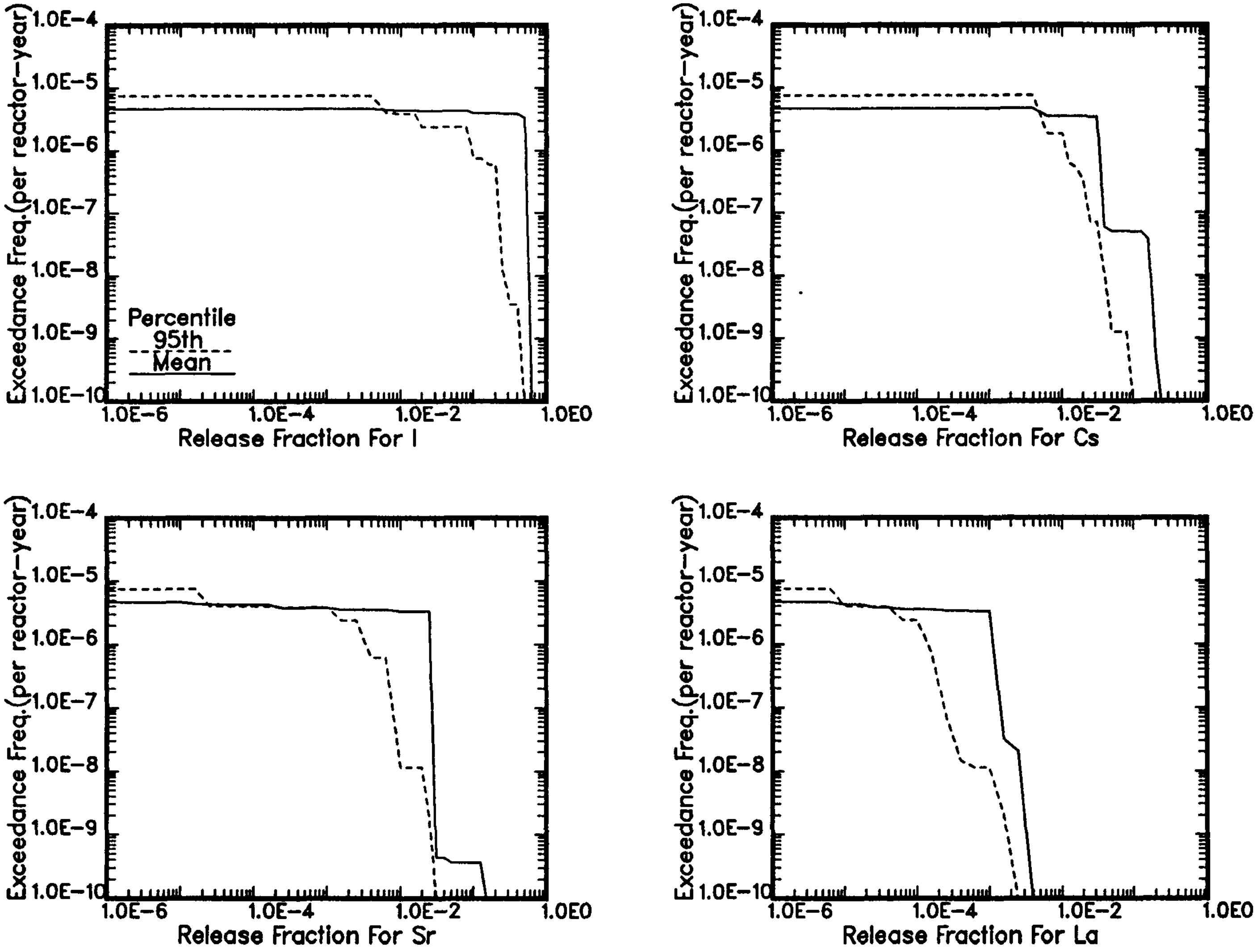

Figure 3.3-58
Peach Bottom: LLNL Seismic Generalized APB 2 - Low PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Wetwell Failure

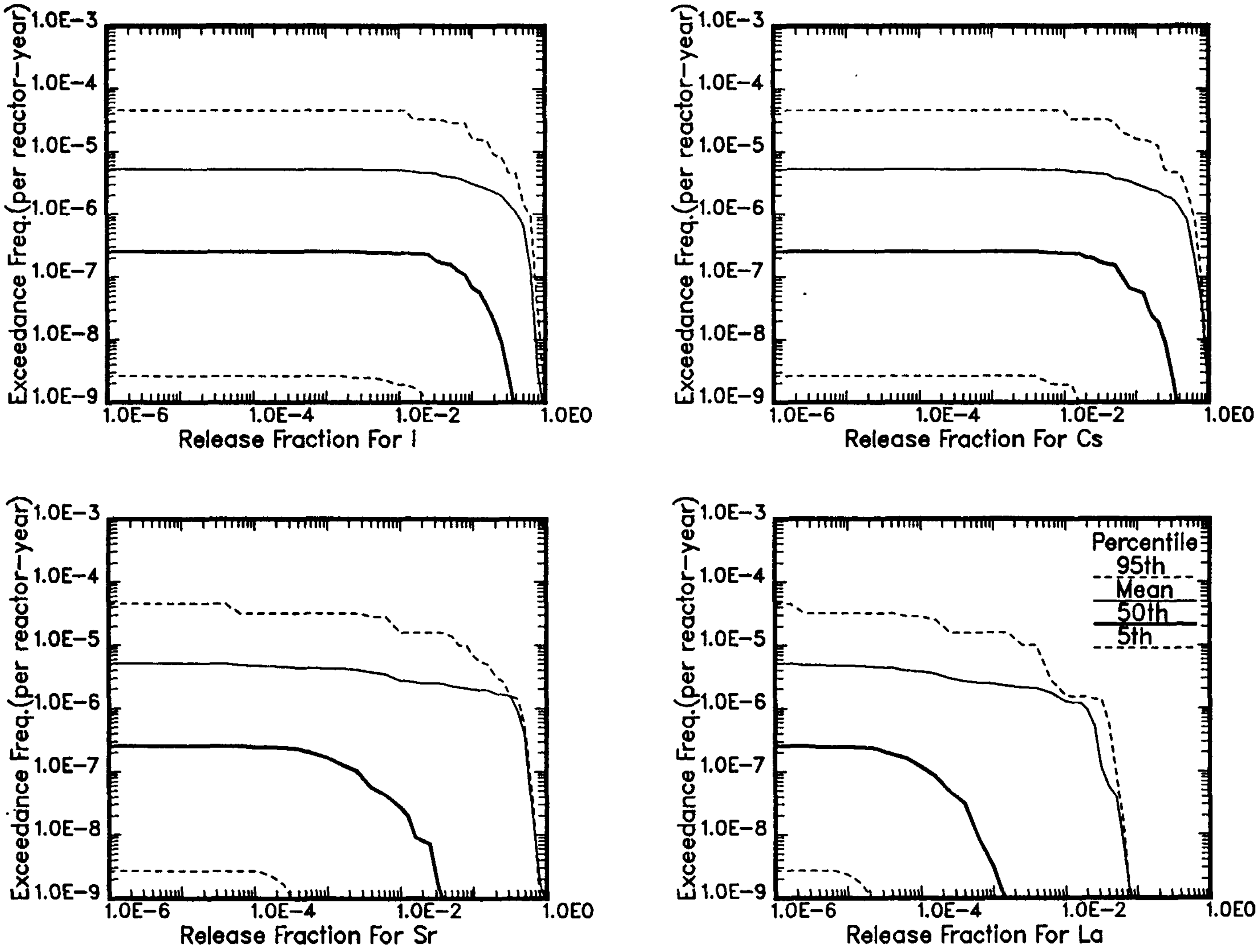

Figure 3.3-59
Peach Bottom: LLNL Seismic Generalized APB 3 - Low PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Drywell Failure

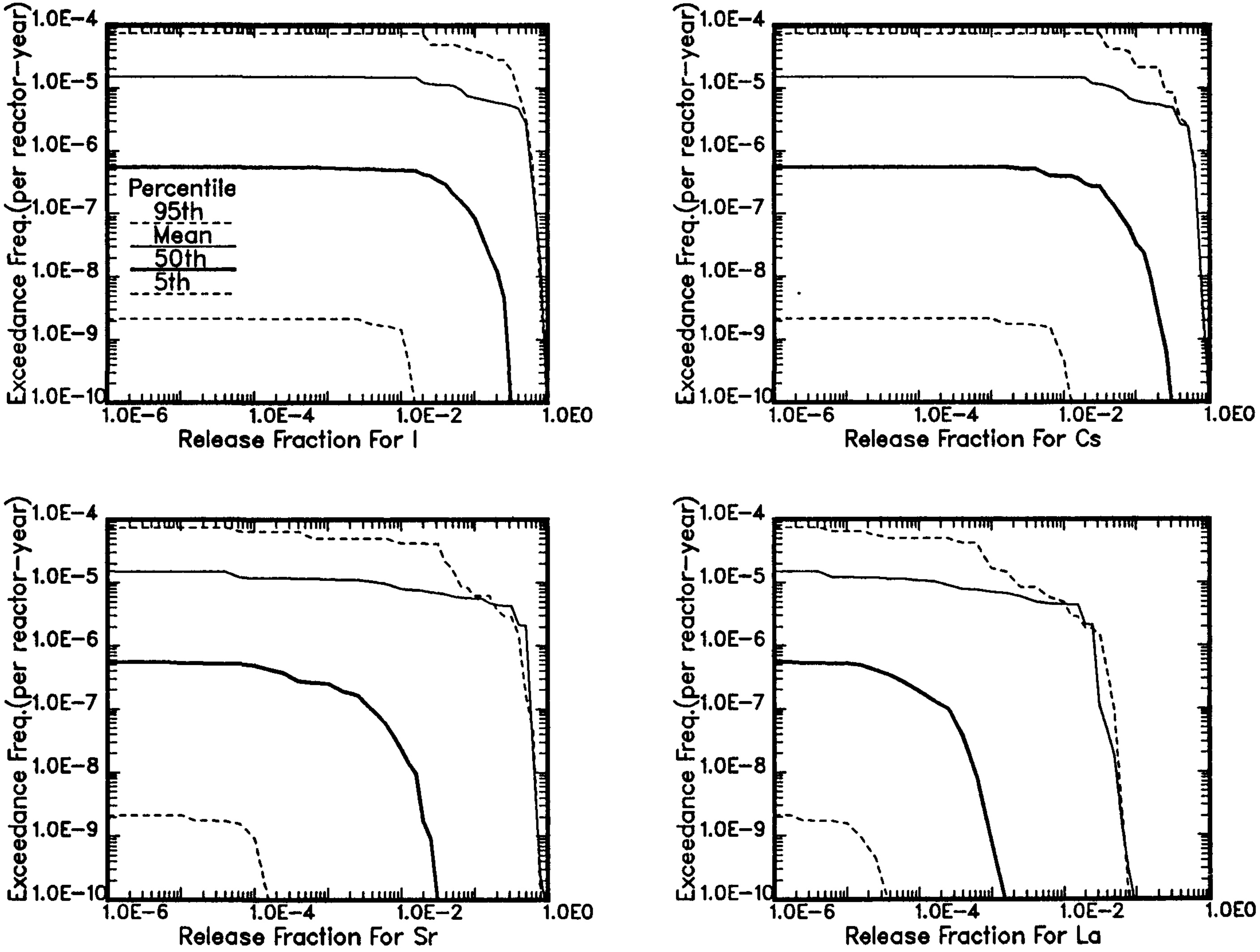

Figure 3.3-60
Peach Bottom: LLNL Seismic Generalized APB 4 - Low PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Drywell Failure

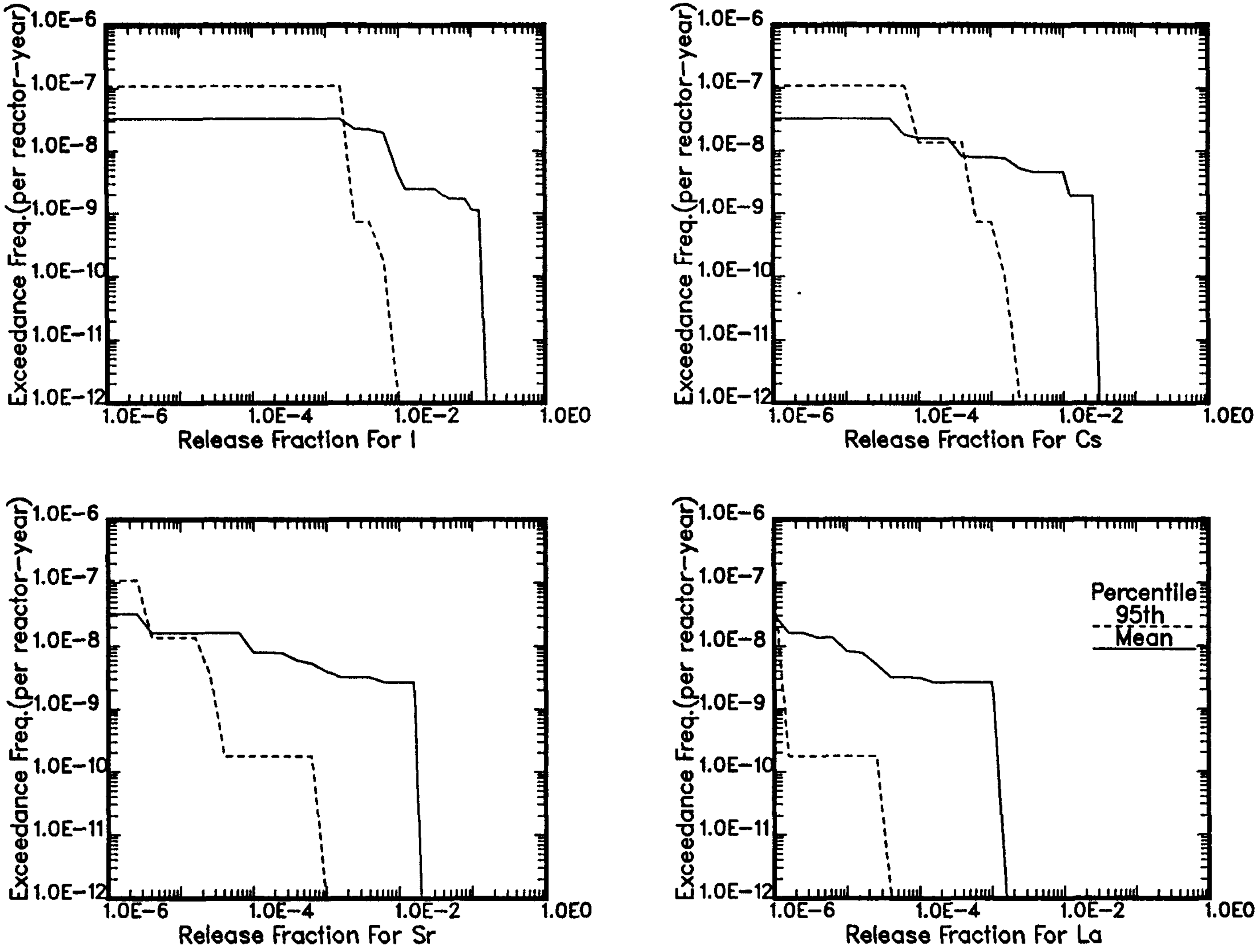

Figure 3.3-61
Peach Bottom: LLNL Seismic Generalized APB 5 - Low PGA
Source Term CCDF: Core Damage, VB, Late Wetwell Failure

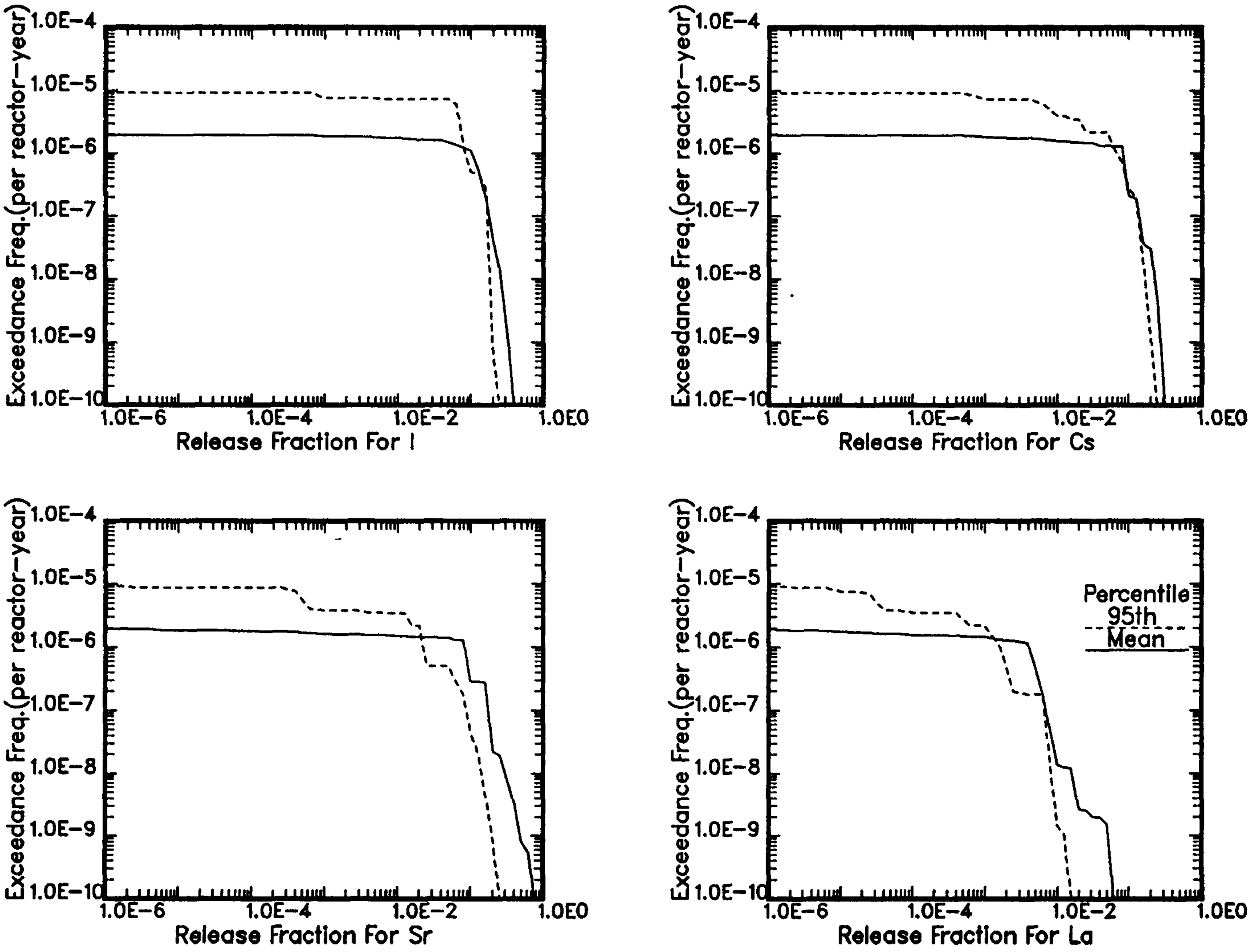

Figure 3.3-62
Peach Bottom: LLNL Seismic Generalized APB 6 - Low PGA
Source Term CCDF: Core Damage, VB, Late Drywell Failure

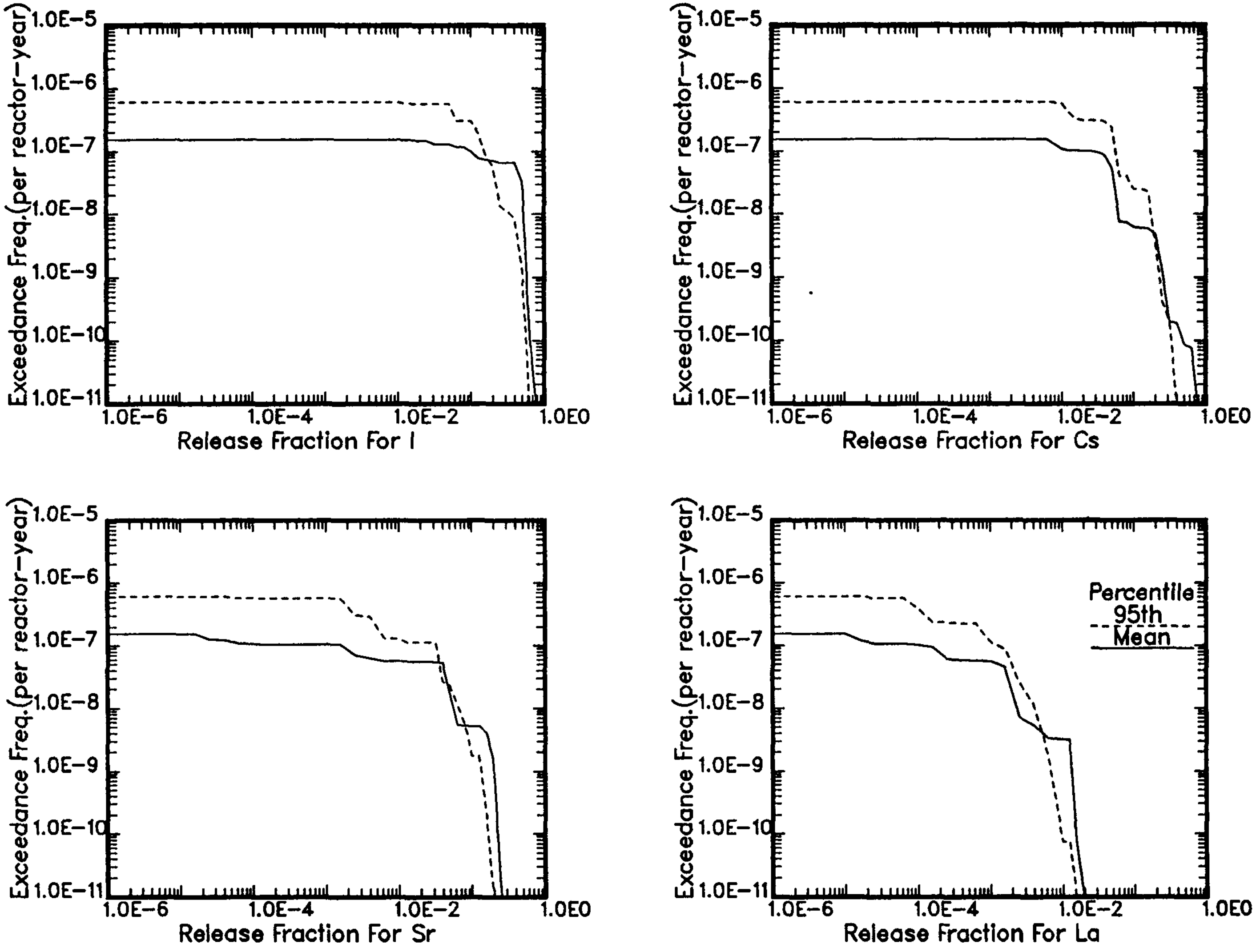

Figure 3.3-63
Peach Bottom: LLNL Seismic Generalized APB 7 - Low PGA
Source Term CCDF: Core Damage, VB, Venting

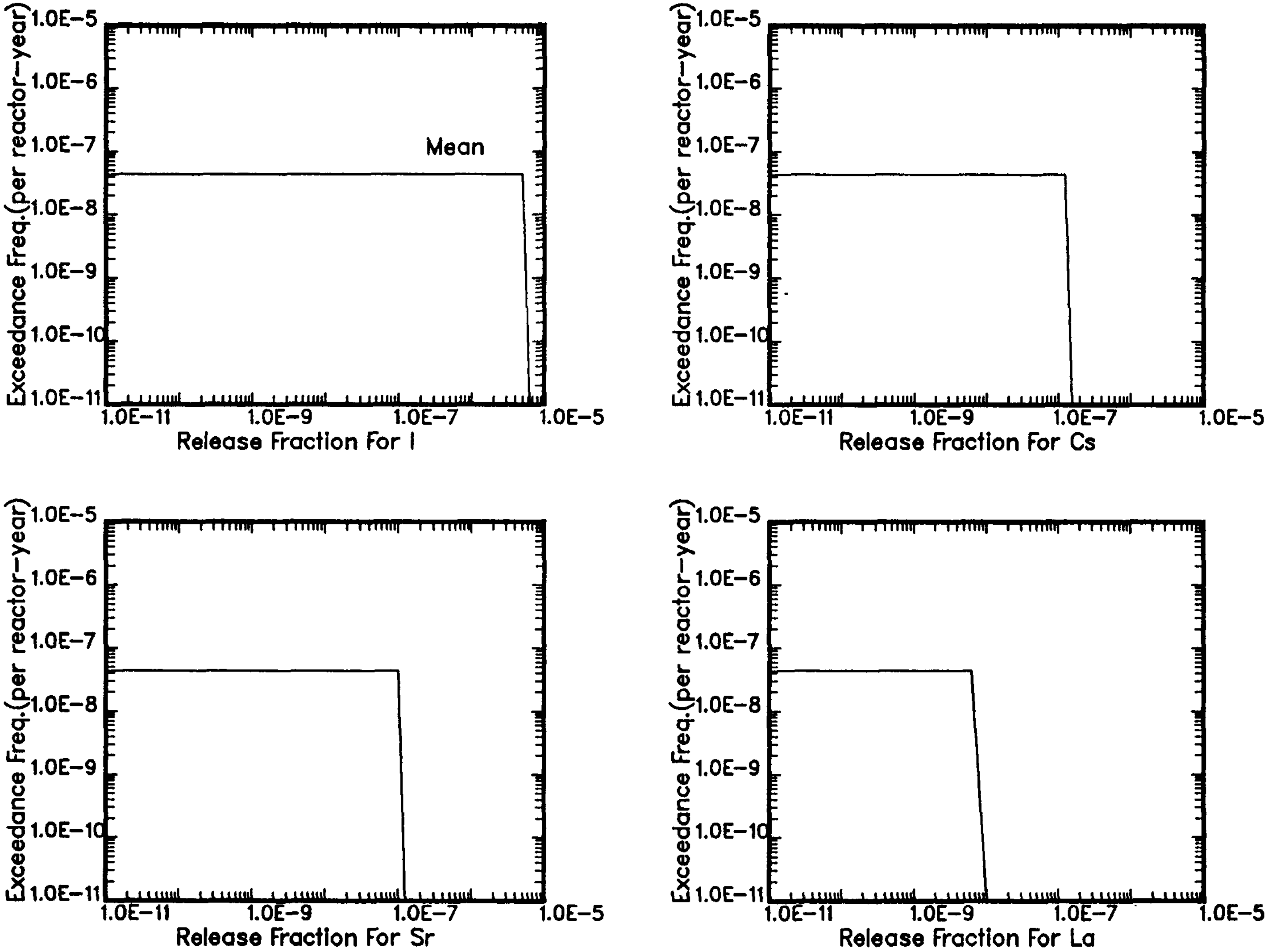

Figure 3.3-64
Peach Bottom: LLNL Seismic Generalized APB 8 - Low PGA
Source Term CCDF: Core Damage, VB, No Containment Failure

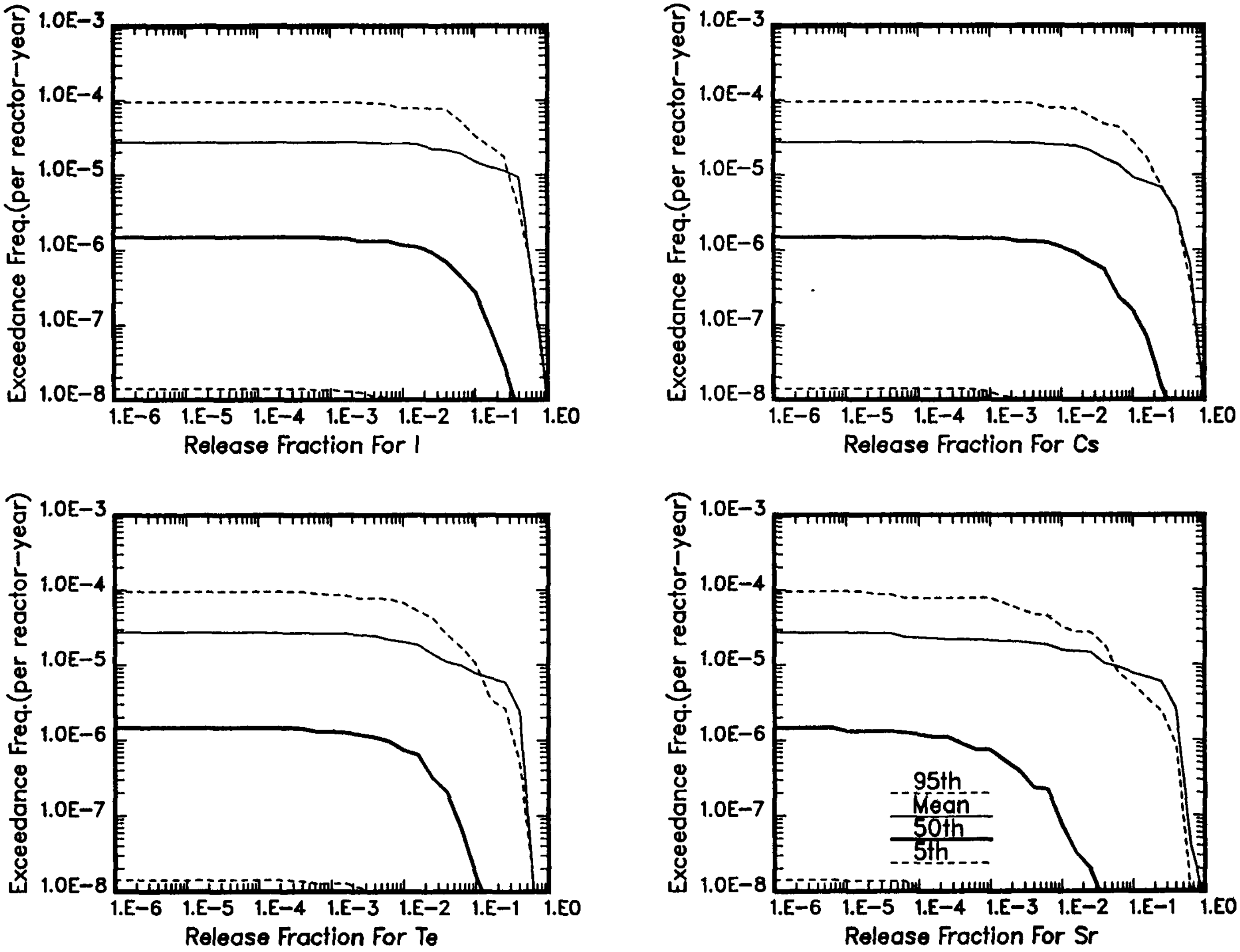

Figure 3.3-65a
Peach Bottom: LLNL Seismic - Low PGA
Source Term CCDF

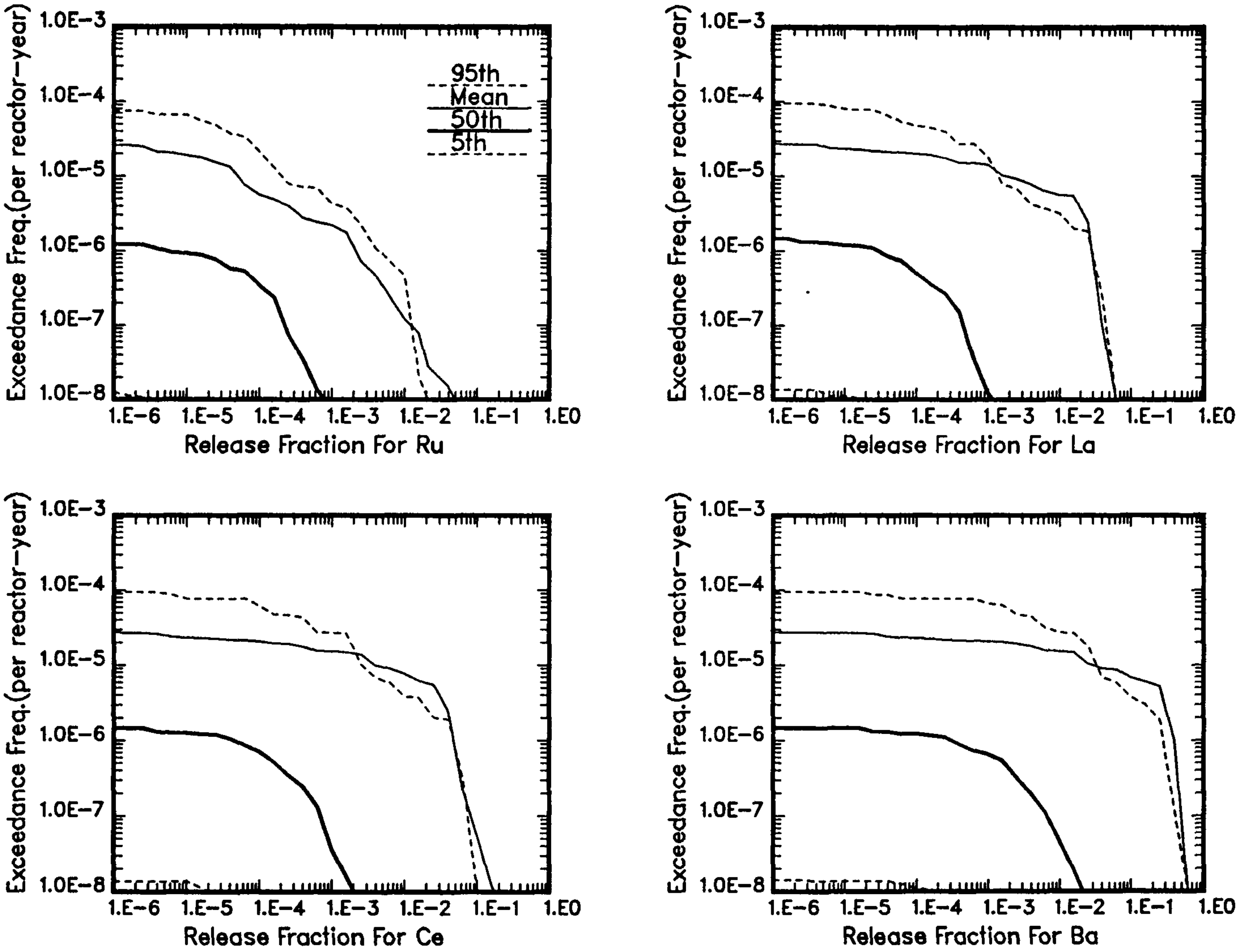

Figure 3.3-65b
Peach Bottom: LLNL Seismic - Low PGA
Source Term CCDF

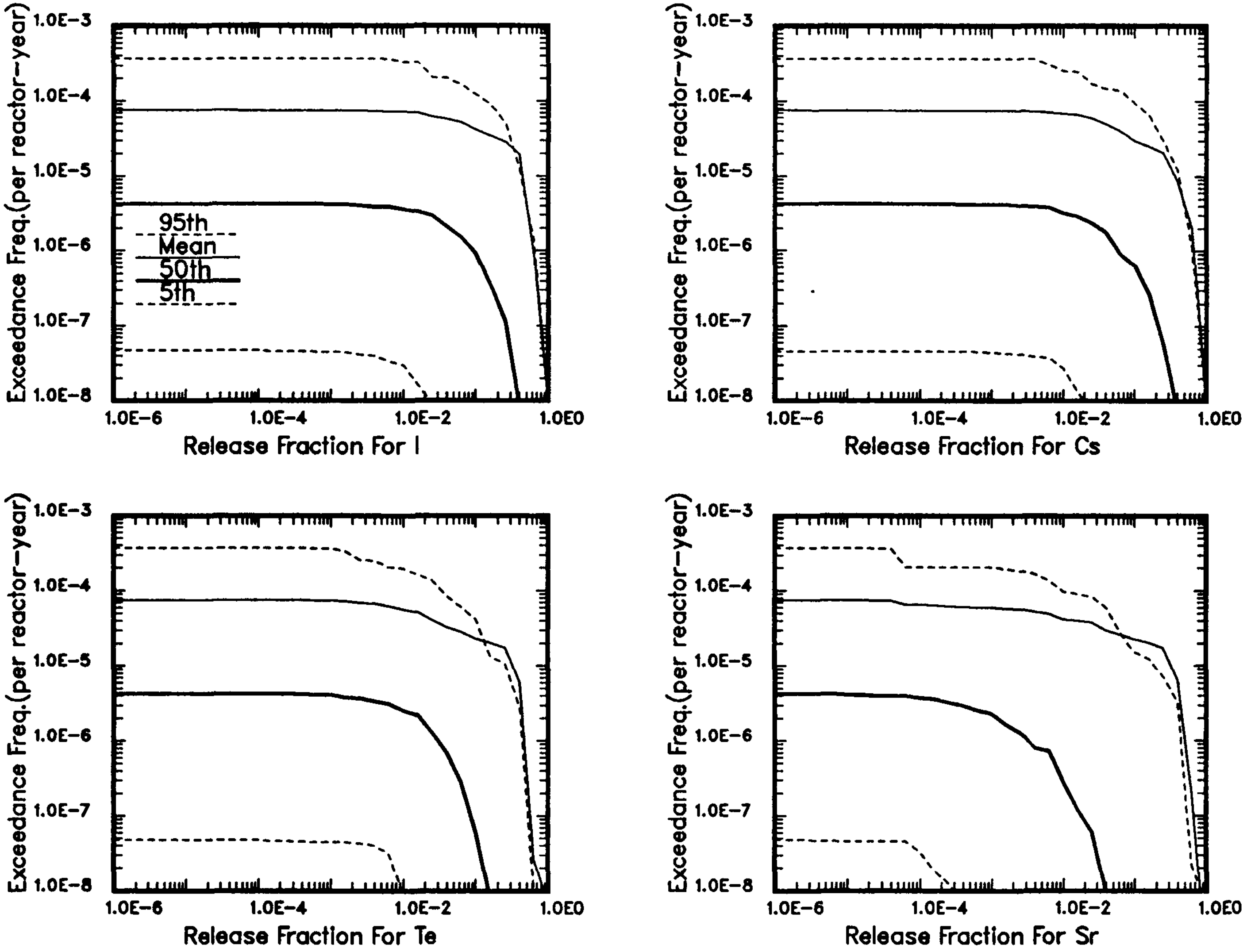

Figure 3.3-66a
Peach Bottom: LLNL Seismic - Hi & Low PGA
Source Term CCDF

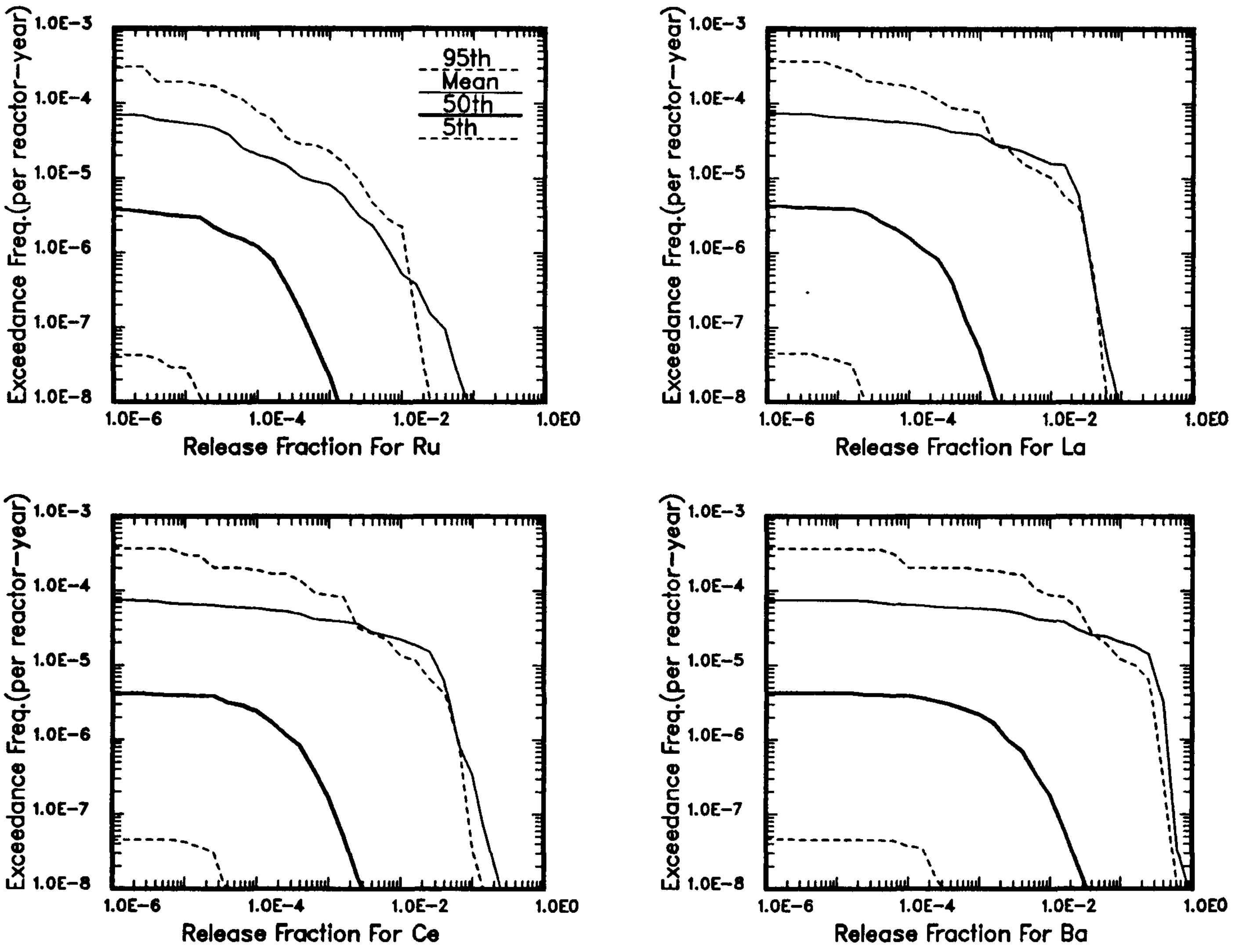

Figure 3.3-66b
Peach Bottom: LLNL Seismic - Hi & Low PGA
Source Term CCDF

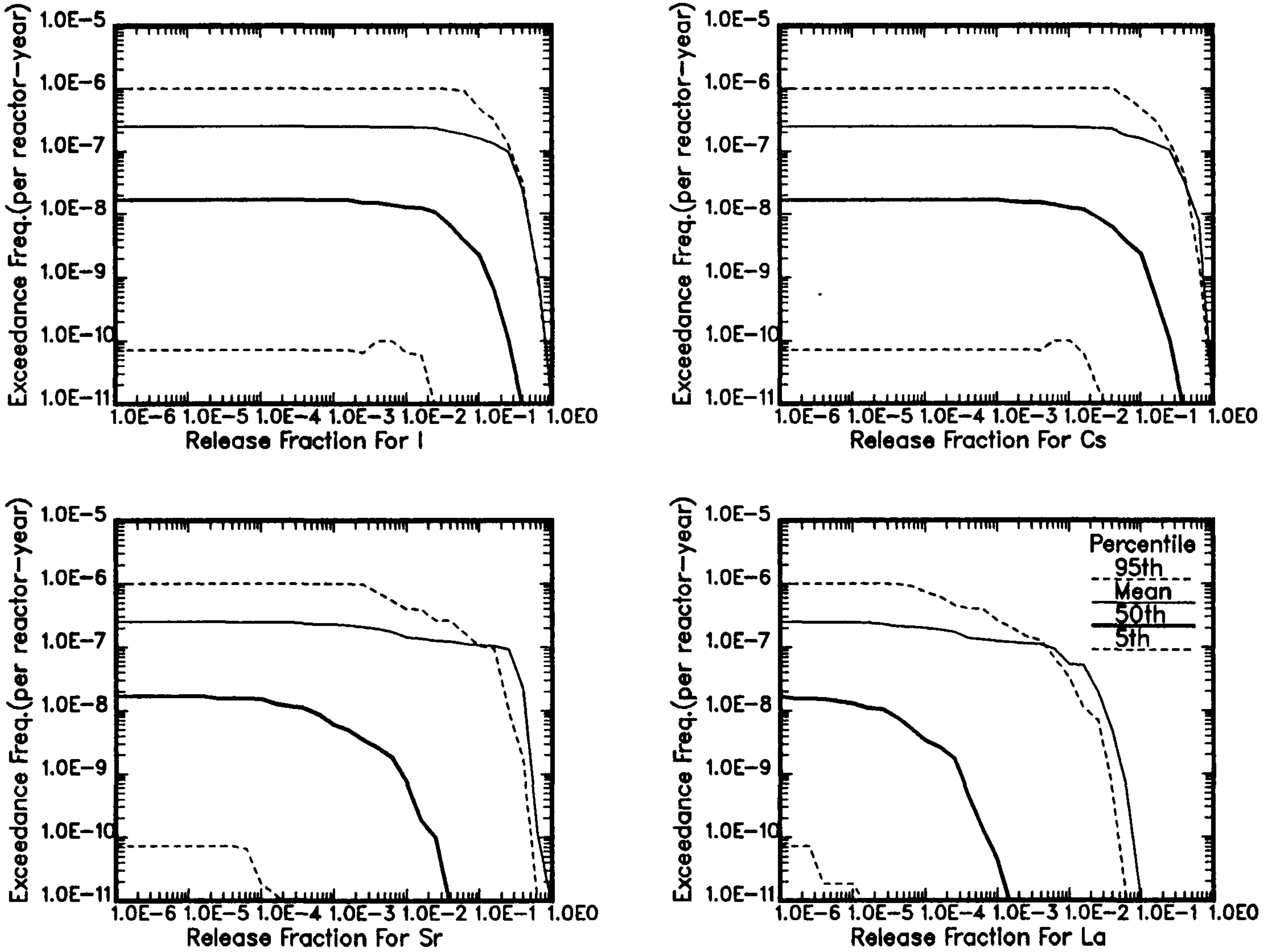

Figure 3.3-67
Peach Bottom: EPRI Seismic PDS 1 - FSB RPV - Hi PGA
Source Term CCDF

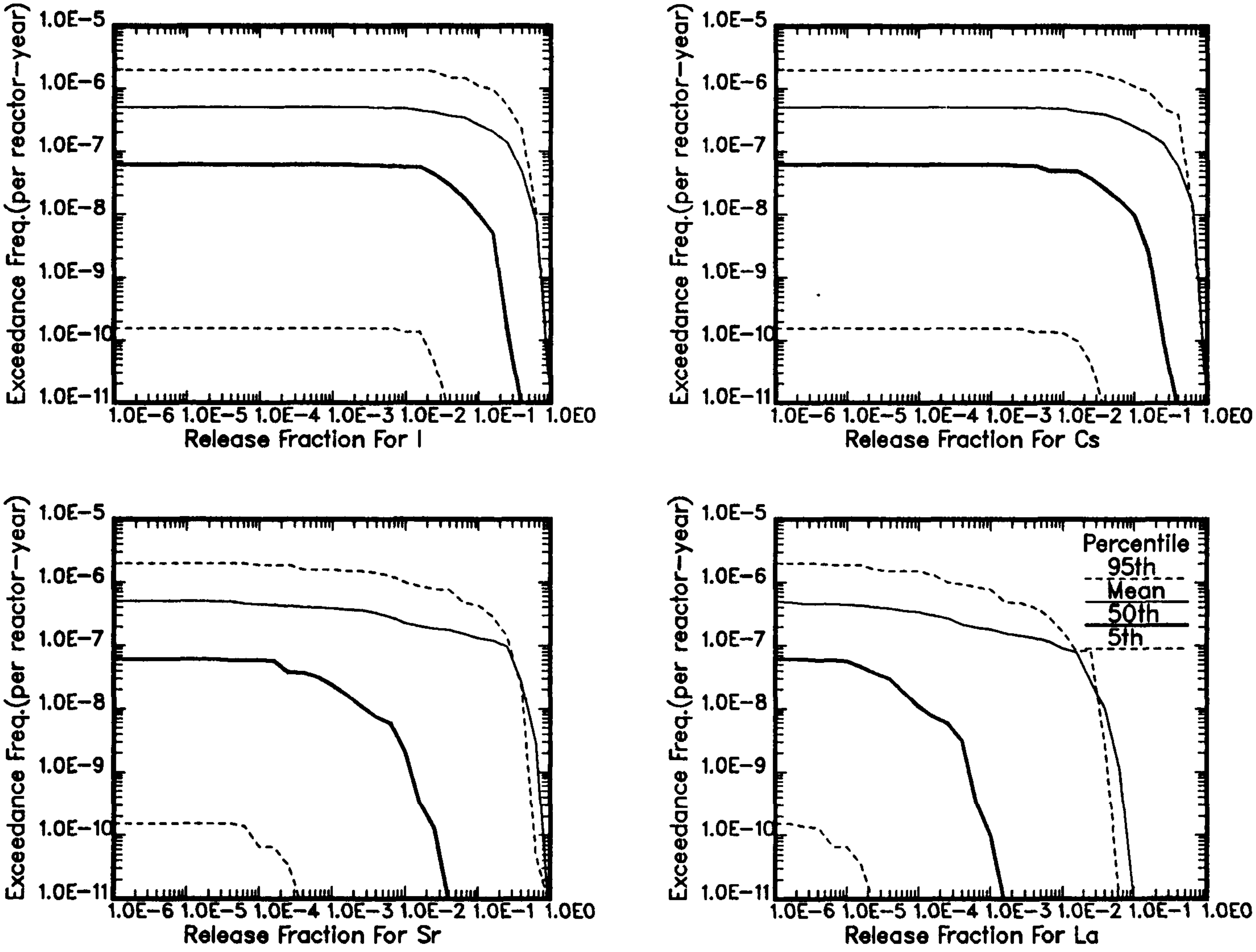

Figure 3.3-68
Peach Bottom: EPRI Seismic PDS 2 - FSB LOCA - Hi PGA
Source Term CCDF

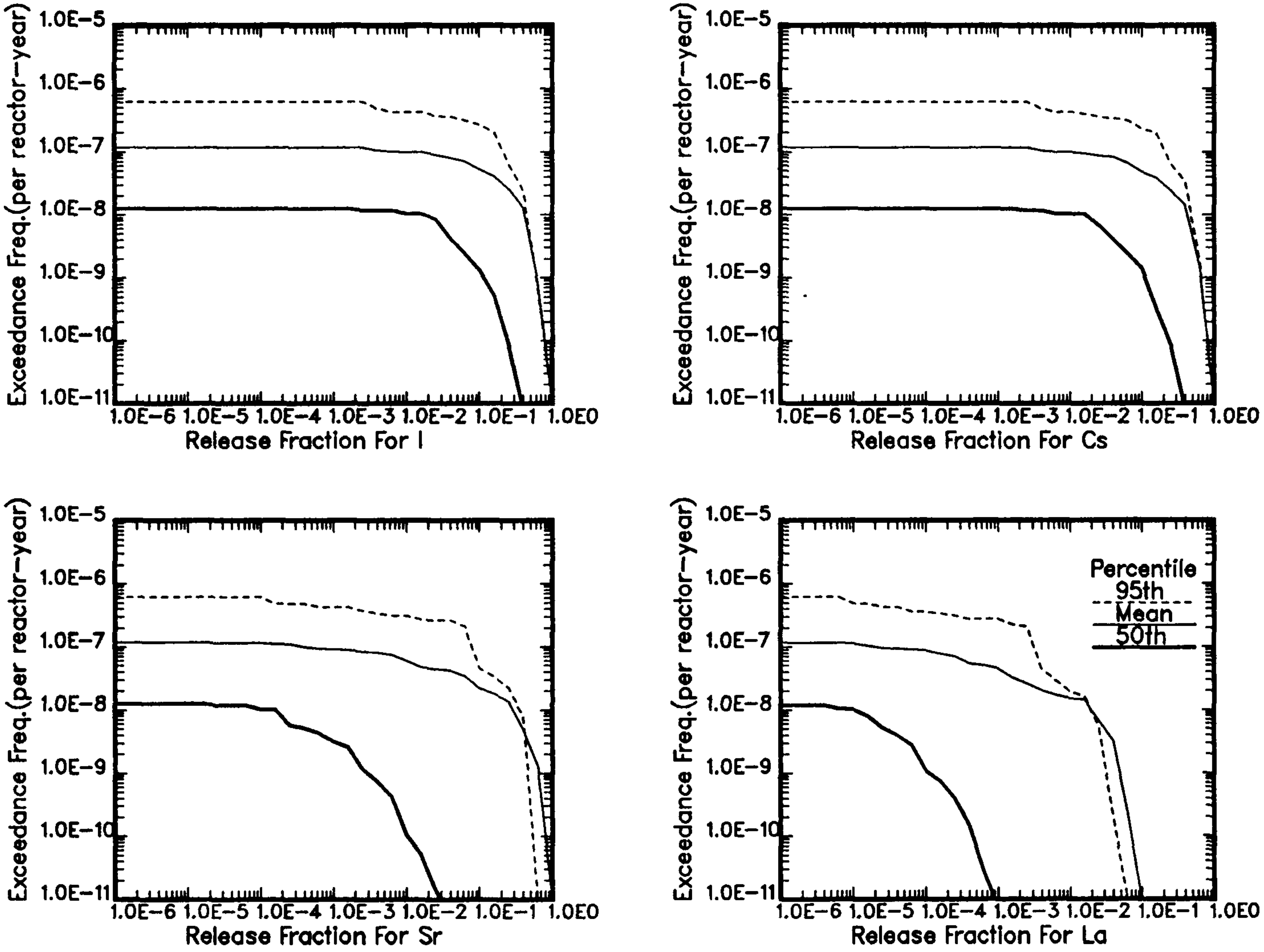

Figure 3.3-69
Peach Bottom: EPRI Seismic PDS 3 - FSB LOCA - Hi PGA
Source Term CCDF

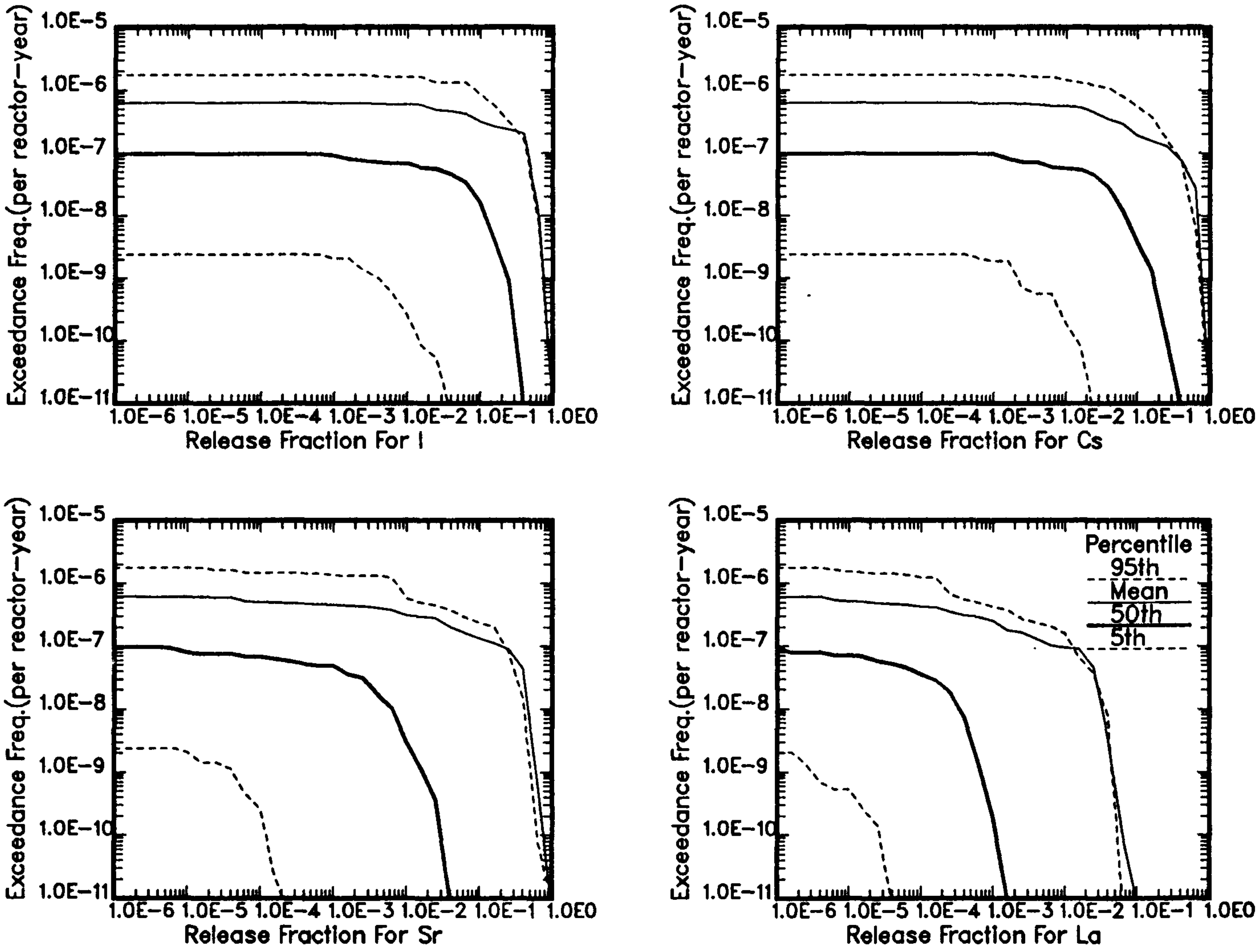

Figure 3.3-70
Peach Bottom: EPRI Seismic PDS 4 - Slow SBO - Hi PGA
Source Term CCDF

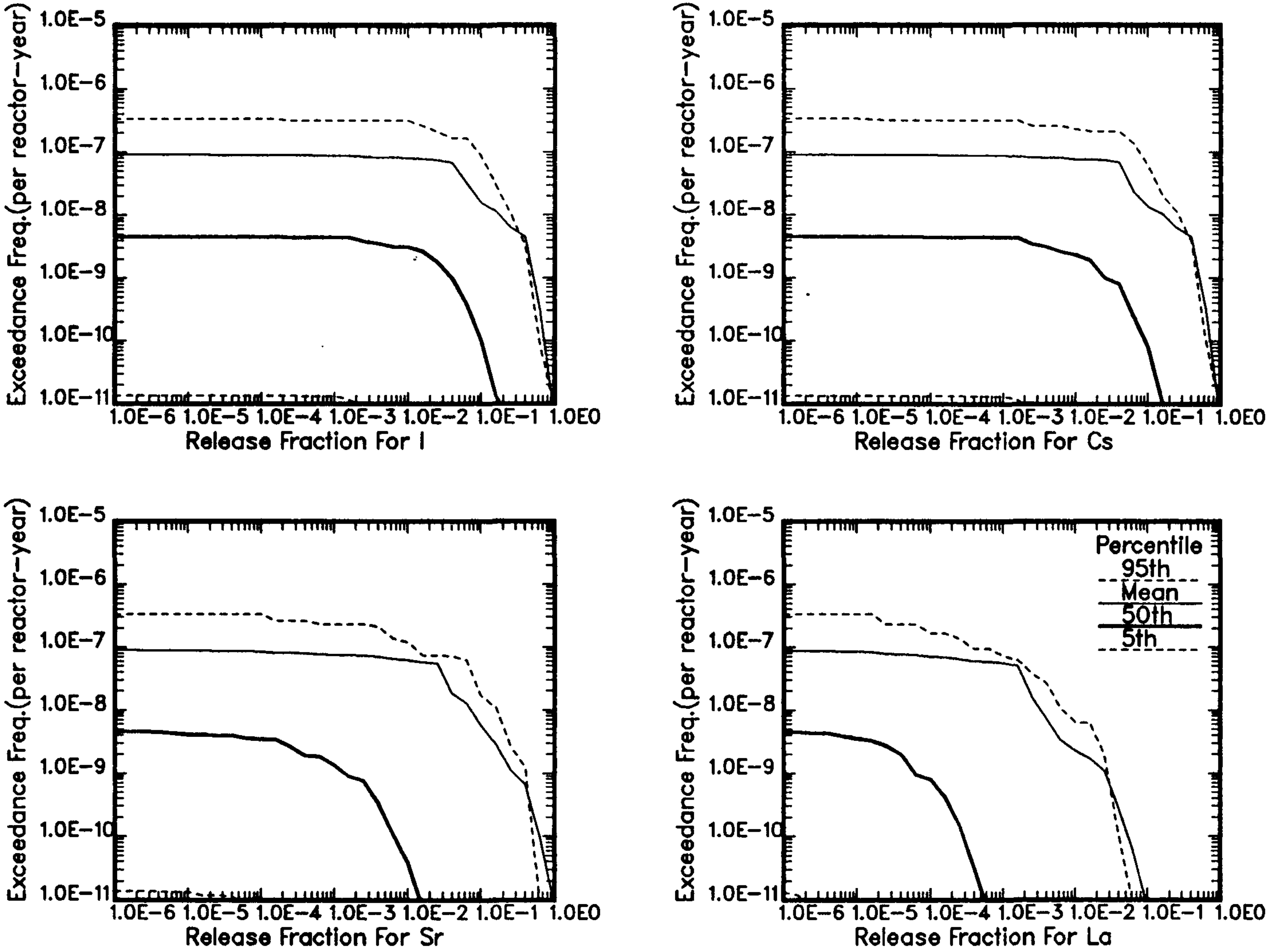

Figure 3.3-71
Peach Bottom: EPRI Seismic PDS 5 - Fast SBO - Hi PGA
Source Term CCDF

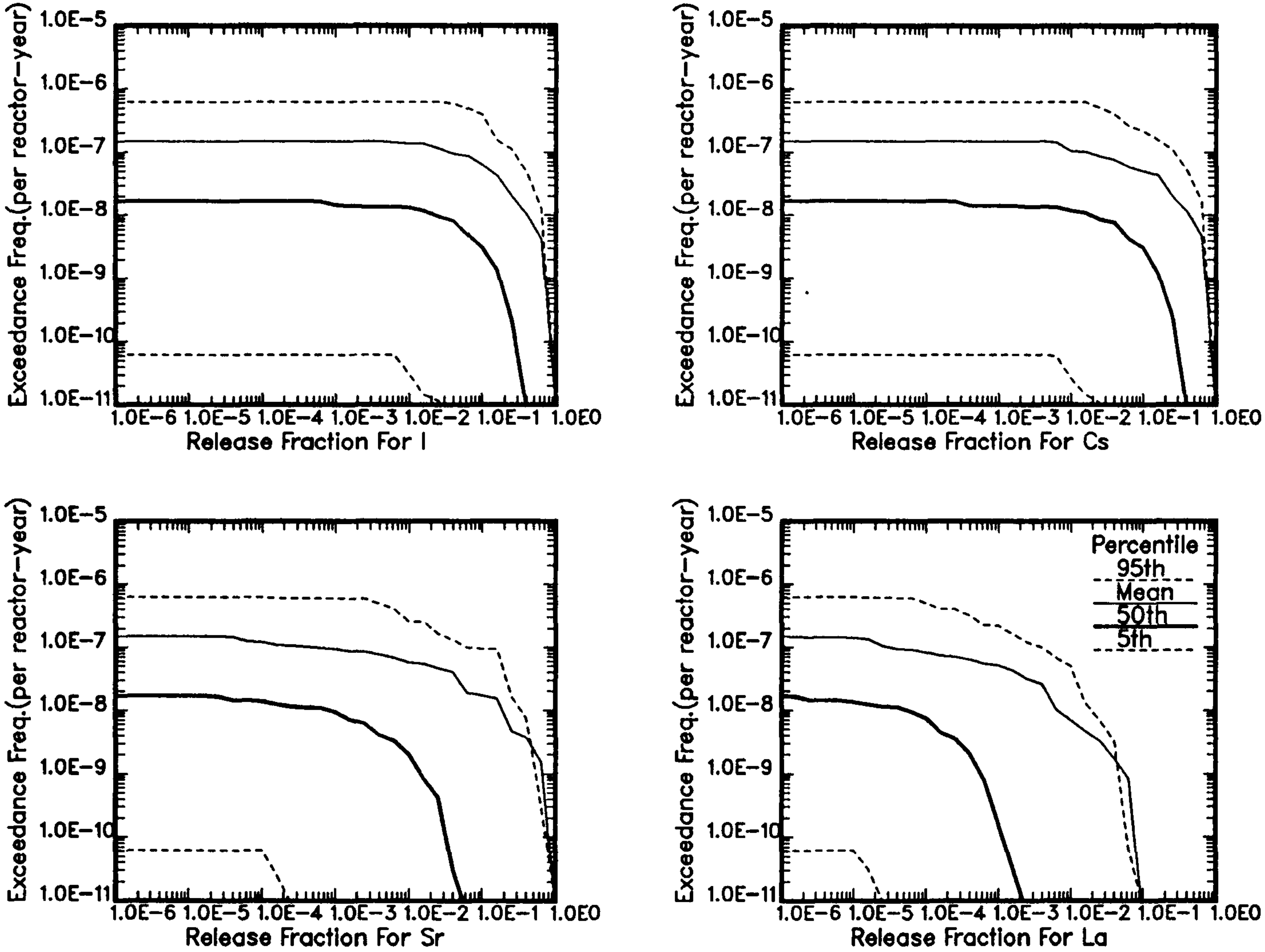

Figure 3.3-72
Peach Bottom: EPRI Seismic PDS 6 - FSB ILOCA - Hi PGA
Source Term CCDF

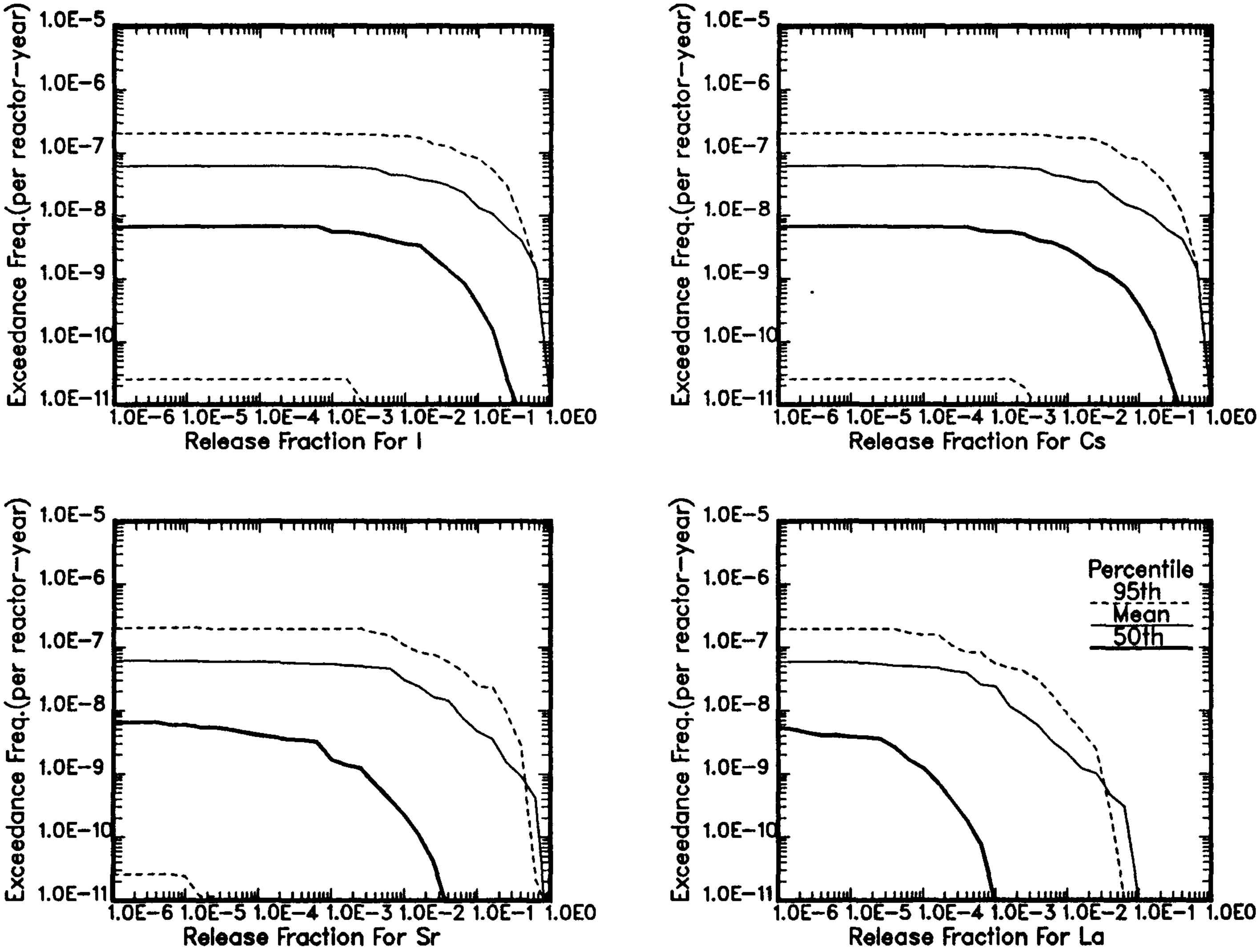

Figure 3.3-73
Peach Bottom: EPRI Seismic PDS 7 - FSB I/SLOCA - Hi PGA
Source Term CCDF

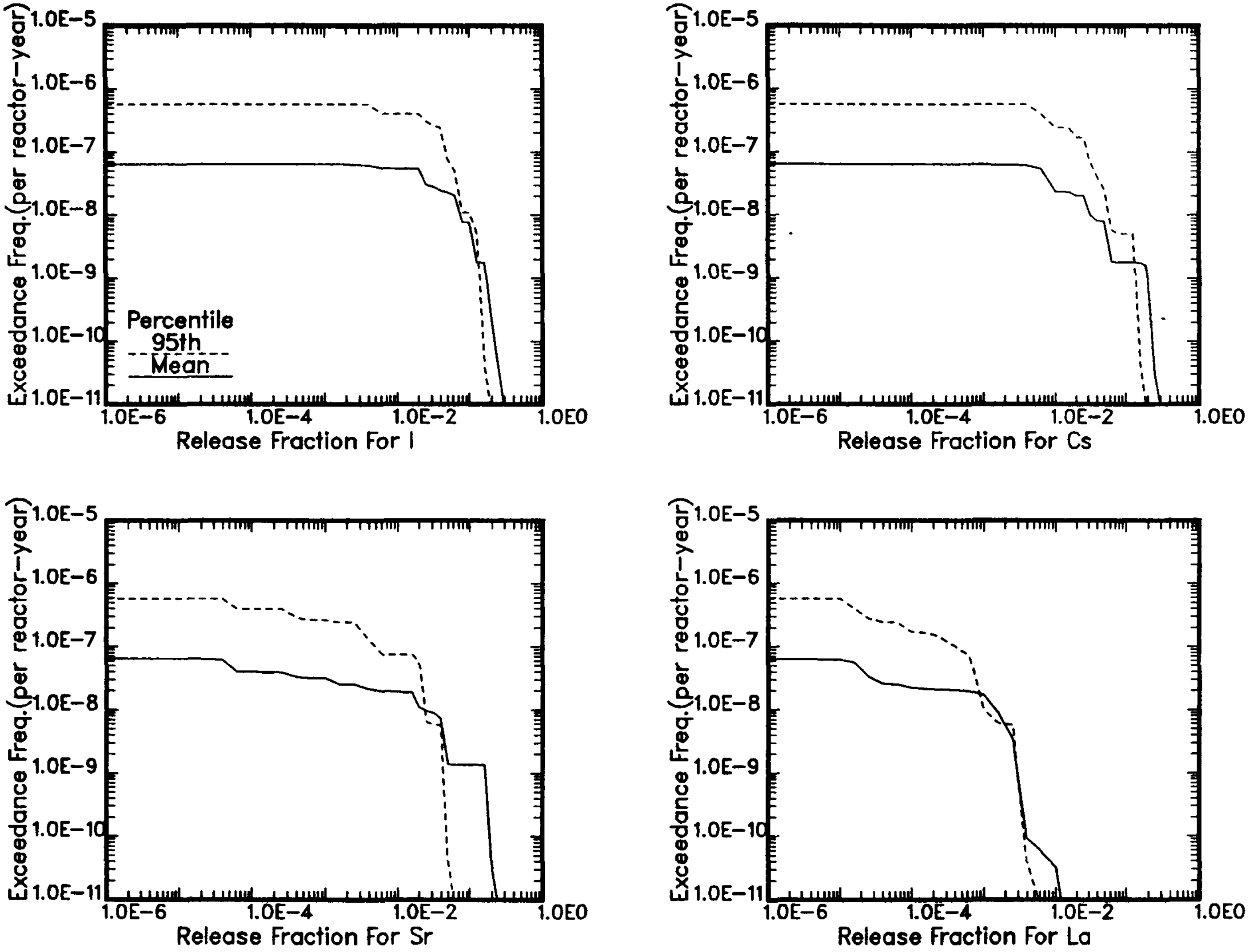

Figure 3.3-74
Peach Bottom: EPRI Seismic Generalized APB 1 - Hi PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Wetwell Failure

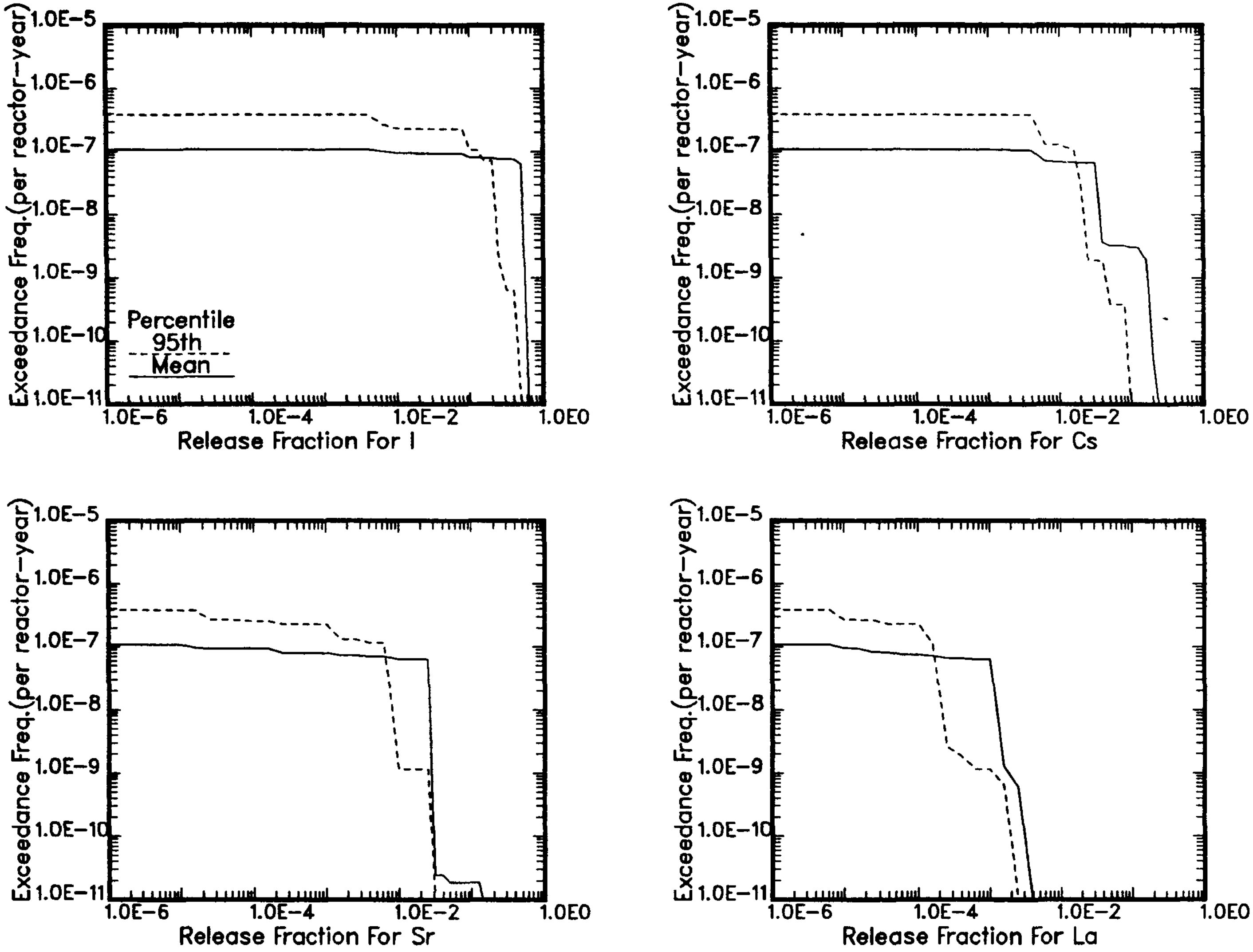

Figure 3.3-75
Peach Bottom: EPRI Seismic Generalized APB 2 - Hi PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Wetwell Failure

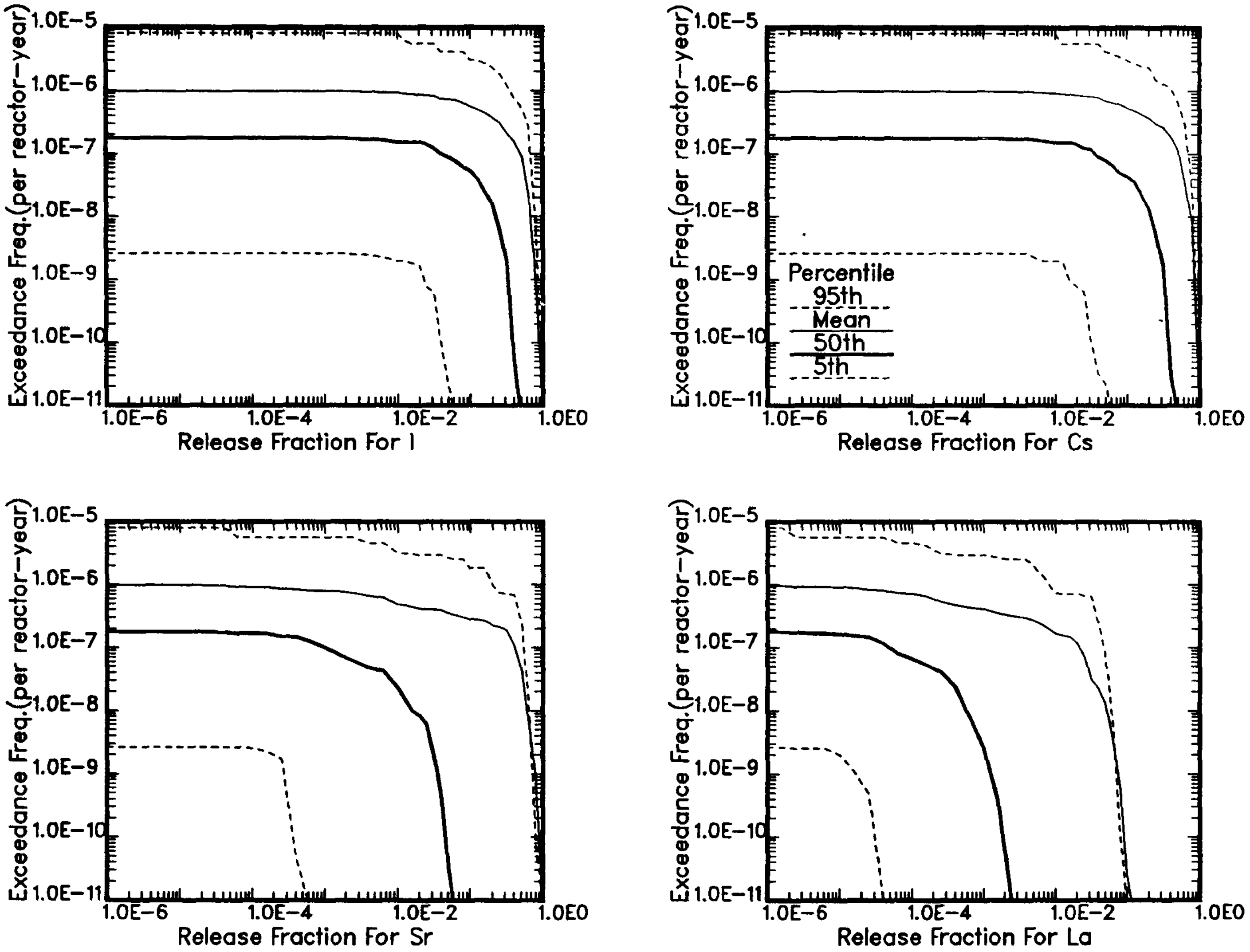

Figure 3.3-76
Peach Bottom: EPRI Seismic Generalized APB 3 - Hi PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Drywell Failure

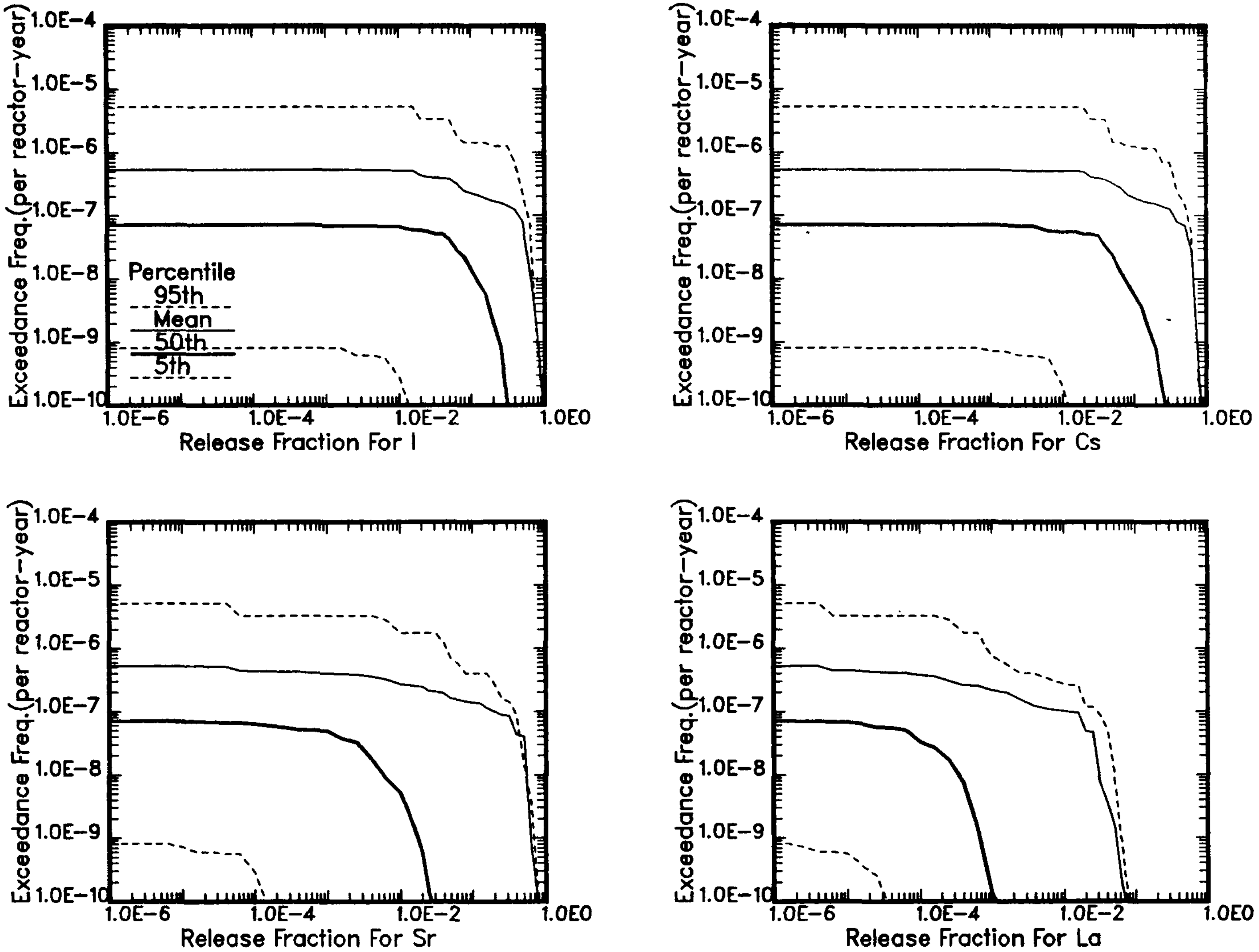

Figure 3.3-77
Peach Bottom: EPRI Seismic Generalized APB 4 - Hi PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Drywell Failure

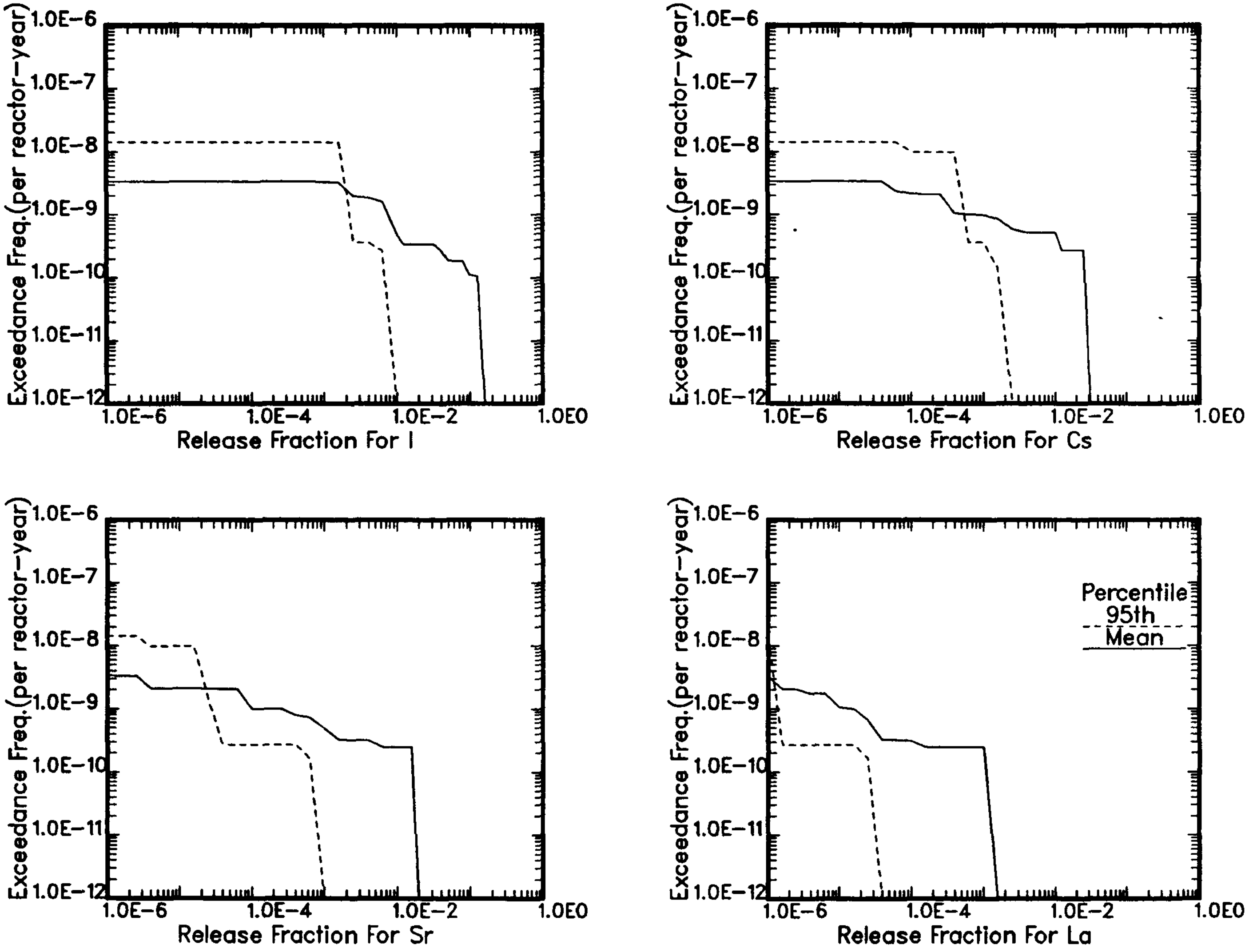

Figure 3.3-78
Peach Bottom: EPRI Seismic Generalized APB 5 - Hi PGA
Source Term CCDF: Core Damage, VB, Late Wetwell Failure

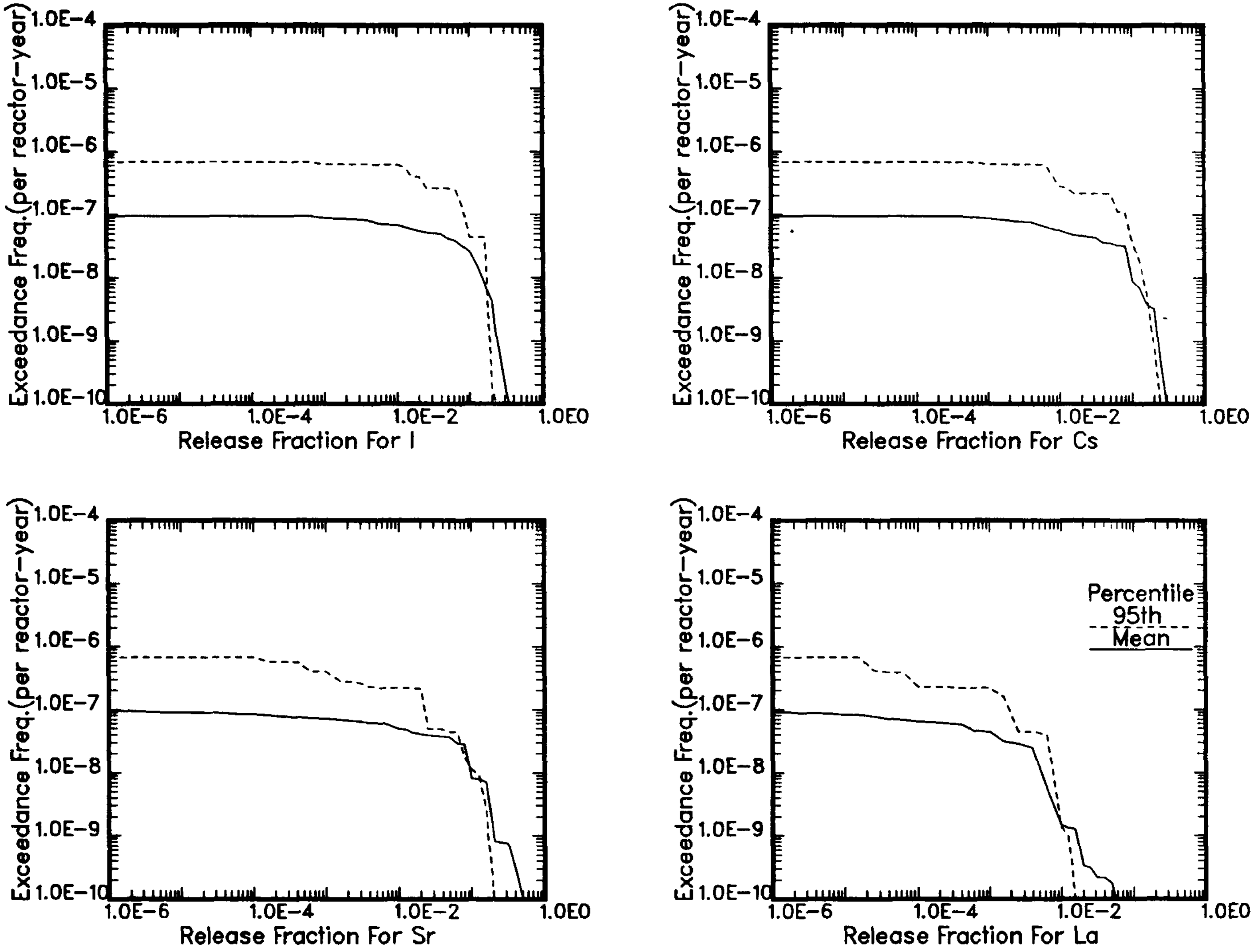

Figure 3.3-79
Peach Bottom: EPRI Seismic Generalized APB 6 - Hi PGA
Source Term CCDF: Core Damage, VB, Late Drywell Failure

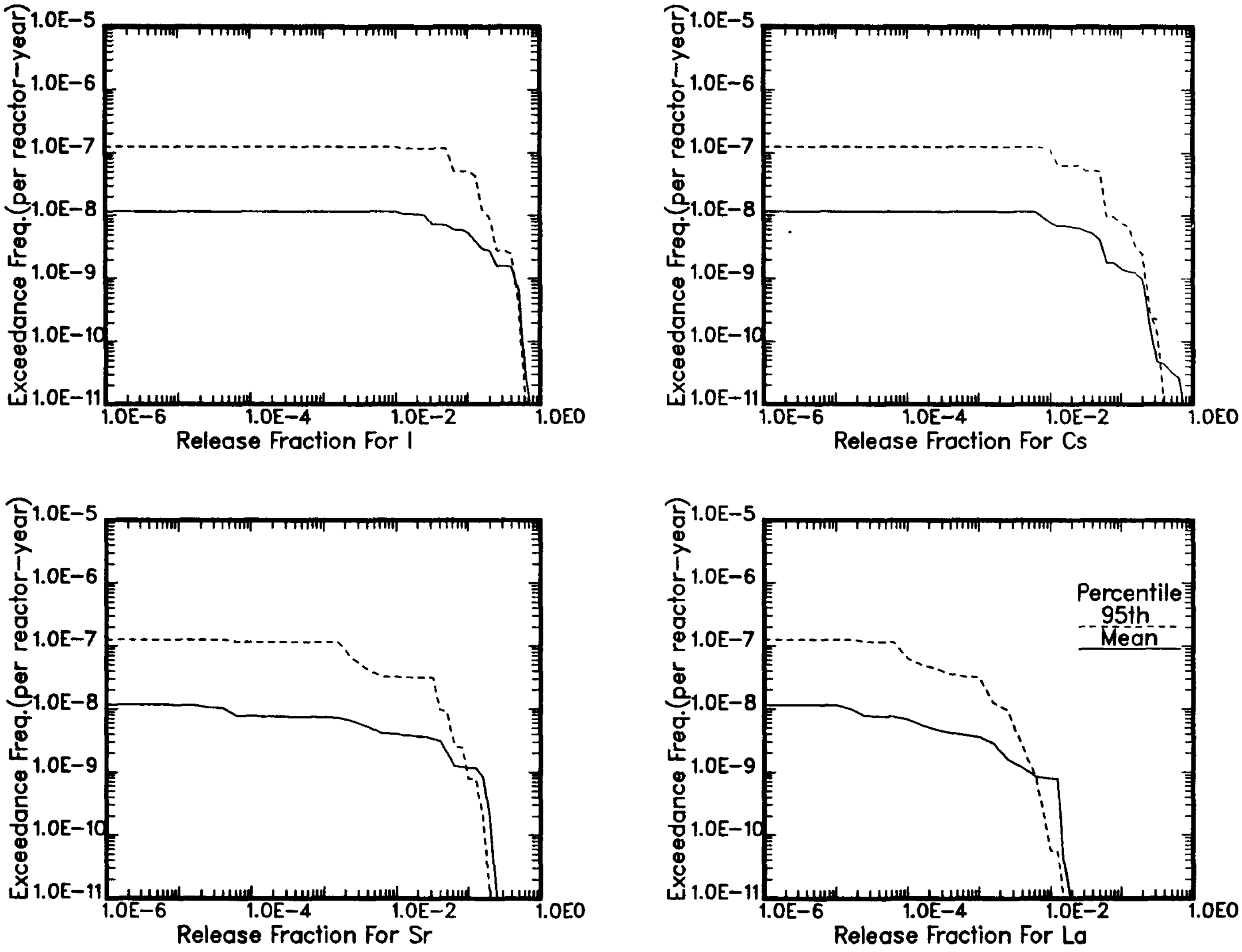

Figure 3.3-80
Peach Bottom: EPRI Seismic Generalized APB 7 - Hi PGA
Source Term CCDF: Core Damage, VB, Venting

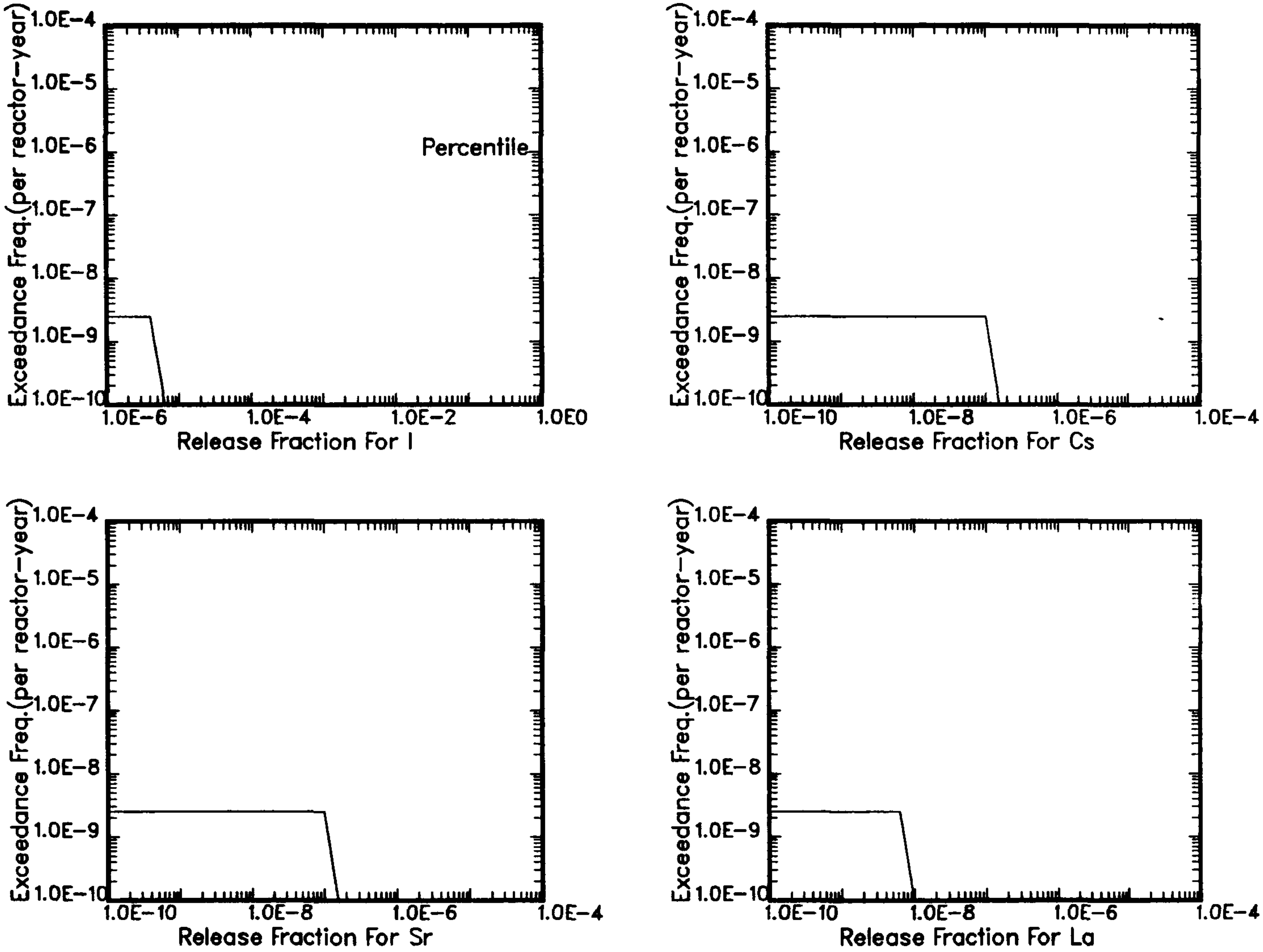

Figure 3.3-81
Peach Bottom: EPRI Seismic Generalized APB 8 - Hi PGA
Source Term CCDF: Core Damage, VB, No Containment Failure

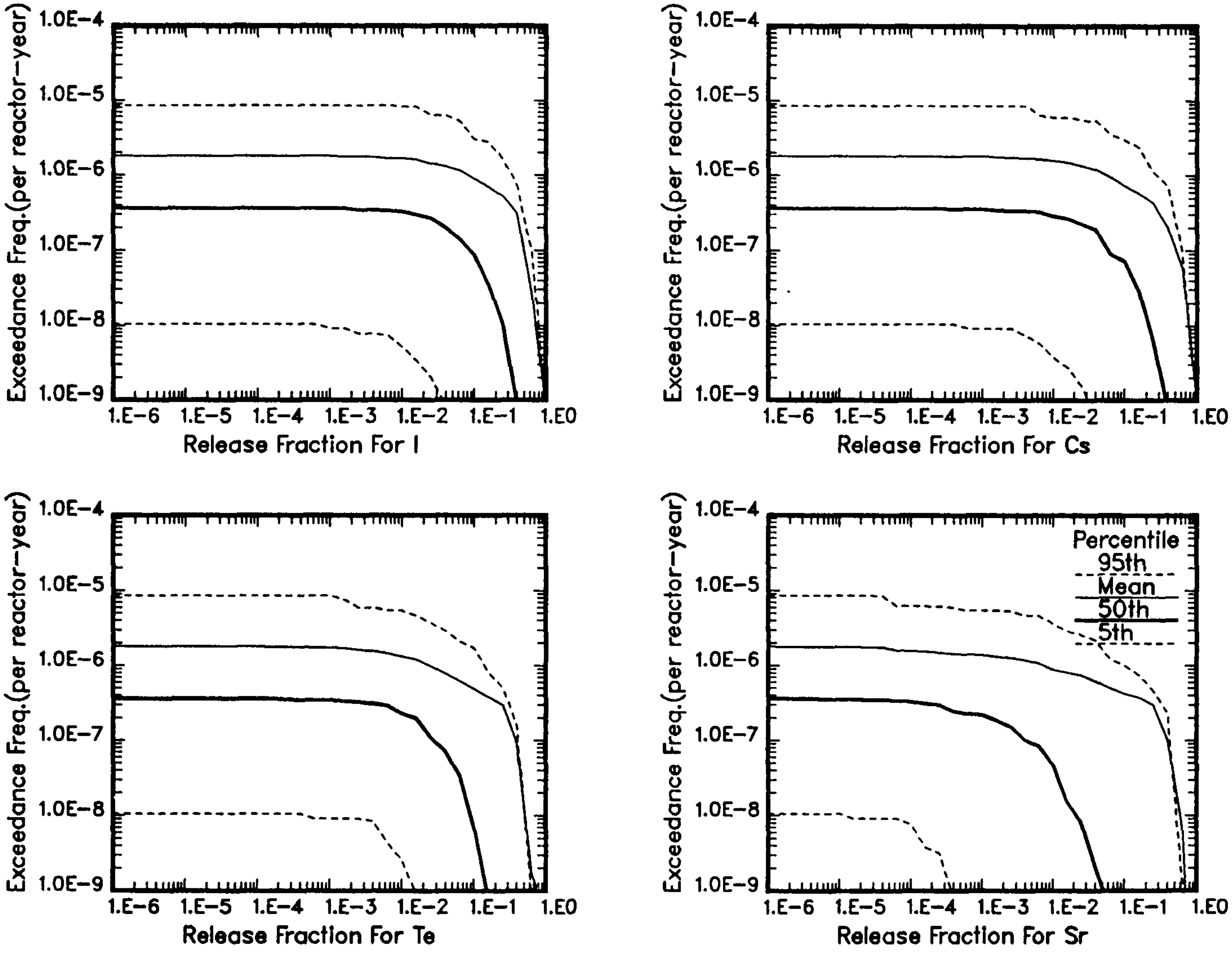

Figure 3.3-82a
Peach Bottom: EPRI Seismic - Hi PGA
Source Term CCDF

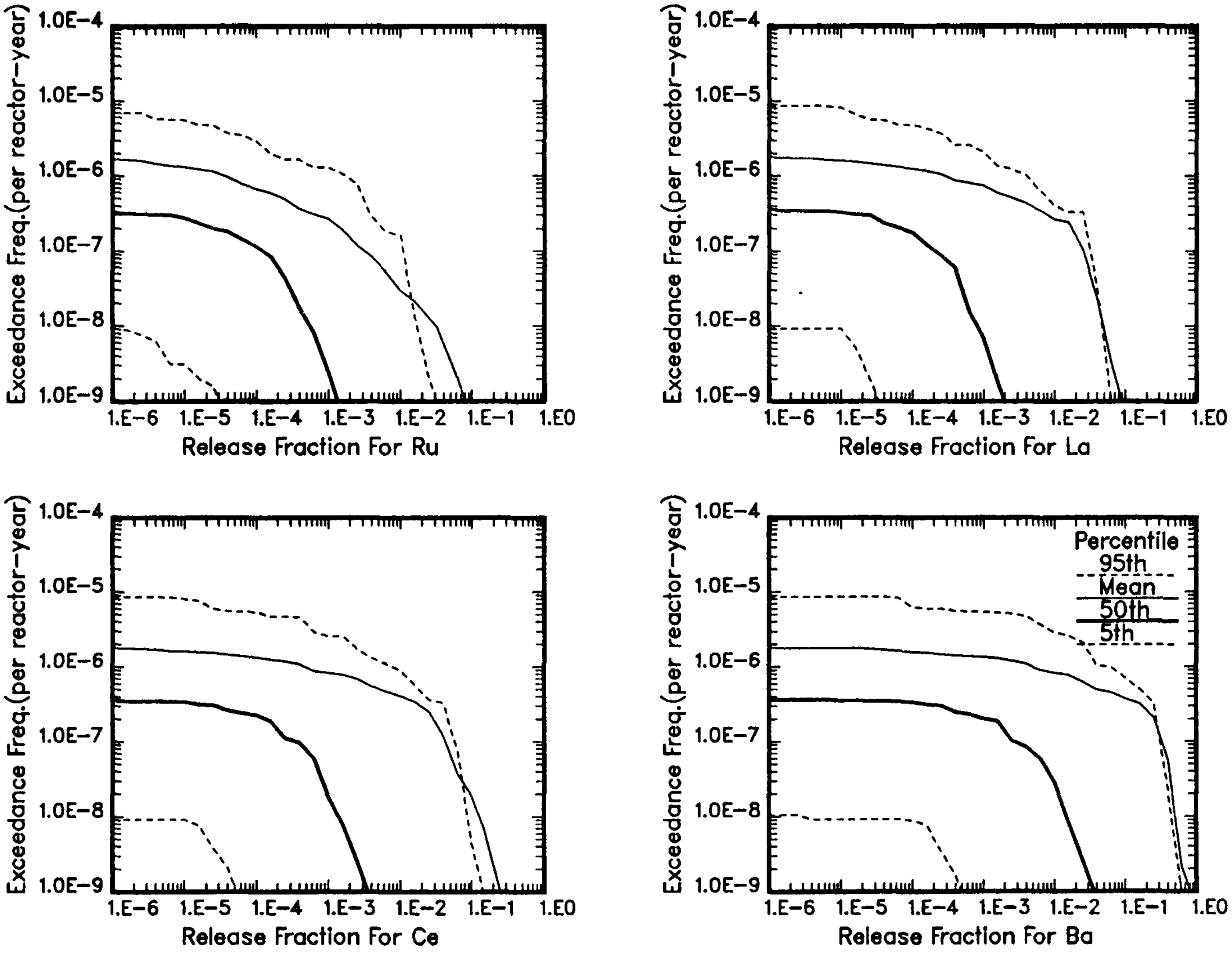

Figure 3.3-82b
Peach Bottom: EPRI Seismic - Hi PGA
Source Term CCDF

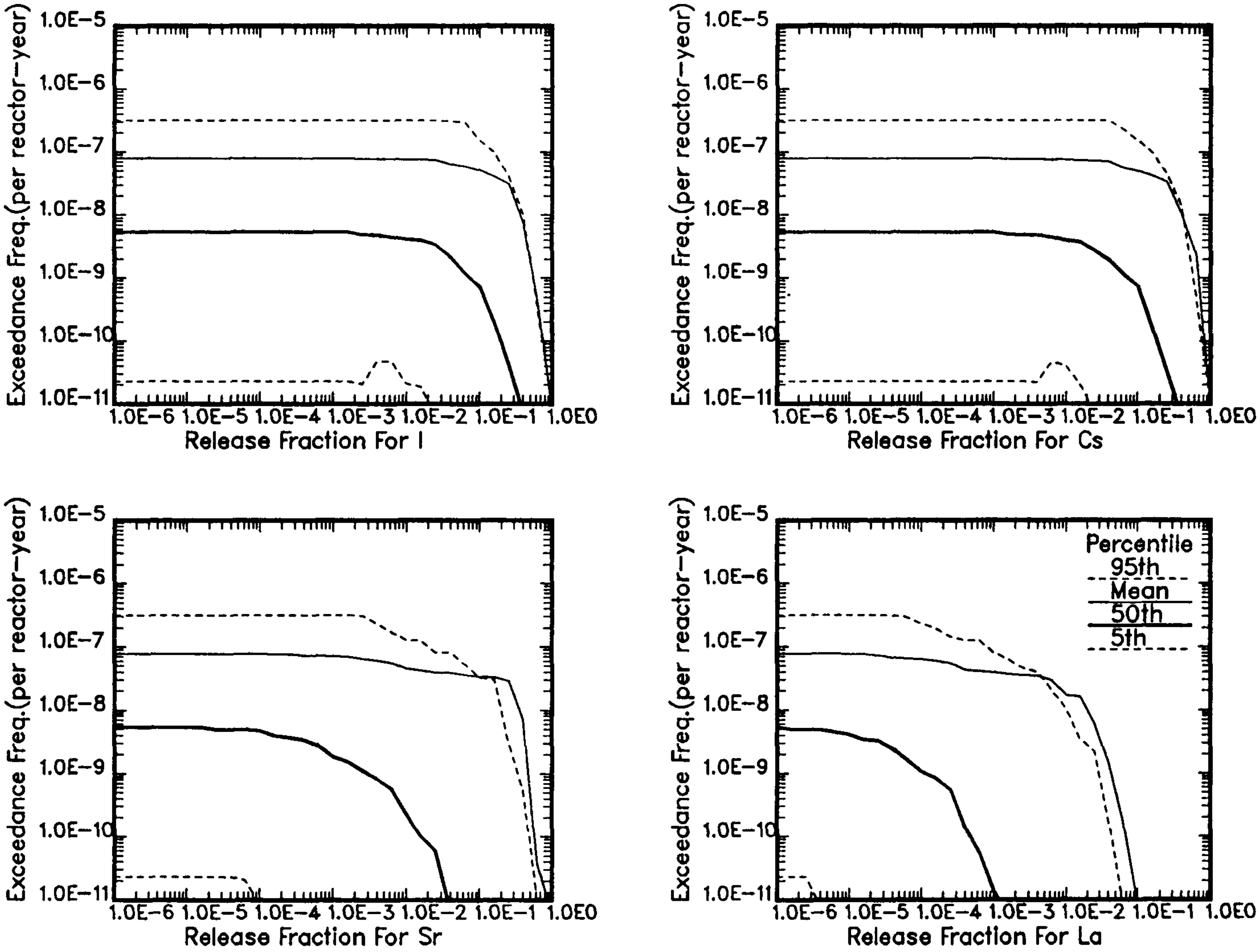

Figure 3.3-83
Peach Bottom: EPRI Seismic PDS 1 - FSB RPV - Low PGA
Source Term CCDF

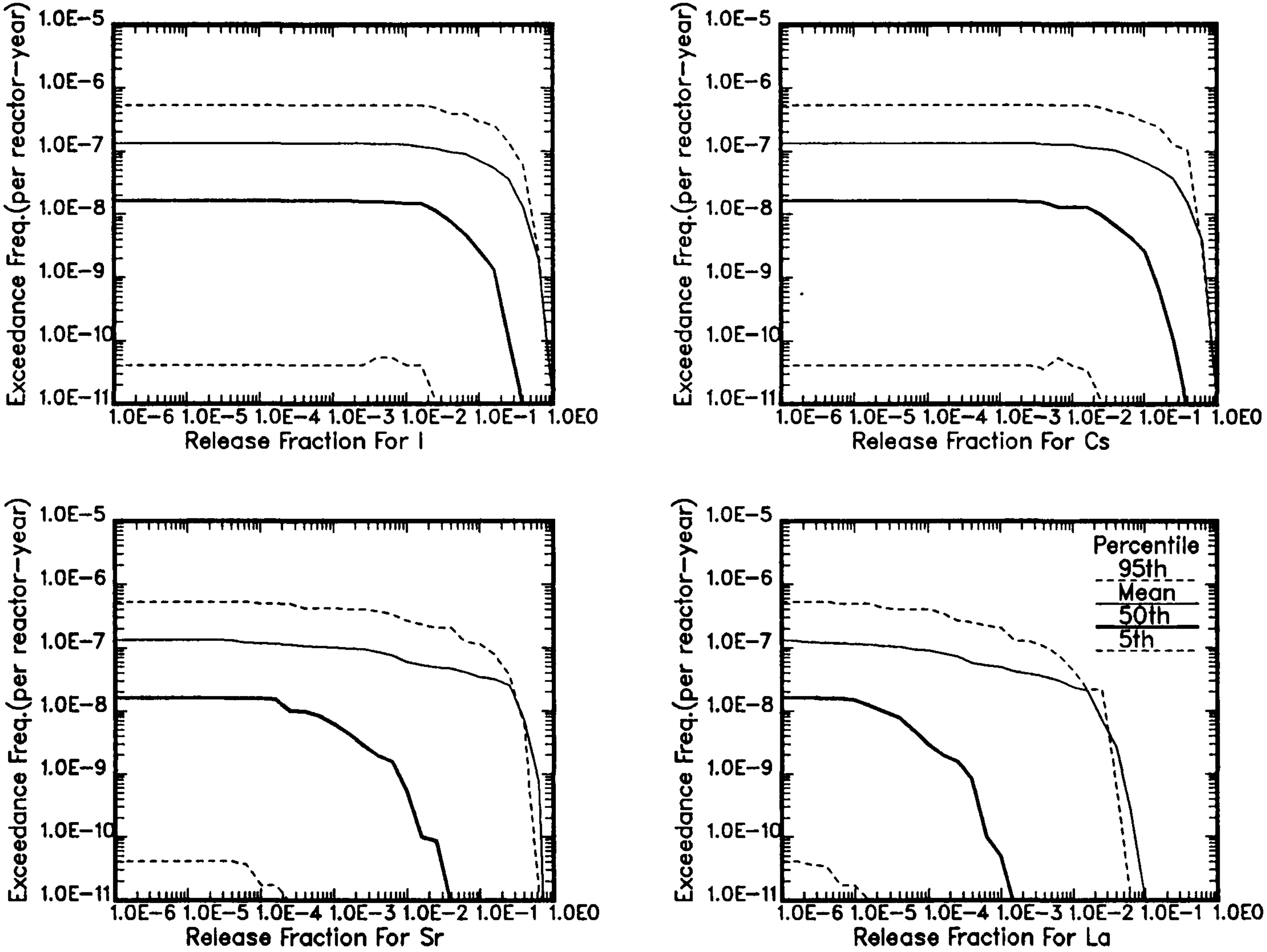

Figure 3.3-84
Peach Bottom: EPRI Seismic PDS 2 - FSB LOCA - Low PGA
Source Term CCDF

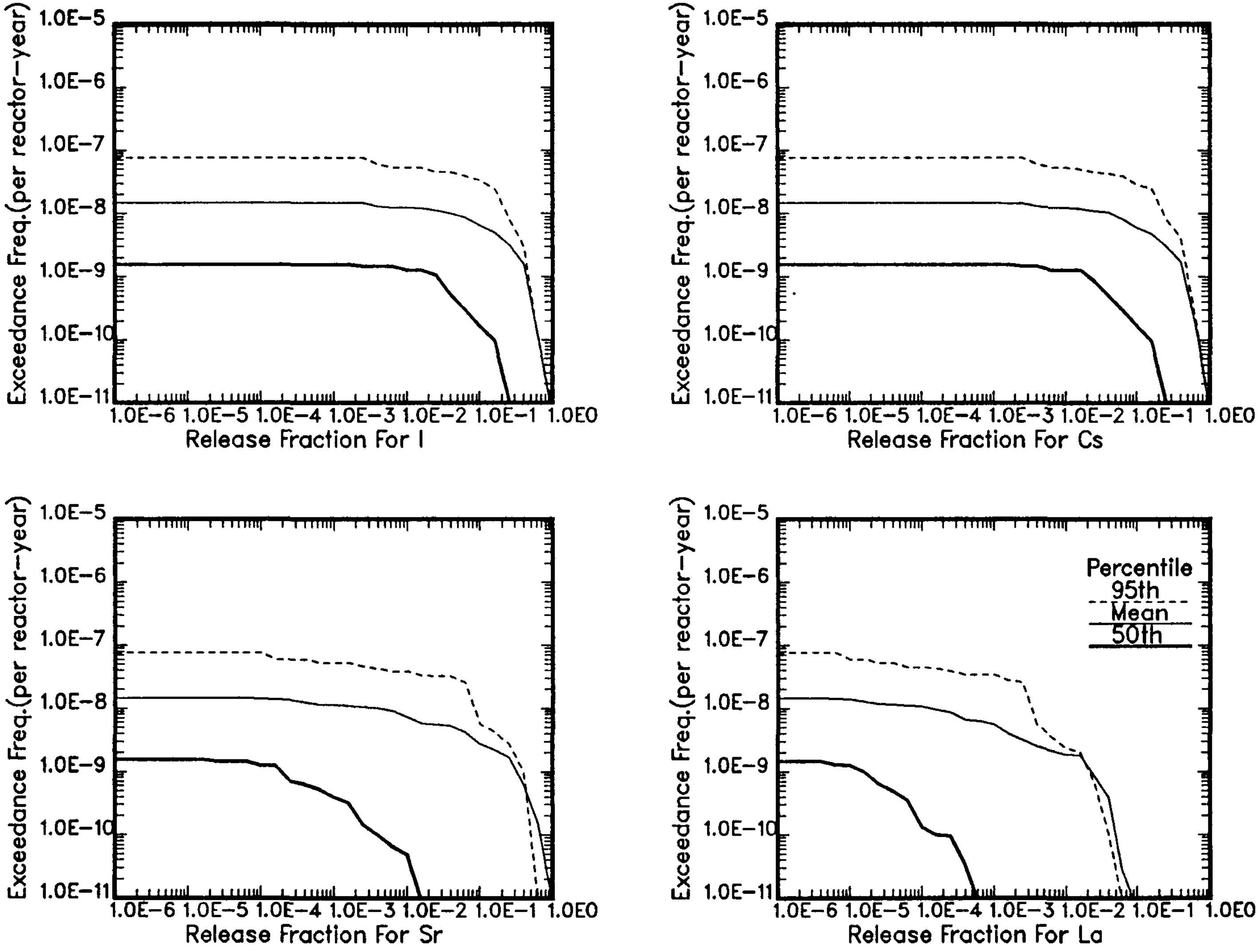

Figure 3.3-85
Peach Bottom: EPRI Seismic PDS 3 - FSB LOCA - Low PGA
Source Term CCDF

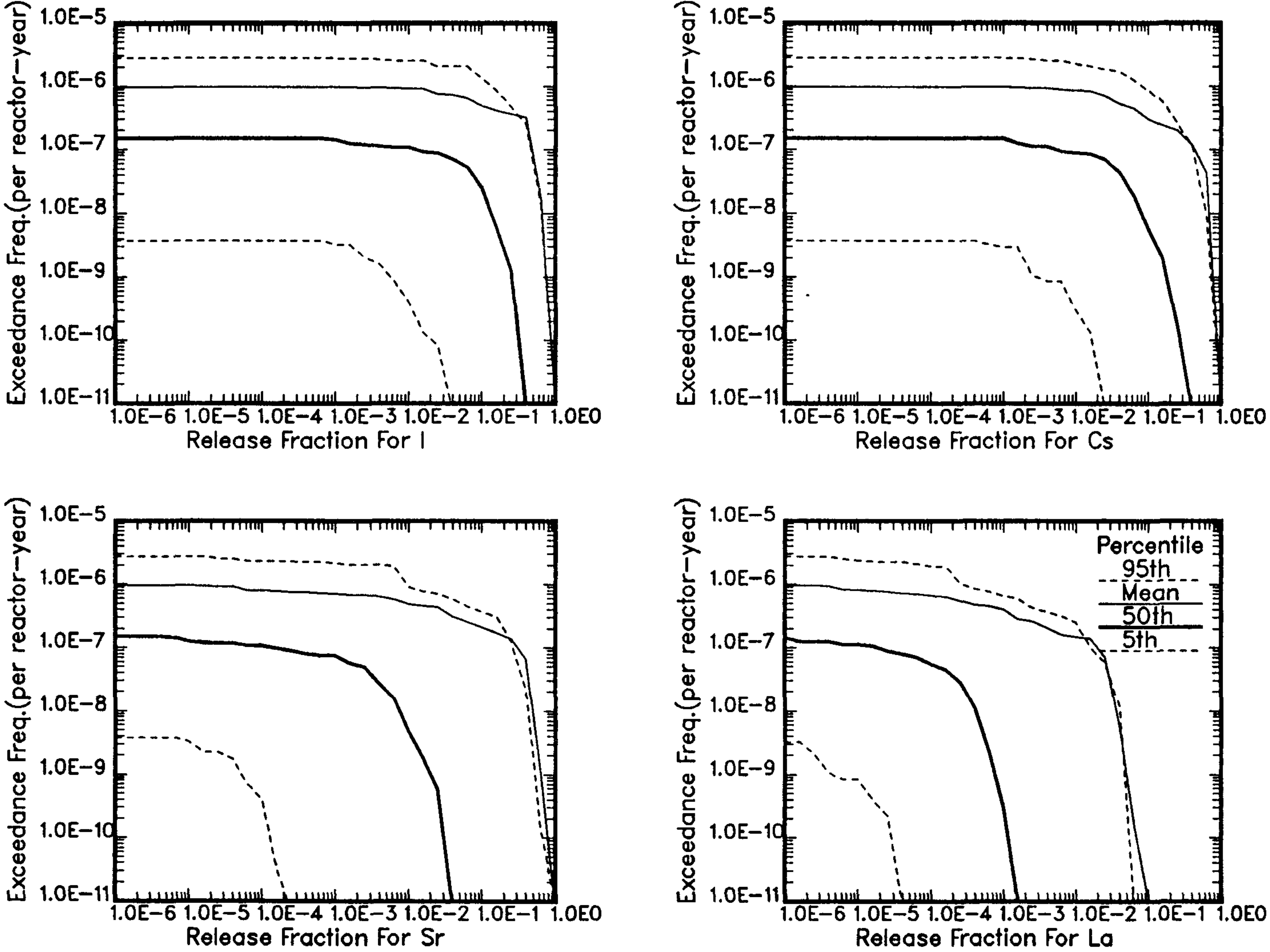

Figure 3.3-86
Peach Bottom: EPRI Seismic PDS 4 - Slow SBO - Low PGA
Source Term CCDF

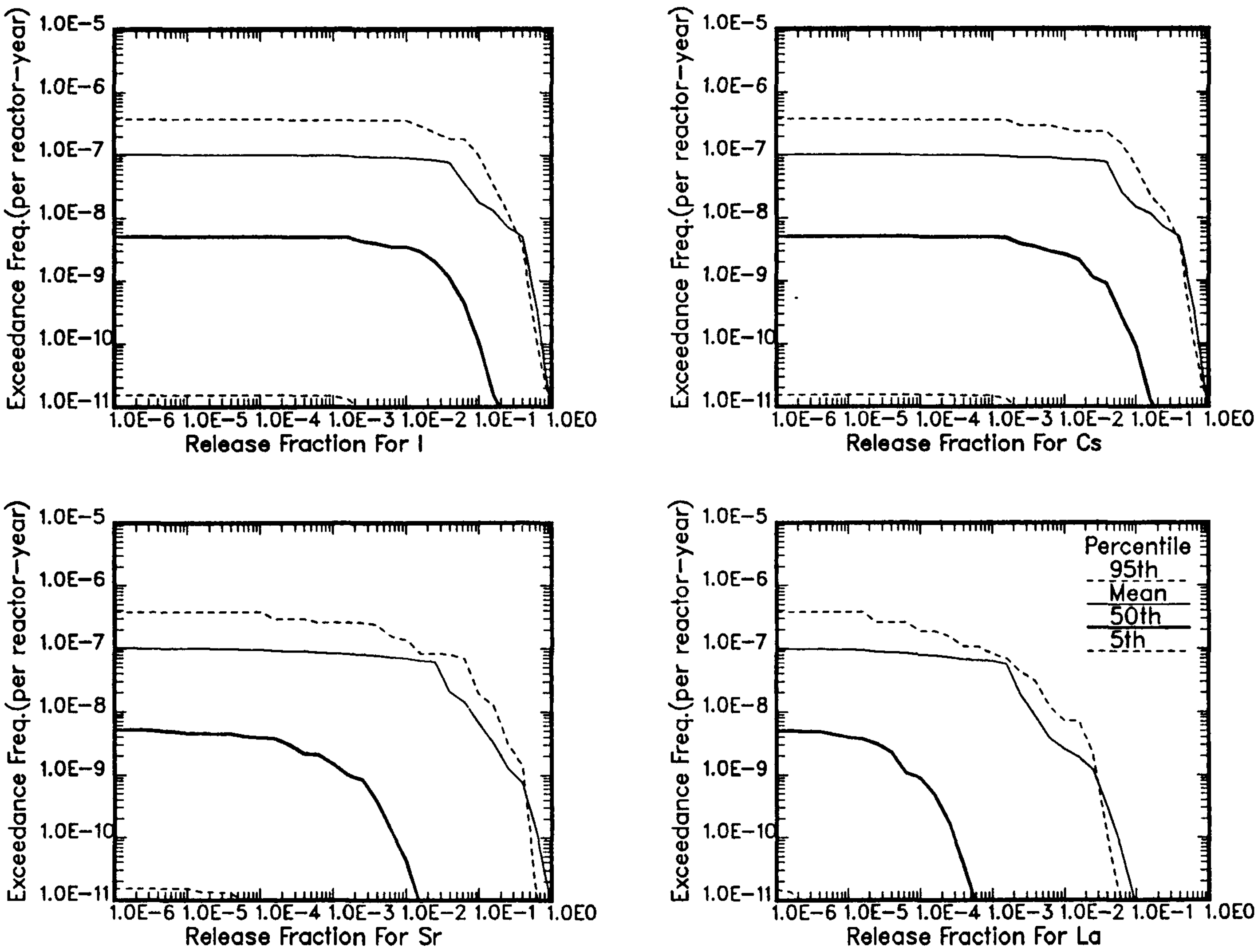

Figure 3.3-87
Peach Bottom: EPRI Seismic PDS 5 - Fast SBO - Low PGA
Source Term CCDF

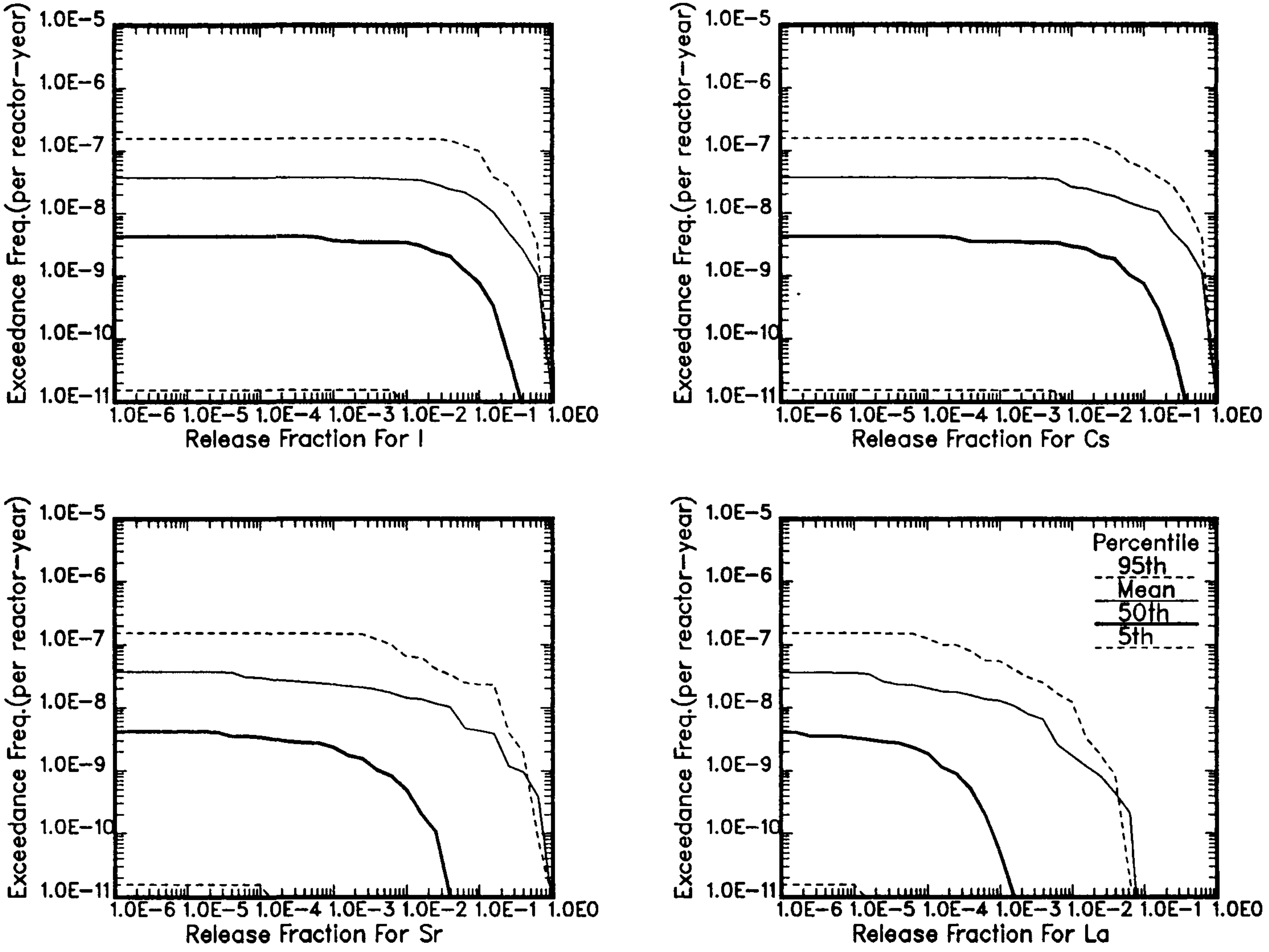

Figure 3.3-88
Peach Bottom: EPRI Seismic PDS 6 - FSB ILOCA - Low PGA
Source Term CCDF

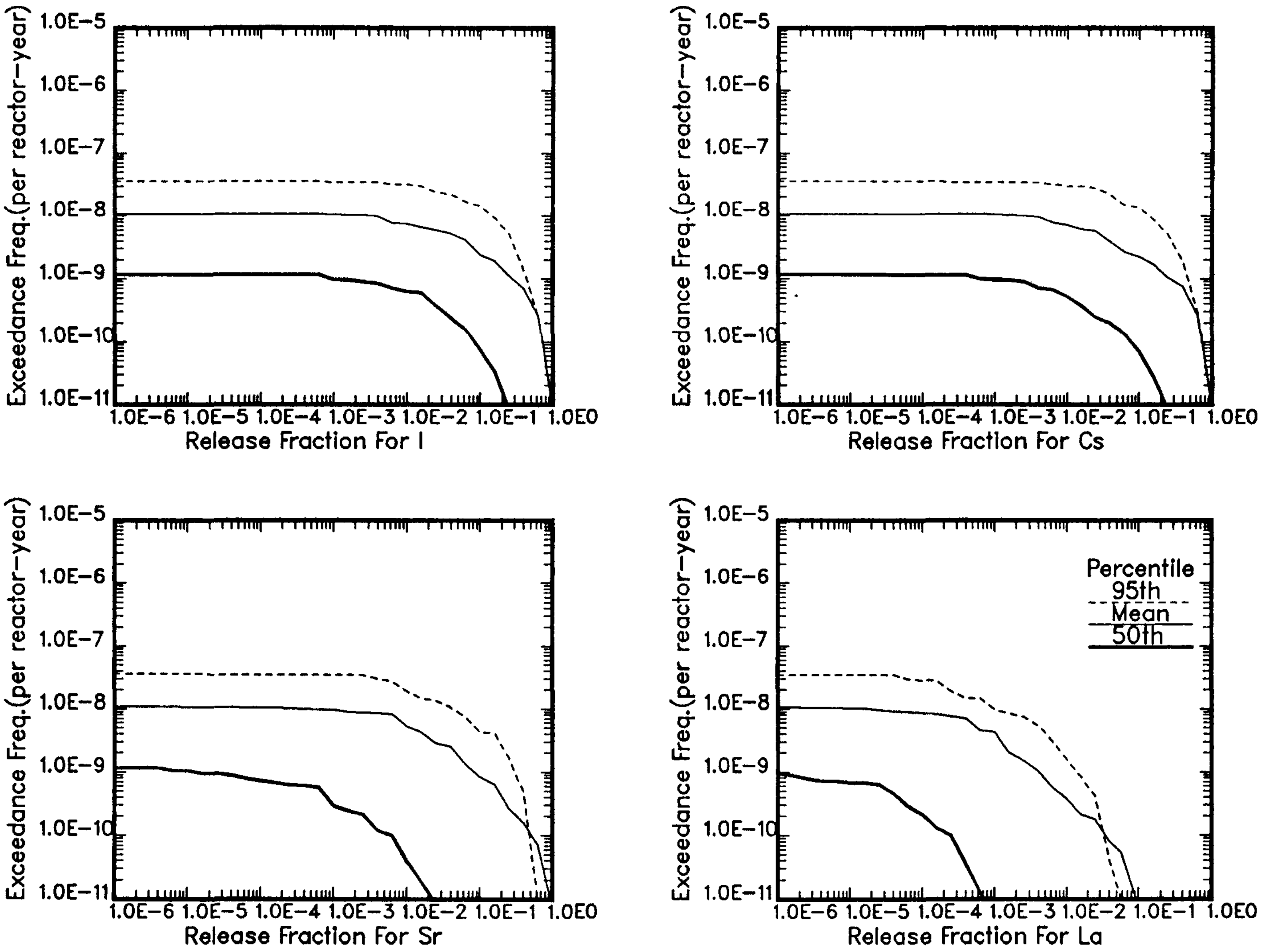

Figure 3.3-89
Peach Bottom: EPRI Seismic PDS 7 - FSB I/SLOCA - Low PGA
Source Term CCDF

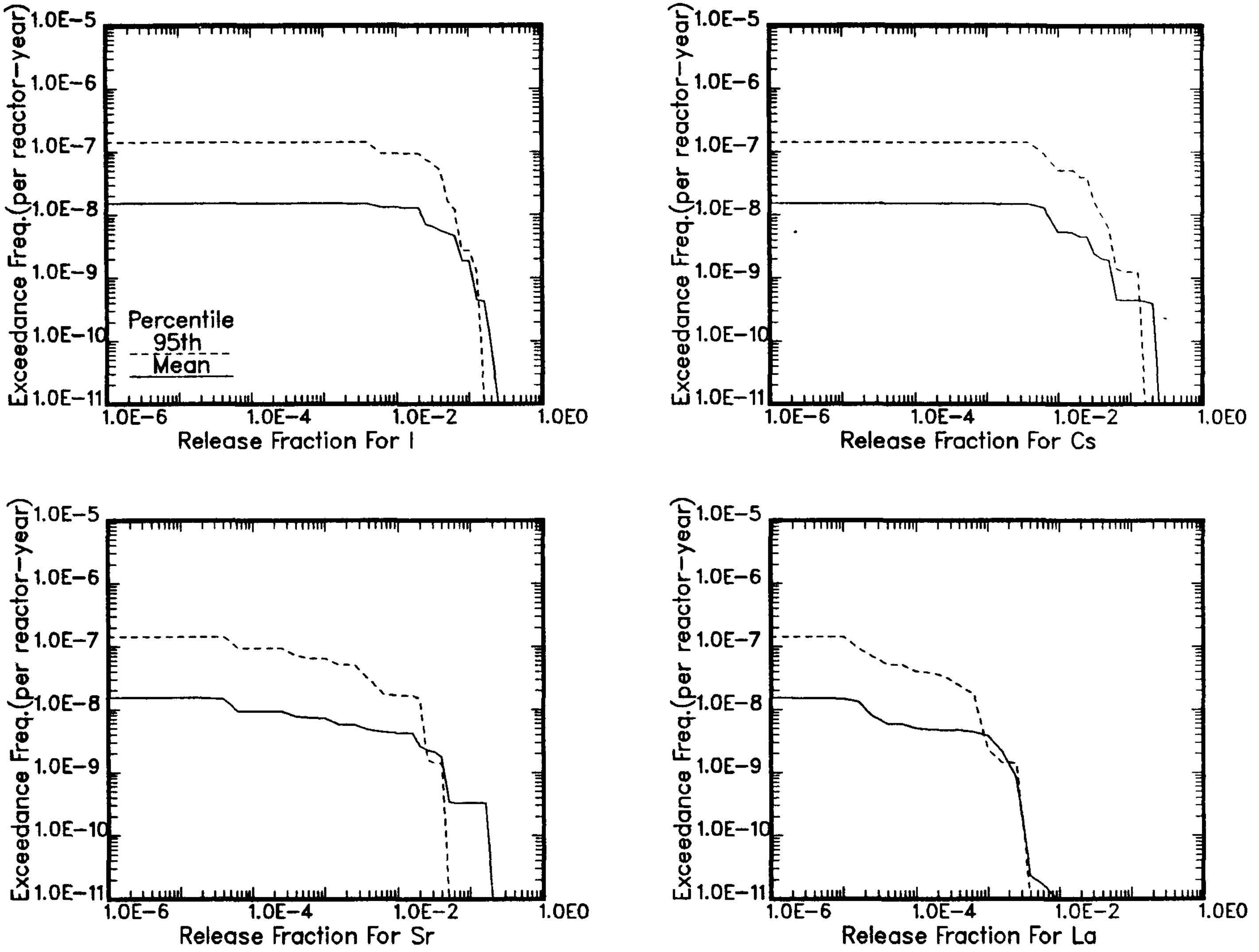

Figure 3.3-90
Peach Bottom: EPRI Seismic Generalized APB 1 - Low PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Wetwell Failure

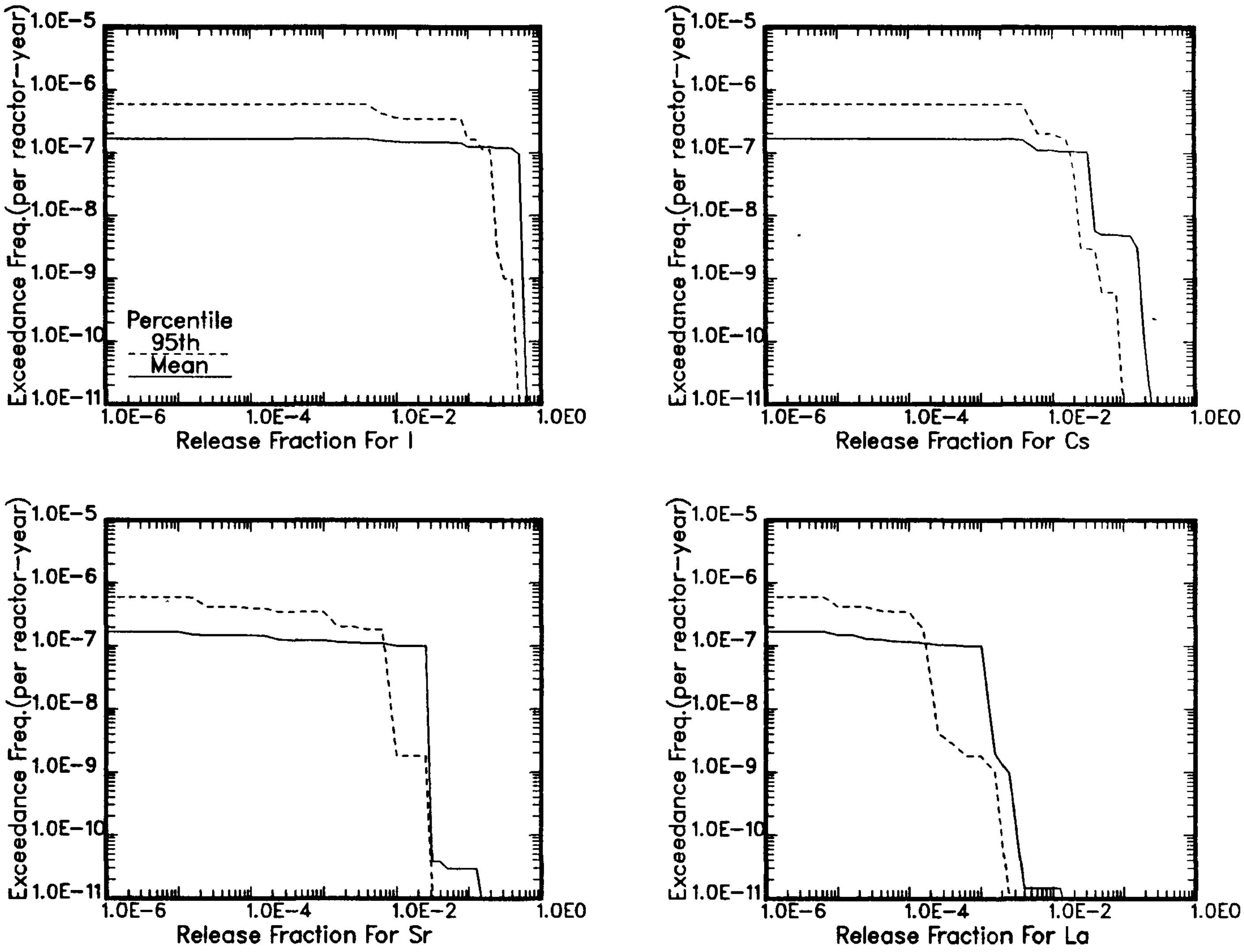

Figure 3.3-91
Peach Bottom: EPRI Seismic Generalized APB 2 - Low PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Wetwell Failure

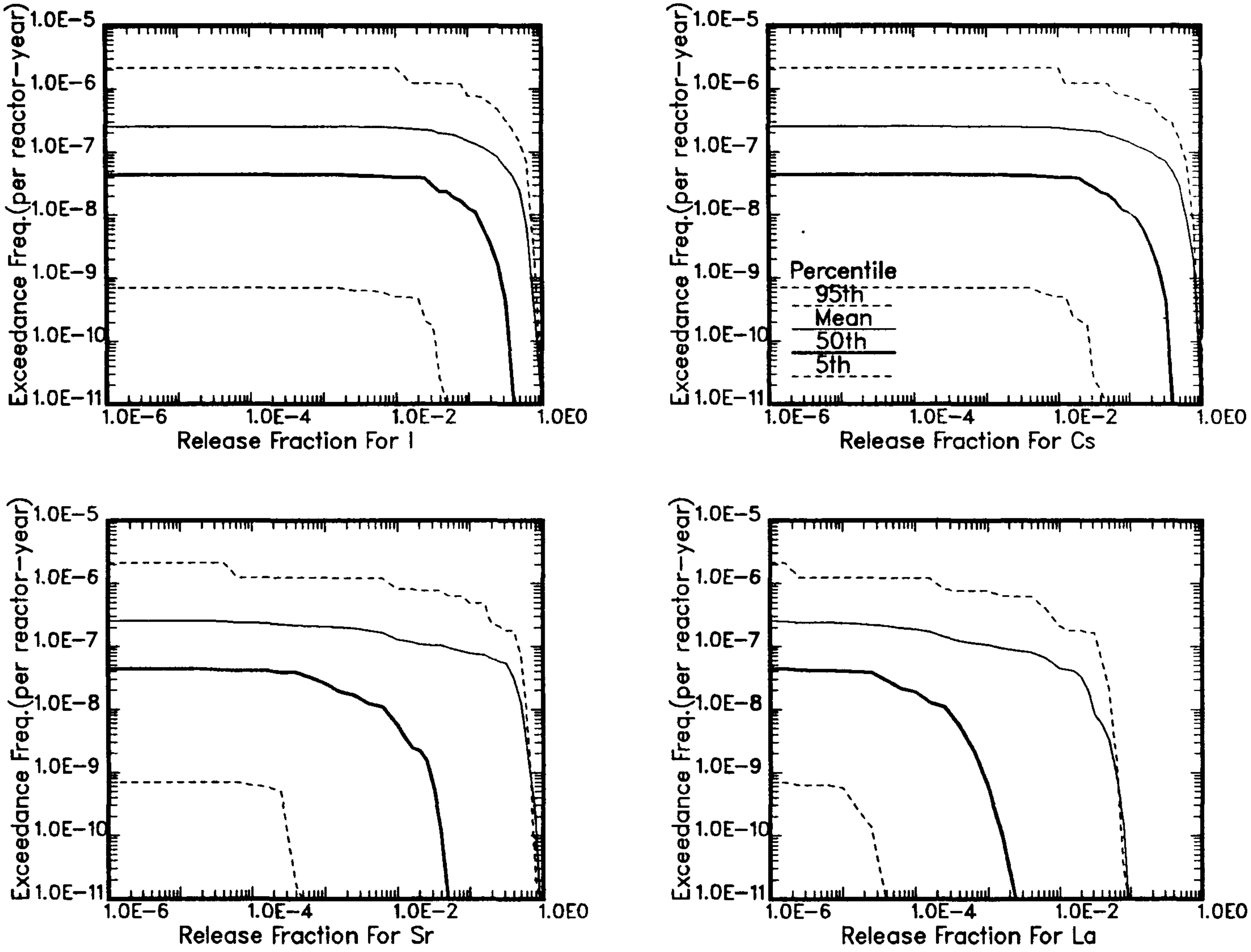

Figure 3.3-92
Peach Bottom: EPRI Seismic Generalized APB 3 - Low PGA
Source Term CCDF: Core Damage, VB>200 Psi, Early Drywell Failure

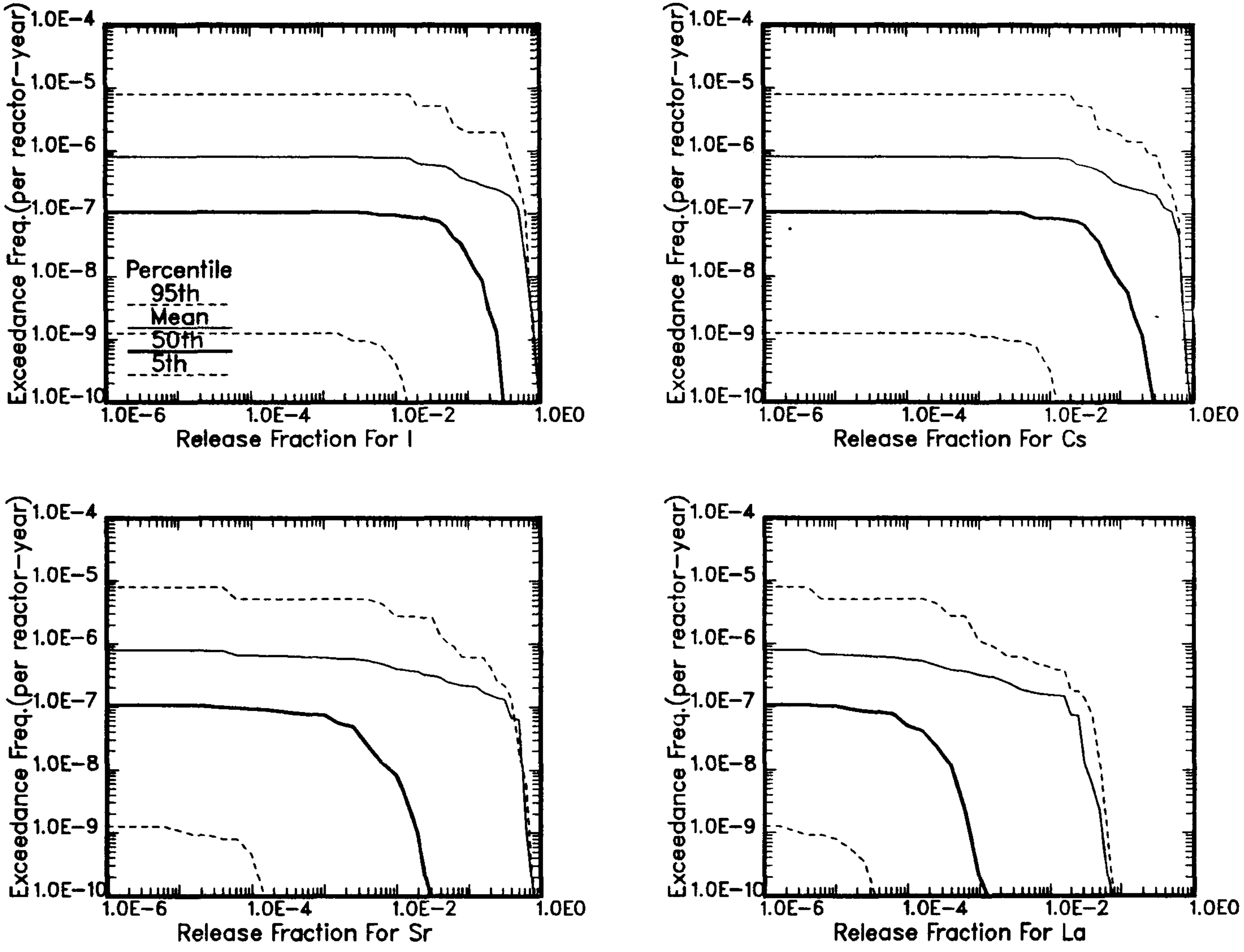

Figure 3.3-93
Peach Bottom: EPRI Seismic Generalized APB 4 - Low PGA
Source Term CCDF: Core Damage, VB<200 Psi, Early Drywell Failure

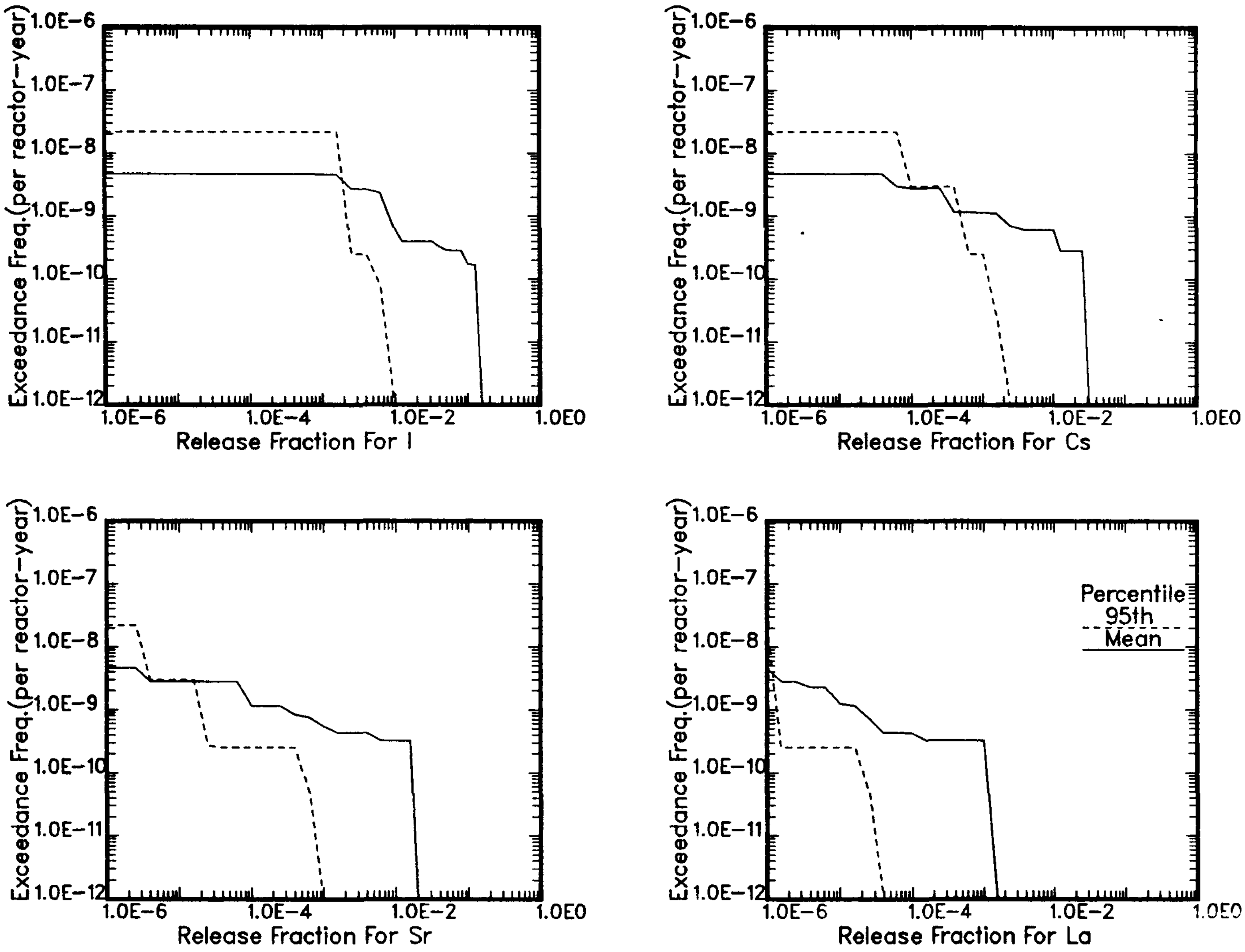

Figure 3.3-94
Peach Bottom: EPRI Seismic Generalized APB 5 - Low PGA
Source Term CCDF: Core Damage, VB, Late Wetwell Failure

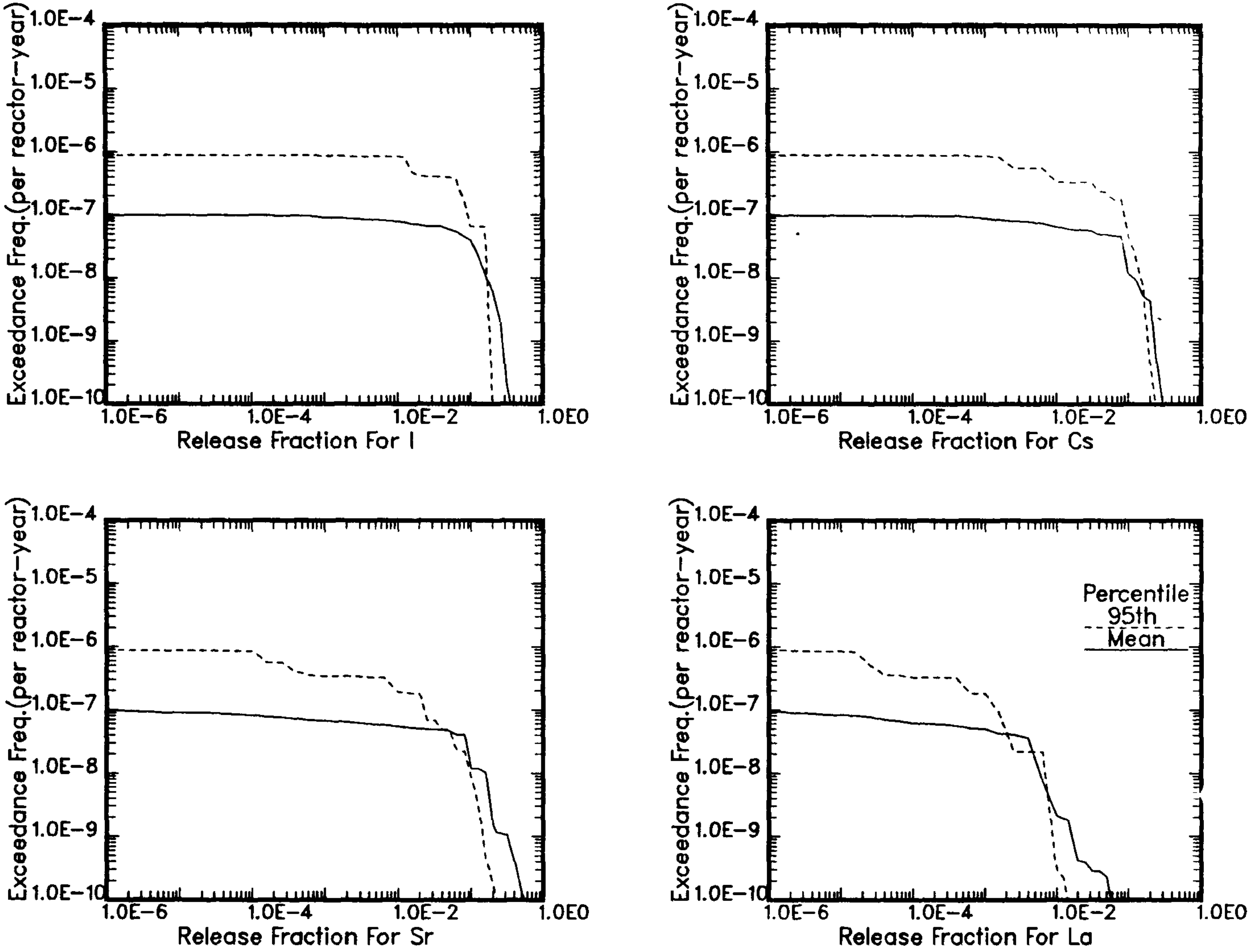

Figure 3.3-95
Peach Bottom: EPRI Seismic Generalized APB 6 - Low PGA
Source Term CCDF: Core Damage, VB, Late Drywell Failure

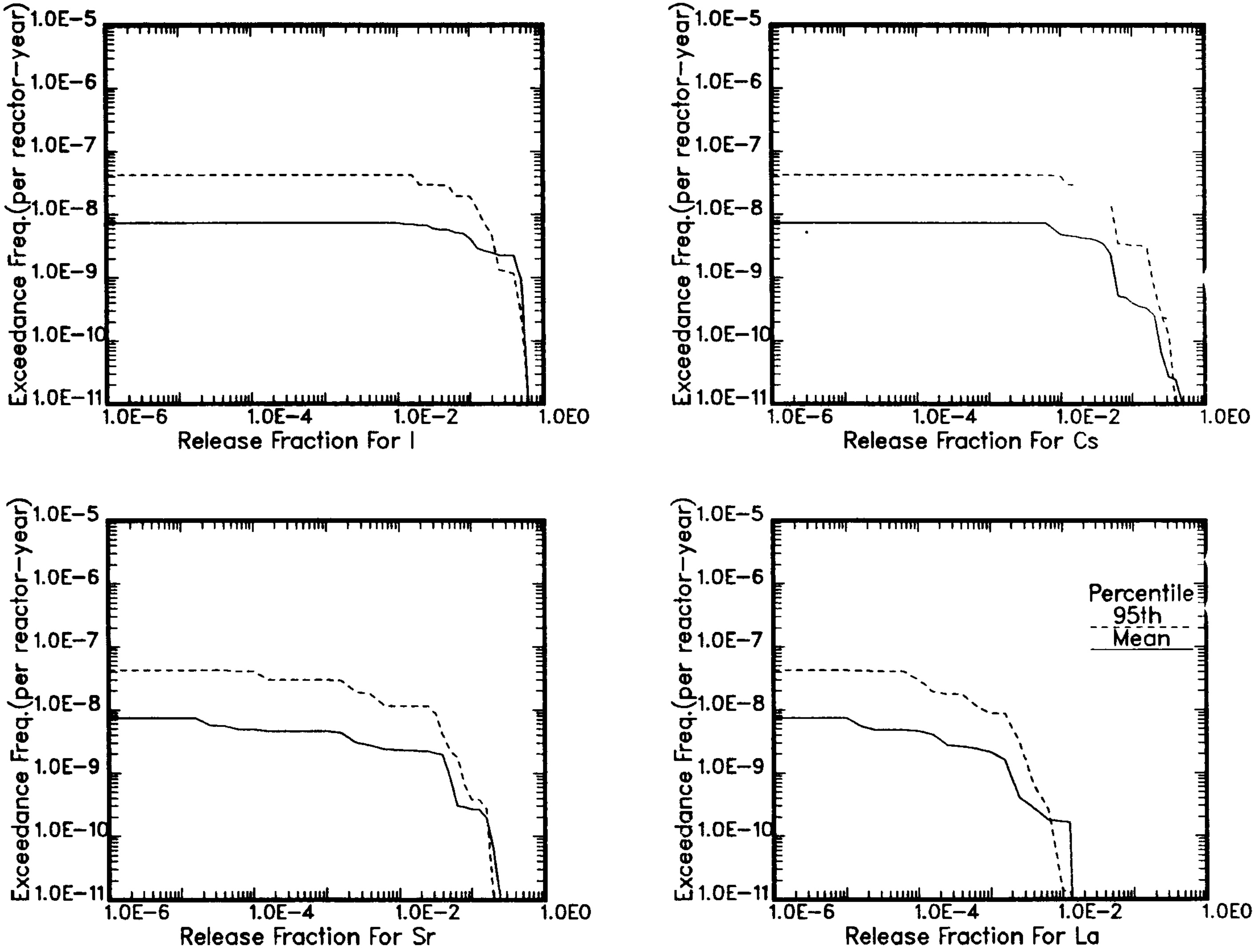

Figure 3.3-96
Peach Bottom: EPRI Seismic Generalized APB 7 - Low PGA
Source Term CCDF: Core Damage, VB, Venting

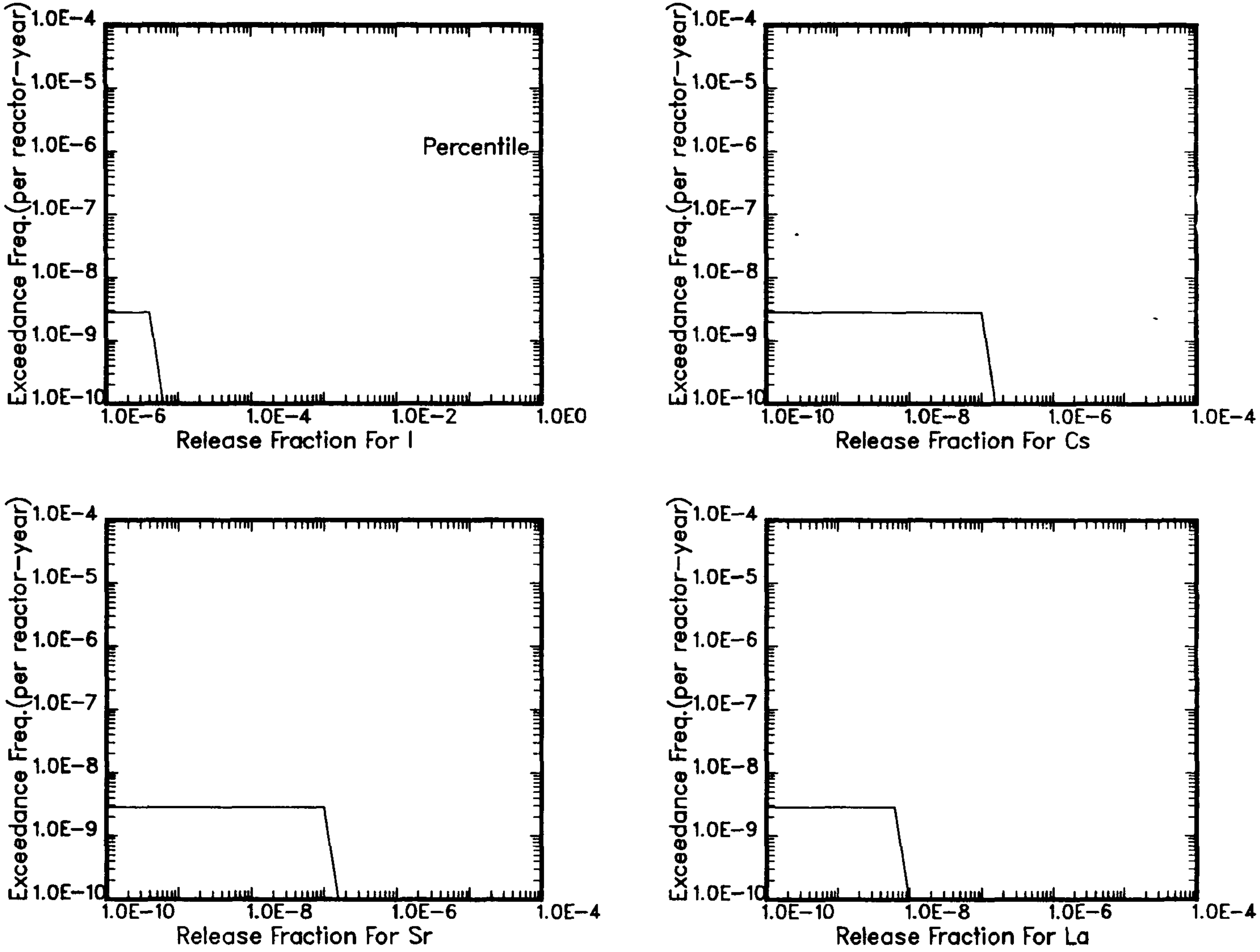

Figure 3.3-97
Peach Bottom: EPRI Seismic Generalized APB 8 - Low PGA
Source Term CCDF: Core Damage, VB, No Containment Failure

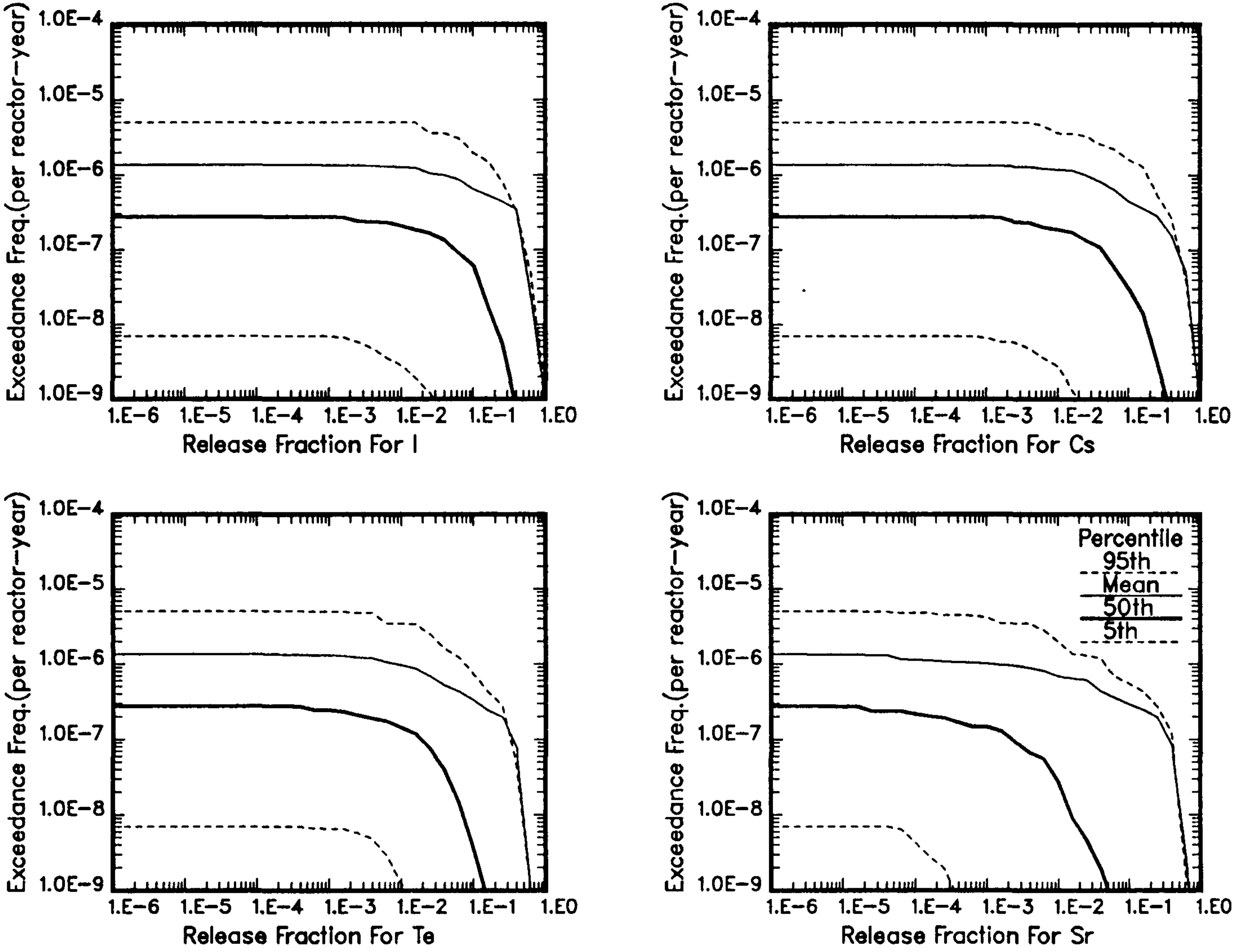

Figure 3.3-98a
Peach Bottom: EPRI Seismic - Low PGA
Source Term CCDF

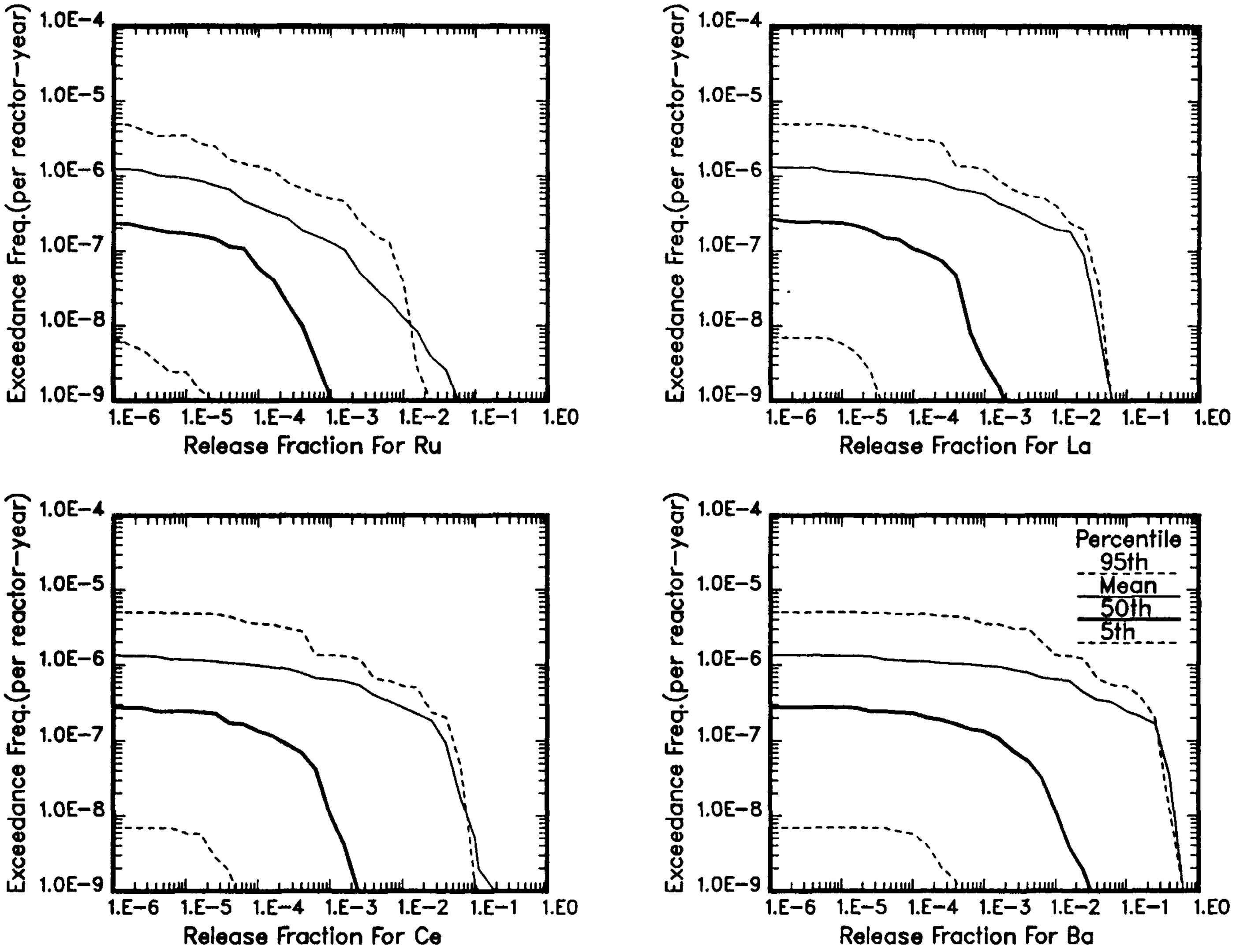

Figure 3.3-98b
Peach Bottom: EPRI Seismic - Low PGA
Source Term CCDF

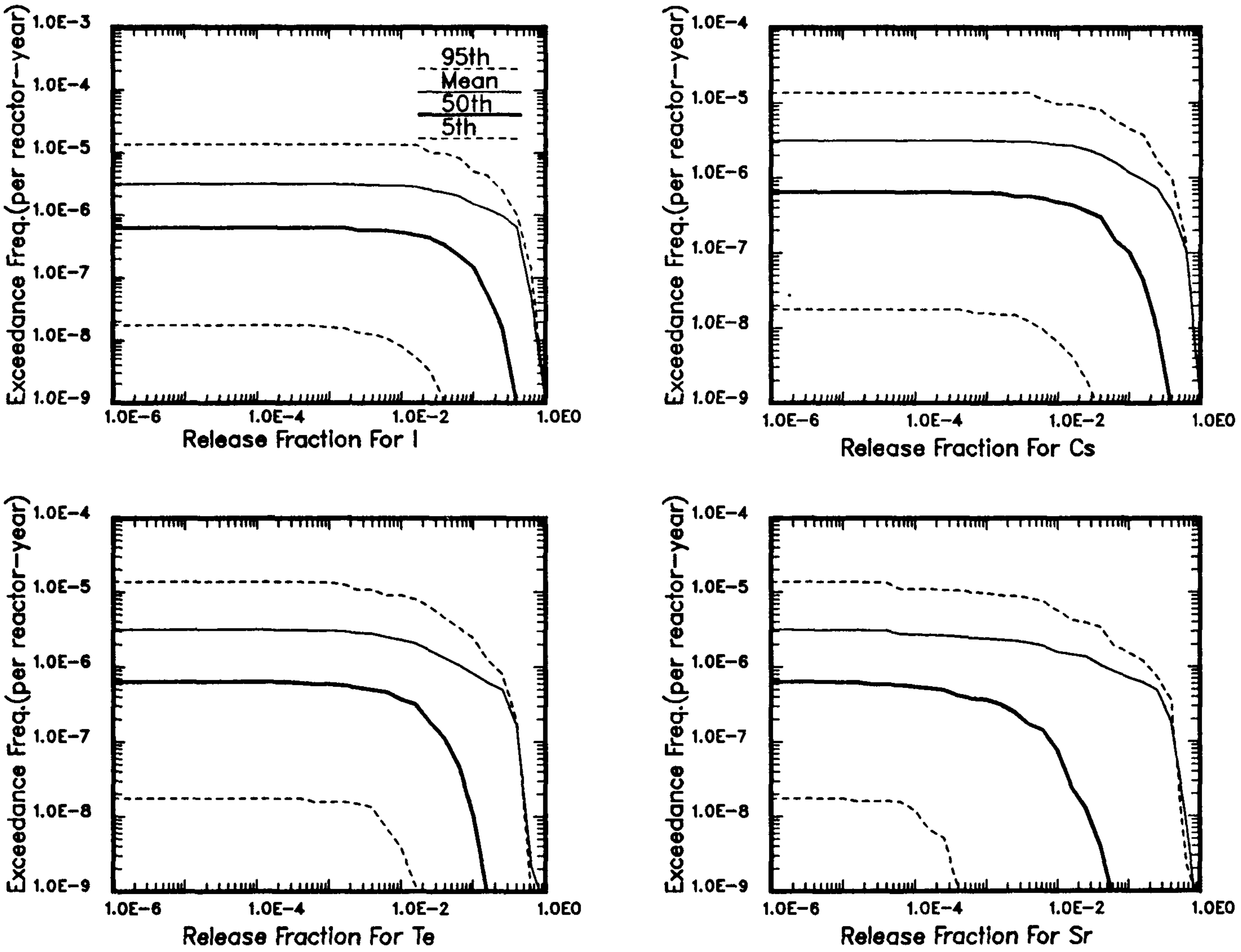

Figure 3.3-99a
Peach Bottom: EPRI Seismic - Hi & Low PGA
Source Term CCDF

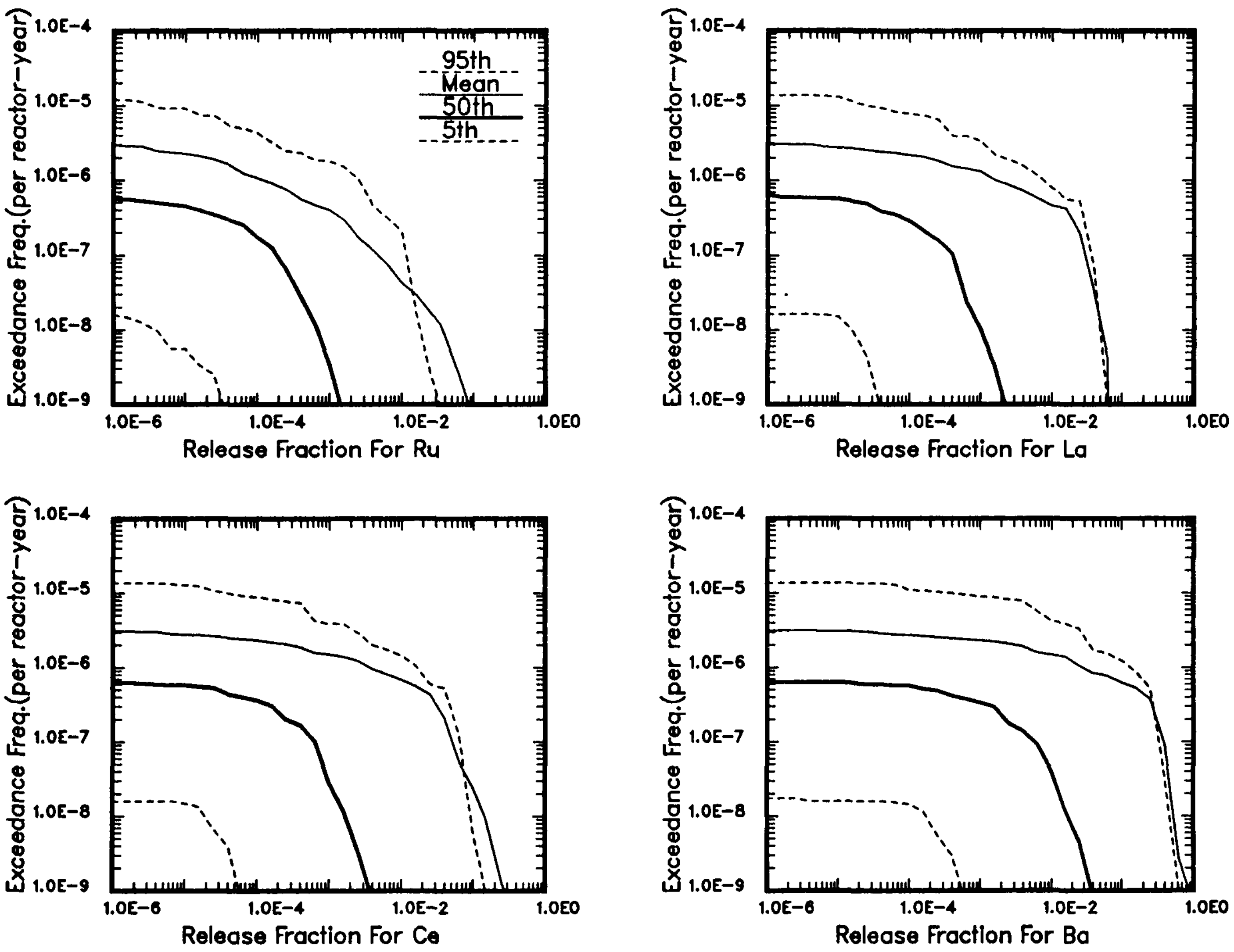

Figure 3.3-99b
Peach Bottom: EPRI Seismic - Hi & Low PGA
Source Term CCDF

seismic event. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 1.0 which occurs initially as a result of the earthquake. The probability of recovering AC and averting VB is 0.00.

Table 2.5-18 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.5.1. Table 3.3-14 lists the mean source terms for these same APBs. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than seismic reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection.

Figures 3.3-34, 50, 67, and 83 summarize the release fraction CCDFs for PDS 1.

3.3.3.2 Results for PDS 2: FSB LLOCA

This PDS is composed of one sequence with a seismically induced LOSP followed by a loss of all onsite AC leading to a station blackout. A large LOCA is also induced by the seismic event resulting in high pressure injection failure (only steam-driven systems are available and these fail on low pressure in the RPV) and early core damage. Early containment failure occurs as a result of the seismic event. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 1.0. which occurs initially as a result of the earthquake. The probability of recovering AC and averting VB is 0.00.

Table 2.5-19 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.5.2. Table 3.3-15 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection.

Figures 3.3-35, 51, 68, and 84 summarize the release fraction CCDFs for PDS 2.

3.3.3.3 Results for PDS 3: FSB LLOCA

This PDS is the same as PDS-2 except that DC power has also failed. This has no effect on accident progression since all systems have failed anyway.

Table 2.5-20 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for

Table 3.3-14
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 1 - FSB RPV

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	2.0E-02	1.6E-02	8.5E-03	1.8E-03	6.2E-04	1.7E-04	7.9E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	7.9E-02	8.4E-02	3.9E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
2	AABDBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	7.3E-01	3.6E-02	2.8E-02	1.6E-02	4.7E-03	9.4E-04	2.2E-04	9.6E-04	4.9E-03
				2.4E+05	1.3E+04	2.2E+04	2.7E-01	8.2E-02	9.0E-02	5.6E-02	5.8E-02	9.1E-04	3.3E-03	6.9E-03	4.4E-02
3	AABEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	1.9E-02	1.5E-02	8.2E-03	1.8E-03	4.7E-04	1.4E-04	8.4E-04	2.0E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	9.0E-02	9.6E-02	4.1E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
4	ABBDBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.8E-01	3.1E-02	2.7E-02	1.8E-02	9.4E-03	1.1E-03	4.6E-04	2.1E-03	9.4E-03
				2.4E+05	1.3E+04	2.2E+04	3.2E-01	9.0E-02	8.7E-02	4.4E-02	3.5E-02	1.2E-03	4.1E-03	6.0E-03	2.9E-02
5	ABBDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.4E-01	2.2E-02	2.1E-02	1.6E-02	1.2E-02	2.0E-03	1.2E-03	5.6E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	2.6E-01	1.2E-01	1.2E-01	5.8E-02	5.3E-02	5.5E-05	4.4E-03	7.2E-03	4.2E-02
6	ABBEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.7E-01	2.0E-02	1.8E-02	1.3E-02	9.2E-03	1.3E-03	8.4E-04	4.2E-03	9.3E-03
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	1.5E-01	1.5E-01	7.1E-02	5.7E-02	1.7E-04	4.6E-03	7.4E-03	4.5E-02
7	AABDEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.5E-01	8.6E-02	6.6E-02	3.6E-02	1.0E-02	2.5E-03	7.2E-04	4.7E-03	1.1E-02
				1.5E+06	1.3E+04	3.6E+03	2.5E-01	1.1E-01	1.2E-01	6.7E-02	6.7E-02	9.2E-04	4.1E-03	8.3E-03	5.1E-02
8	AABEBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	7.2E-01	3.7E-02	2.9E-02	1.6E-02	5.3E-03	1.0E-03	2.6E-04	1.2E-03	5.5E-03
				2.4E+05	1.3E+04	2.2E+04	2.8E-01	8.0E-02	8.9E-02	5.5E-02	5.8E-02	6.2E-04	3.2E-03	6.7E-03	4.4E-02
9	ABBEBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.8E-01	3.0E-02	2.6E-02	1.7E-02	8.9E-03	1.1E-03	4.4E-04	2.0E-03	9.0E-03
				2.4E+05	1.3E+04	2.2E+04	3.2E-01	1.0E-01	1.0E-01	5.7E-02	5.0E-02	1.2E-03	5.9E-03	8.8E-03	4.3E-02
10	ABBDEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.0E-01	7.8E-02	6.7E-02	4.2E-02	2.0E-02	2.8E-03	1.4E-03	6.7E-03	2.1E-02
				1.5E+06	1.3E+04	3.6E+03	3.0E-01	1.6E-01	1.6E-01	8.6E-02	7.6E-02	1.3E-03	7.6E-03	1.2E-02	6.1E-02
11	AABEEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.5E-01	8.7E-02	6.7E-02	3.6E-02	1.1E-02	2.6E-03	7.9E-04	4.9E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	2.5E-01	1.2E-01	1.3E-01	6.8E-02	6.9E-02	5.7E-04	4.1E-03	8.3E-03	5.2E-02
12	ABBCFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.2E-01	2.9E-02	2.5E-02	6.4E-03	1.5E-03	1.4E-03	2.3E-04	2.3E-04	1.8E-03
				3.7E+05	1.3E+04	1.4E+04	3.8E-01	1.8E-01	1.9E-01	9.0E-02	5.6E-02	4.6E-04	4.0E-03	6.1E-03	4.4E-02
13	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01
14	ABBEEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	6.7E-01	7.5E-02	6.3E-02	3.8E-02	1.7E-02	2.4E-03	1.2E-03	5.8E-03	1.8E-02
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	1.8E-01	1.9E-01	1.0E-01	8.7E-02	1.1E-03	8.7E-03	1.3E-02	7.2E-02
15	AABCBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.9E-01	3.3E-02	2.8E-02	2.1E-02	1.3E-02	1.9E-03	7.4E-04	3.6E-03	1.3E-02
				2.4E+05	1.3E+04	2.2E+04	3.1E-01	2.6E-02	2.1E-02	1.3E-02	2.9E-02	2.5E-04	1.4E-03	2.7E-03	2.0E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-15
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 2 - FSB LLOCA

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	2.0E-02	1.6E-02	8.5E-03	1.8E-03	6.2E-04	1.7E-04	7.9E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	7.9E-02	8.4E-02	3.9E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
2	AABDBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	7.3E-01	3.6E-02	2.8E-02	1.6E-02	4.7E-03	9.4E-04	2.2E-04	9.6E-04	4.9E-03
				2.4E+05	1.3E+04	2.2E+04	2.7E-01	8.2E-02	9.0E-02	5.6E-02	5.8E-02	9.1E-04	3.3E-03	6.9E-03	4.4E-02
3	AABEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	1.9E-02	1.5E-02	8.2E-03	1.8E-03	4.7E-04	1.4E-04	8.4E-04	2.0E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	9.0E-02	9.6E-02	4.1E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
4	ABBDBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.8E-01	3.1E-02	2.7E-02	1.8E-02	9.4E-03	1.1E-03	4.6E-04	2.1E-03	9.4E-03
				2.4E+05	1.3E+04	2.2E+04	3.2E-01	9.0E-02	8.7E-02	4.4E-02	3.5E-02	1.2E-03	4.1E-03	6.0E-03	2.9E-02
5	ABBDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.4E-01	2.2E-02	2.1E-02	1.6E-02	1.2E-02	2.0E-03	1.2E-03	5.6E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	2.6E-01	1.2E-01	1.2E-01	5.8E-02	5.3E-02	5.5E-05	4.4E-03	7.2E-03	4.2E-02
6	AABEBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	7.2E-01	3.7E-02	2.9E-02	1.6E-02	5.3E-03	1.0E-03	2.6E-04	1.2E-03	5.5E-03
				2.4E+05	1.3E+04	2.2E+04	2.8E-01	8.0E-02	8.9E-02	5.5E-02	5.8E-02	6.2E-04	3.2E-03	6.7E-03	4.4E-02
7	ABBEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.7E-01	2.0E-02	1.8E-02	1.3E-02	9.2E-03	1.3E-03	8.4E-04	4.2E-03	9.3E-03
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	1.5E-01	1.5E-01	7.1E-02	5.7E-02	1.7E-04	4.6E-03	7.4E-03	4.5E-02
8	AABDEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.5E-01	8.6E-02	6.6E-02	3.6E-02	1.0E-02	2.5E-03	7.2E-04	4.7E-03	1.1E-02
				1.5E+06	1.3E+04	3.6E+03	2.5E-01	1.1E-01	1.2E-01	6.7E-02	6.7E-02	9.2E-04	4.1E-03	8.3E-03	5.1E-02
9	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01
10	ABBEBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.8E-01	3.0E-02	2.6E-02	1.7E-02	8.9E-03	1.1E-03	4.4E-04	2.0E-03	9.0E-03
				2.4E+05	1.3E+04	2.2E+04	3.2E-01	1.0E-01	1.0E-01	5.7E-02	5.0E-02	1.2E-03	5.9E-03	8.8E-03	4.3E-02
11	ABBDEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.0E-01	7.8E-02	6.7E-02	4.2E-02	2.0E-02	2.8E-03	1.4E-03	6.7E-03	2.1E-02
				1.5E+06	1.3E+04	3.6E+03	3.0E-01	1.6E-01	1.6E-01	8.6E-02	7.6E-02	1.3E-03	7.6E-03	1.2E-02	6.1E-02
12	AABEEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.5E-01	8.7E-02	6.7E-02	3.6E-02	1.1E-02	2.6E-03	7.9E-04	4.9E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	2.5E-01	1.2E-01	1.3E-01	6.8E-02	6.9E-02	5.7E-04	4.1E-03	8.3E-03	5.2E-02
13	ABBCFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.2E-01	2.9E-02	2.5E-02	6.4E-03	1.5E-03	1.4E-03	2.3E-04	2.3E-04	1.8E-03
				3.7E+05	1.3E+04	1.4E+04	3.8E-01	1.8E-01	1.9E-01	9.0E-02	5.6E-02	4.6E-04	4.0E-03	6.1E-03	4.4E-02
14	ABBEEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	6.7E-01	7.5E-02	6.3E-02	3.8E-02	1.7E-02	2.4E-03	1.2E-03	5.8E-03	1.8E-02
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	1.8E-01	1.9E-01	1.0E-01	8.7E-02	1.1E-03	8.7E-03	1.3E-02	7.2E-02
15	ABBDBAAACB	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	8.4E-01	1.9E-01	1.7E-01	1.5E-01	8.8E-02	1.1E-02	4.7E-03	2.1E-02	8.8E-02
				2.4E+05	1.3E+04	2.2E+04	1.6E-01	9.8E-02	9.6E-02	3.4E-02	1.7E-02	2.8E-04	4.7E-03	5.9E-03	1.4E-02

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* A listing of source terms for all bins is available on computer media

these APBs is presented in Section 2.5.5.3. Table 3.3-16 lists the mean source terms for these same APBs.

Figures 3.3-36, 52, 69, and 85 summarize the release fraction CCDFs for PDS 3.

3.3.3.4 Results for PDS 4: Slow SBO

This PDS is composed of one sequence with seismically induced LOSP followed by loss of all AC leading to station blackout. HPCI succeeds until battery depletion or high suppression pool temperature results in HPCI failure and late core damage. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.86. The probability of recovering AC and averting VB is 0.00.

Table 2.5-21 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.5.4. Table 3.3-17 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at high pressure and without any injection.

Figures 3.3-37, 53, 70, and 86 summarize the release fraction CCDFs for PDS 4.

3.3.3.5 Results for PDS 5: Fast SBO

This PDS is composed of two sequences, one with a stuck open SRV and one without. Both sequences have seismically induced LOSP followed by a loss of all AC resulting in station blackout. High pressure injection fails initially upon Radwaste/Turbine building failure and early core damage ensues.

Table 2.5-22 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.5.5. Table 3.3-18 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. Thirteen of the most probable bins have vessel breach with the RPV at high pressure and without any injection, two at low pressure with no injection.

Figures 3.3-38, 54, 71, and 87 summarize the release fraction CCDFs for PDS 5.

Table 3.3-16
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 3 - FSB LLOCA

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	2.0E-02	1.6E-02	8.5E-03	1.8E-03	6.2E-04	1.7E-04	7.9E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	7.9E-02	8.4E-02	3.9E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
2	AABDBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	7.3E-01	3.6E-02	2.8E-02	1.6E-02	4.7E-03	9.4E-04	2.2E-04	9.6E-04	4.9E-03
				2.4E+05	1.3E+04	2.2E+04	2.7E-01	8.2E-02	9.0E-02	5.6E-02	5.8E-02	9.1E-04	3.3E-03	6.9E-03	4.4E-02
3	AABEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	1.9E-02	1.5E-02	8.2E-03	1.8E-03	4.7E-04	1.4E-04	8.4E-04	2.0E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	9.0E-02	9.6E-02	4.1E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
4	ABBDBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.8E-01	3.1E-02	2.7E-02	1.8E-02	9.4E-03	1.1E-03	4.6E-04	2.1E-03	9.4E-03
				2.4E+05	1.3E+04	2.2E+04	3.2E-01	9.0E-02	8.7E-02	4.4E-02	3.5E-02	1.2E-03	4.1E-03	6.0E-03	2.9E-02
5	ABBDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.4E-01	2.2E-02	2.1E-02	1.6E-02	1.2E-02	2.0E-03	1.2E-03	5.6E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	2.6E-01	1.2E-01	1.2E-01	5.8E-02	5.3E-02	5.5E-05	4.4E-03	7.2E-03	4.2E-02
6	AABEBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	7.2E-01	3.7E-02	2.9E-02	1.6E-02	5.3E-03	1.0E-03	2.6E-04	1.2E-03	5.5E-03
				2.4E+05	1.3E+04	2.2E+04	2.8E-01	8.0E-02	8.9E-02	5.5E-02	5.8E-02	6.2E-04	3.2E-03	6.7E-03	4.4E-02
7	ABBEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.7E-01	2.0E-02	1.8E-02	1.3E-02	9.2E-03	1.3E-03	8.4E-04	4.2E-03	9.3E-03
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	1.5E-01	1.5E-01	7.1E-02	5.7E-02	1.7E-04	4.6E-03	7.4E-03	4.5E-02
8	AABDEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.5E-01	8.6E-02	6.6E-02	3.6E-02	1.0E-02	2.5E-03	7.2E-04	4.7E-03	1.1E-02
				1.5E+06	1.3E+04	3.6E+03	2.5E-01	1.1E-01	1.2E-01	6.7E-02	6.7E-02	9.2E-04	4.1E-03	8.3E-03	5.1E-02
9	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01
10	ABBEBAAACA	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	6.8E-01	3.0E-02	2.6E-02	1.7E-02	8.9E-03	1.1E-03	4.4E-04	2.0E-03	9.0E-03
				2.4E+05	1.3E+04	2.2E+04	3.2E-01	1.0E-01	1.0E-01	5.7E-02	5.0E-02	1.2E-03	5.9E-03	8.8E-03	4.3E-02
11	ABBDEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.0E-01	7.8E-02	6.7E-02	4.2E-02	2.0E-02	2.8E-03	1.4E-03	6.7E-03	2.1E-02
				1.5E+06	1.3E+04	3.6E+03	3.0E-01	1.6E-01	1.6E-01	8.6E-02	7.6E-02	1.3E-03	7.6E-03	1.2E-02	6.1E-02
12	AABEEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	7.5E-01	8.7E-02	6.7E-02	3.6E-02	1.1E-02	2.6E-03	7.9E-04	4.9E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	2.5E-01	1.2E-01	1.3E-01	6.8E-02	6.9E-02	5.7E-04	4.1E-03	8.3E-03	5.2E-02
13	ABBCFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.2E-01	2.9E-02	2.5E-02	6.4E-03	1.5E-03	1.4E-03	2.3E-04	2.3E-04	1.8E-03
				3.7E+05	1.3E+04	1.4E+04	3.8E-01	1.8E-01	1.9E-01	9.0E-02	5.6E-02	4.6E-04	4.0E-03	6.1E-03	4.4E-02
14	ABBEEAAACA	4.0E+03	3.0E+01	1.3E+06	4.0E+03	9.0E+03	6.7E-01	7.5E-02	6.3E-02	3.8E-02	1.7E-02	2.4E-03	1.2E-03	5.8E-03	1.8E-02
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	1.8E-01	1.9E-01	1.0E-01	8.7E-02	1.1E-03	8.7E-03	1.3E-02	7.2E-02
15	ABBDBAAACB	4.0E+03	3.0E+01	3.2E+06	4.0E+03	3.6E+03	8.4E-01	1.9E-01	1.7E-01	1.5E-01	8.8E-02	1.1E-02	4.7E-03	2.1E-02	8.8E-02
				2.4E+05	1.3E+04	2.2E+04	1.6E-01	9.8E-02	9.6E-02	3.4E-02	1.7E-02	2.8E-04	4.7E-03	5.9E-03	1.4E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-17
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 4 - Slow SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	GAABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.8E-01	3.0E-03	3.0E-03	1.4E-03	3.6E-04	2.4E-04	6.6E-05	1.1E-04	4.1E-04
				1.9E+06	4.2E+04	1.4E+04	2.2E-01	8.6E-02	6.5E-02	3.5E-02	3.9E-02	4.4E-04	2.6E-03	5.1E-03	2.9E-02
2	GBABFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.8E-01	5.9E-03	6.0E-03	4.6E-03	3.6E-03	8.6E-04	4.0E-04	1.6E-03	3.7E-03
				1.9E+06	4.2E+04	1.4E+04	2.2E-01	1.7E-01	1.1E-01	5.6E-02	4.9E-02	1.0E-03	5.7E-03	8.5E-03	4.1E-02
3	GAABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	4.3E-03	4.3E-03	2.3E-03	6.3E-04	5.0E-04	1.2E-04	1.7E-04	7.4E-04
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	1.1E-01	9.6E-02	5.1E-02	4.8E-02	4.5E-04	2.8E-03	5.6E-03	3.5E-02
4	GAABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.3E-02	1.2E-02	6.4E-03	2.1E-03	1.6E-03	4.0E-04	5.8E-04	2.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	3.0E-01	2.9E-01	1.6E-01	1.5E-01	2.4E-03	9.6E-03	1.9E-02	1.2E-01
5	FAABFBAAAA	1.4E+04	3.0E+01	7.7E+06	2.7E+04	9.0E+02	7.6E-01	3.4E-03	3.4E-03	1.7E-03	3.6E-04	2.5E-04	8.0E-05	1.3E-04	4.3E-04
				1.9E+06	2.8E+04	1.4E+04	2.4E-01	9.0E-02	7.0E-02	3.6E-02	4.0E-02	4.4E-04	2.6E-03	5.2E-03	3.0E-02
6	GAADFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.5E-01	8.3E-03	7.0E-03	4.2E-03	4.5E-04	3.4E-04	9.4E-05	2.5E-04	5.7E-04
				1.9E+06	4.2E+04	1.4E+04	1.5E-01	1.2E-01	6.1E-02	3.1E-02	2.6E-02	1.1E-06	1.0E-03	2.1E-03	1.8E-02
7	GBABEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	6.9E-03	7.0E-03	5.6E-03	4.3E-03	1.1E-03	4.8E-04	1.9E-03	4.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	1.9E-01	1.3E-01	7.3E-02	6.4E-02	1.2E-03	6.5E-03	9.8E-03	5.2E-02
8	FBABFBAAAA	1.4E+04	3.0E+01	7.7E+06	2.7E+04	9.0E+02	7.9E-01	5.7E-03	5.8E-03	4.4E-03	3.4E-03	8.1E-04	3.7E-04	1.5E-03	3.5E-03
				1.9E+06	2.8E+04	1.4E+04	2.1E-01	1.6E-01	1.0E-01	5.4E-02	4.7E-02	9.9E-04	5.4E-03	8.0E-03	3.9E-02
9	GBAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.6E-01	1.1E-02	1.2E-02	4.4E-03	1.0E-03	1.4E-03	4.3E-04	4.3E-04	1.4E-03
				1.9E+06	4.2E+04	1.4E+04	2.4E-01	1.1E-01	9.7E-02	5.2E-02	3.6E-02	3.1E-04	2.6E-03	4.0E-03	2.8E-02
10	GAAAFBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.2E-01	1.2E-02	1.3E-02	1.6E-03	2.0E-04	3.7E-04	2.0E-04	2.0E-04	3.1E-04
				1.9E+06	4.2E+04	1.4E+04	1.8E-01	1.4E-01	8.0E-02	2.3E-02	2.3E-02	8.0E-06	1.1E-03	2.1E-03	1.5E-02
11	GAABACAAAB	2.9E+04	3.0E+01	7.7E+05	4.7E+04	9.0E+03	5.0E-01	2.4E-02	2.3E-02	3.0E-02	2.8E-02	2.7E-04	1.8E-03	3.9E-03	2.4E-02
				1.3E+06	5.6E+04	2.2E+04	5.0E-01	2.4E-02	2.3E-02	3.0E-02	2.8E-02	2.7E-04	1.8E-03	3.9E-03	2.4E-02
12	GBABFBAAAB	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	7.9E-01	1.7E-02	1.7E-02	1.2E-02	8.8E-03	2.0E-03	9.2E-04	3.7E-03	9.0E-03
				1.9E+06	4.2E+04	1.4E+04	2.1E-01	3.5E-01	3.0E-01	1.6E-01	1.5E-01	2.0E-03	1.5E-02	2.3E-02	1.2E-01
13	GAABHBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.3E-01	3.6E-03	3.5E-03	1.3E-03	3.2E-04	3.1E-04	5.6E-05	5.7E-05	3.9E-04
				1.9E+06	4.2E+04	1.4E+04	1.7E-01	1.4E-01	1.9E-02	1.7E-02	1.8E-02	3.8E-08	3.7E-04	7.4E-04	1.0E-02
14	GBADACAAAB	2.9E+04	3.0E+01	7.7E+05	4.7E+04	9.0E+03	5.0E-01	3.0E-02	3.1E-02	8.2E-03	1.6E-03	1.3E-05	4.7E-05	8.1E-05	1.0E-03
				1.3E+06	5.6E+04	2.2E+04	5.0E-01	3.0E-02	3 1E-02	8.2E-03	1.6E-03	1.3E-05	4.7E-05	8.1E-05	1.0E-03
15	GAADEBAAAA	2.9E+04	3.0E+01	7.7E+06	4.1E+04	9.0E+02	8.0E-01	8.7E-03	7.3E-03	4.2E-03	6.7E-04	5.5E-04	1.2E-04	2.8E-04	8.8E-04
				1.9E+06	4.2E+04	1.4E+04	2.0E-01	1.5E-01	1.2E-01	8.5E-02	8.6E-02	1.2E-03	5.4E-03	1.1E-02	7.0E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-18
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 5 - Fast SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	EAABFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	4.1E-03	4.1E-03	1.8E-03	4.0E-04	2.8E-04	8.8E-05	1.4E-04	4.7E-04
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	8.1E-02	8.3E-02	4.0E-02	4.5E-02	5.1E-04	3.0E-03	5.9E-03	3.4E-02
2	EBABFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	7.2E-03	7.3E-03	5.0E-03	3.8E-03	9.3E-04	4.3E-04	1.8E-03	3.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	1.4E-01	1.3E-01	6.2E-02	5.4E-02	1.1E-03	5.8E-03	8.8E-03	4.4E-02
3	EAAEFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	8.6E-01	9.1E-03	7.4E-03	4.2E-03	3.3E-04	1.6E-04	3.0E-05	2.2E-04	4.0E-04
				3.7E+05	1.3E+04	1.4E+04	1.4E-01	7.3E-02	7.3E-02	3.7E-02	3.3E-02	1.3E-06	1.3E-03	2.7E-03	2.3E-02
4	EAABFBAAAB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.7E-01	1.1E-02	1.0E-02	5.5E-03	4.4E-03	3.7E-03	9.0E-04	1.4E-03	4.5E-03
				3.7E+05	1.3E+04	1.4E+04	3.3E-01	4.0E-01	4.1E-01	1.8E-01	1.1E-01	9.9E-05	6.1E-03	1.2E-02	7.5E-02
5	EAABEBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	5.4E-03	5.4E-03	2.5E-03	5.7E-04	4.5E-04	1.1E-04	1.4E-04	6.7E-04
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	1.0E-01	1.1E-01	5.5E-02	5.7E-02	6.1E-04	3.3E-03	6.8E-03	4.2E-02
6	EAABACAAAB	4.0E+03	3.0E+01	3.2E+06	2.2E+04	3.6E+03	5.0E-01	1.8E-02	1.9E-02	2.3E-02	2.0E-02	1.9E-04	1.3E-03	2.7E-03	1.7E-02
				2.4E+05	2.6E+04	2.2E+04	5.0E-01	1.8E-02	1.9E-02	2.3E-02	2.0E-02	1.9E-04	1.3E-03	2.7E-03	1.7E-02
7	EABEFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	9.2E-03	7.6E-03	4.3E-03	6.8E-04	1.9E-04	4.4E-05	2.1E-04	7.5E-04
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	8.5E-02	9.1E-02	4.1E-02	4.0E-02	4.1E-04	2.5E-03	5.1E-03	3.0E-02
8	EAAAFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	8.2E-01	1.4E-02	1.6E-02	1.8E-03	2.3E-04	4.2E-04	2.3E-04	2.3E-04	3.5E-04
				3.7E+05	1.3E+04	1.4E+04	1.8E-01	1.1E-01	9.6E-02	2.6E-02	2.6E-02	9.7E-06	1.2E-03	2.4E-03	1.8E-02
9	EBAAFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	1.2E-02	1.3E-02	5.2E-03	1.4E-03	1.9E-03	5.4E-04	5.4E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	1.2E-01	1.1E-01	4.9E-02	2.8E-02	9.2E-07	1.1E-03	1.8E-03	1.9E-02
10	EBAEFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	5.4E-01	2.0E-03	1.9E-03	7.2E-04	3.1E-06	1.7E-07	2.0E-08	2.4E-08	3.3E-05
				3.7E+05	1.3E+04	1.4E+04	4.6E-01	2.0E-01	2.1E-01	1.2E-01	9.9E-02	4.2E-05	7.6E-03	1.2E-02	7.9E-02
11	EBABEBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	1.0E-02	1.0E-02	7.7E-03	6.7E-03	1.6E-03	7.2E-04	3.1E-03	6.8E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	1.4E-01	1.3E-01	6.8E-02	7.0E-02	1.8E-03	7.5E-03	1.1E-02	5.5E-02
12	EBAEACAAAB	4.0E+03	3.0E+01	3.2E+06	2.2E+04	3.6E+03	5.0E-01	3.1E-02	3.2E-02	8.5E-03	1.7E-03	2.3E-07	4.4E-05	8.0E-05	1.1E-03
				2.4E+05	2.6E+04	2.2E+04	5.0E-01	3.1E-02	3.2E-02	8.5E-03	1.7E-03	2.3E-07	4.4E-05	8.0E-05	1.1E-03
13	EAAEACAAAB	4.0E+03	3.0E+01	3.2E+06	2.2E+04	3.6E+03	5.0E-01	1.2E-02	1.2E-02	1.5E-02	1.5E-02	1.9E-04	7.8E-04	1.8E-03	1.3E-02
				2.4E+05	2.6E+04	2.2E+04	5.0E-01	1.2E-02	1.2E-02	1.5E-02	1.5E-02	1.9E-04	7.8E-04	1.8E-03	1.3E-02
14	EBABBCAAAA	4.0E+03	3.0E+01	3.2E+06	2.2E+04	3.6E+03	5.0E-01	9.6E-03	7.3E-03	5.5E-03	2.7E-03	8.3E-05	1.6E-04	2.8E-04	2.2E-03
				2.4E+05	2.6E+04	2.2E+04	5.0E-01	9.6E-03	7.3E-03	5.5E-03	2.7E-03	8.3E-05	1.6E-04	2.8E-04	2.2E-03
15	EBBEFBAAAA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.5E-01	8.4E-03	7.9E-03	5.8E-03	4.7E-03	6.5E-04	4.5E-04	2.3E-03	4.8E-03
				3.7E+05	1.3E+04	1.4E+04	3.5E-01	1.6E-01	1.6E-01	7.3E-02	5.5E-02	4.7E-05	4.1E-03	6.7E-03	4.2E-02

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* A listing of source terms for all bins is available on computer media

3.3.3.6 Results for PDS 6: FSB ILOCA

This PDS is composed of one sequence with seismically induced LOSP, failure of onsite AC due to cooling water failure, and seismically induced intermediate LOCA. HPCI works until the primary pressure drops below the working pressure and early core damage ensues. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.96. The probability of recovering AC and averting VB is 0.00.

Table 2.5-23 lists the fifteen most probable APBs since the top five bins all have VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.5.6. Table 3.3-19 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the fifteen most probable bins have vessel breach with the RPV at low pressure and without any injection.

Figures 3.3-39, 55, 72, and 88 summarize the release fraction CCDFs for PDS 6.

3.3.3.7 Results for PDS 7: FSB I/SLOCA

This PDS is composed of two sequences both with seismically induced LOSP followed by loss of onsite AC resulting in station blackout. A seismically induced intermediate or small LOCA occurs and high pressure injection fails when RPV pressure drops below the systems' working pressure resulting in early core damage. For this PDS, the probability of early containment failure (i.e. before or close to the time of VB) is 0.69. The probability of recovering AC and averting VB is 0.00.

Table 2.5-24 lists the ten most probable APBs with VB since the top five bins all have VB and the top five with VB and early CF. A discussion of the accident characteristics for these APBs is presented in Section 2.5.5.7. Table 3.3-20 lists the mean source terms for these same APBs. For this PDS, off-site AC power can not be recovered prior to or during core degradation. For seismically initiated loss of AC, power recovery was not allowed except if the power failed for other than fire reasons. Credit was given in the Level I analysis for recovering onsite AC power before the start of core damage. All of the ten most probable bins have vessel breach with the RPV at low pressure and without any injection.

Figures 3.3-40, 56, 73, and 89 summarize the release fraction CCDFs for PDS 7.

3.3.3.8 Results for Generalized Accident Progression Bins

The preceding seven subsections presented the source term results by PDS group. It is also possible to group the source terms in other ways. These

Table 3.3-19
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 6 - FSB ILOCA

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 8E-01	2 0E-02	1 6E-02	8 5E-03	1 8E-03	6 2E-04	1 7E-04	7 9E-04	1 9E-03
				3 7E+05	1 3E+04	1 4E+04	2 2E-01	7 9E-02	8 4E-02	3 9E-02	3 7E-02	3 8E-04	2 4E-03	4 7E-03	2 8E-02
2	AABDFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 8E-01	4 6E-02	3 7E-02	2 2E-02	7 1E-03	1 8E-03	6 0E-04	3 0E-03	7 4E-03
				3 7E+05	1 3E+04	1 4E+04	2 2E-01	2 5E-01	2 7E-01	1 6E-01	1 5E-01	2 2E-03	8 8E-03	1 8E-02	1 1E-01
3	AABDHBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 7E-01	2 1E-02	1 6E-02	8 0E-03	3 3E-03	1 1E-03	3 4E-04	1 5E-03	3 5E-03
				3 7E+05	1 3E+04	1 4E+04	2 3E-01	4 3E-02	3 5E-02	2 5E-02	2 6E-02	1 2E-04	1 5E-03	2 9E-03	2 0E-02
4	AABEFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 7E-01	1 9E-02	1 5E-02	8 2E-03	1 8E-03	4 7E-04	1 4E-04	8 4E-04	2 0E-03
				3 7E+05	1 3E+04	1 4E+04	2 3E-01	9 0E-02	9 6E-02	4 1E-02	3 7E-02	3 8E-04	2 4E-03	4 7E-03	2 8E-02
5	ABBDFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 4E-01	2 2E-02	2 1E-02	1 6E-02	1 2E-02	2 0E-03	1 2E-03	5 6E-03	1 2E-02
				3 7E+05	1 3E+04	1 4E+04	2 6E-01	1 2E-01	1 2E-01	5 8E-02	5 3E-02	5 5E-05	4 4E-03	7 2E-03	4 2E-02
6	AABDEBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 7E-01	1 6E-02	1 3E-02	6 4E-03	2 6E-03	8 9E-04	2 4E-04	9 5E-04	2 7E-03
				3 7E+05	1 3E+04	1 4E+04	2 3E-01	1 1E-01	1 2E-01	6 0E-02	6 2E-02	6 5E-04	3 2E-03	6 6E-03	4 5E-02
7	ABBEFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	6 7E-01	2 0E-02	1 8E-02	1 3E-02	9 2E-03	1 3E-03	8 4E-04	4 2E-03	9 3E-03
				3 7E+05	1 3E+04	1 4E+04	3 3E-01	1 5E-01	1 5E-01	7 1E-02	5 7E-02	1 7E-04	4 6E-03	7 4E-03	4 5E-02
8	AABDCBAACA	4 0E+03	3 0E+01	3 2E+06	1 3E+04	3 6E+03	7 2E-01	2 9E-03	2 4E-03	1 5E-03	5 1E-04	1 1E-04	2 5E-05	8 4E-05	5 3E-04
				2 4E+05	1 7E+04	2 2E+04	2 8E-01	1 6E-02	2 4E-03	1 1E-03	1 4E-03	7 1E-05	8 5E-05	1 7E-04	1 1E-03
9	AABEFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 6E-01	4 4E-02	3 4E-02	2 1E-02	7 1E-03	1 5E-03	5 3E-04	3 0E-03	7 3E-03
				3 7E+05	1 3E+04	1 4E+04	2 4E-01	2 6E-01	2 9E-01	1 6E-01	1 6E-01	2 1E-03	9 1E-03	1 8E-02	1 2E-01
10	ABBDFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 2E-01	5 1E-02	4 8E-02	3 9E-02	2 9E-02	4 7E-03	2 6E-03	1 2E-02	3 0E-02
				3 7E+05	1 3E+04	1 4E+04	2 8E-01	3 4E-01	3 5E-01	1 6E-01	1 2E-01	2 0E-04	9 2E-03	1 5E-02	9 2E-02
11	ABBEFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	6 5E-01	4 3E-02	4 0E-02	3 1E-02	2 2E-02	3 0E-03	1 9E-03	9 4E-03	2 3E-02
				3 7E+05	1 3E+04	1 4E+04	3 5E-01	3 9E-01	4 1E-01	2 0E-01	1 5E-01	4 5E-04	1 1E-02	1 7E-02	1 1E-01
12	ABBCFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	6 2E-01	2 9E-02	2 5E-02	6 4E-03	1 5E-03	1 4E-03	2 3E-04	2 3E-04	1 8E-03
				3 7E+05	1 3E+04	1 4E+04	3 8E-01	1 8E-01	1 9E-01	9 0E-02	5 6E-02	4 6E-04	4 0E-03	6 1E-03	4 4E-02
13	AABDEBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 6E-01	3 7E-02	2 9E-02	1 6E-02	5 3E-03	1 9E-03	4 5E-04	1 4E-03	5 6E-03
				3 7E+05	1 3E+04	1 4E+04	2 4E-01	2 8E-01	3 1E-01	1 9E-01	1 9E-01	2 9E-03	1 1E-02	2 2E-02	1 4E-01
14	ABBDABAACB	4 0E+03	3 0E+01	3 2E+06	1 3E+04	3 6E+03	8 3E-01	1 5E-02	1 3E-02	1 1E-02	7 0E-03	1 6E-03	6 2E-04	2 5E-03	7 2E-03
				2 4E+05	1 7E+04	2 2E+04	1 7E-01	1 7E-01	1 8E-01	9 0E-02	5 6E-02	8 2E-05	4 6E-03	6 2E-03	3 3E-02
15	AABEHBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 5E-01	1 8E-02	1 4E-02	6 9E-03	2 7E-03	5 3E-04	2 1E-04	1 2E-03	2 8E-03
				3 7E+05	1 3E+04	1 4E+04	2 5E-01	4 4E-02	3 4E-02	2 4E-02	2 6E-02	1 1E-04	1 5E-03	2 9E-03	2 0E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-20
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 7 - I/SLOCA SBO

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Ten Most Probable Bins*															
1	EABEFBAABA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	1.3E-02	1.0E-02	5.8E-03	1.1E-03	3.0E-04	8.0E-05	4.6E-04	1.2E-03
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	8.3E-02	8.8E-02	4.1E-02	4.1E-02	4.3E-04	2.6E-03	5.3E-03	3.1E-02
2	EBBEFBAABA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.5E-01	1.3E-02	1.2E-02	8.7E-03	6.7E-03	9.3E-04	6.2E-04	3.1E-03	6.7E-03
				3.7E+05	1.3E+04	1.4E+04	3.5E-01	1.6E-01	1.6E-01	7.3E-02	5.5E-02	4.7E-05	4.1E-03	6.7E-03	4.2E-02
3	EABEACAABB	4.0E+03	3.0E+01	3.2E+06	2.2E+04	3.6E+03	5.0E-01	1.7E-02	1.5E-02	2.0E-02	2.0E-02	8.3E-04	1.5E-03	3.2E-03	1.8E-02
				2.4E+05	2.6E+04	2.2E+04	5.0E-01	1.7E-02	1.5E-02	2.0E-02	2.0E-02	8.3E-04	1.5E-03	3.2E-03	1.8E-02
4	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	2.0E-02	1.6E-02	8.5E-03	1.8E-03	6.2E-04	1.7E-04	7.9E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	7.9E-02	8.4E-02	3.9E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
5	EABEFBAABB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	3.5E-02	2.8E-02	1.9E-02	7.0E-03	1.4E-03	5.1E-04	2.8E-03	7.2E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	2.4E-01	2.7E-01	1.7E-01	1.7E-01	2.7E-03	1.0E-02	2.0E-02	1.3E-01
6	EBBEACAABB	4.0E+03	3.0E+01	3.2E+06	2.2E+04	3.6E+03	5.0E-01	2.6E-02	2.4E-02	1.5E-02	9.4E-03	1.4E-04	9.8E-04	1.7E-03	8.8E-03
				2.4E+05	2.6E+04	2.2E+04	5.0E-01	2.6E-02	2.4E-02	1.5E-02	9.4E-03	1.4E-04	9.8E-04	1.7E-03	8.8E-03
7	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01
8	EABEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	1.8E-02	1.5E-02	8.0E-03	1.8E-03	4.7E-04	1.3E-04	8.2E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	8.3E-02	8.8E-02	4.1E-02	4.1E-02	4.3E-04	2.6E-03	5.3E-03	3.1E-02
9	EABEECAABA	4.0E+03	3.0E+01	6.4E+07	2.2E+04	1.8E+02	9.0E-01	2.5E-02	2.1E-02	3.1E-02	3.1E-02	4.9E-04	1.6E-03	3.3E-03	2.3E-02
				3.7E+05	2.2E+04	1.4E+04	1.0E-01	2.8E-03	2.4E-03	3.4E-03	3.4E-03	5.5E-05	1.8E-04	3.7E-04	2.6E-03
10	AABDHBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	2.1E-02	1.6E-02	8.0E-03	3.3E-03	1.1E-03	3.4E-04	1.5E-03	3.5E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	4.3E-02	3.5E-02	2.5E-02	2.6E-02	1.2E-04	1.5E-03	2.9E-03	2.0E-02
Mean Source Terms for Five Most Probable Bins that have VB and Early CF*															
1	EABEFBAABA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	1.3E-02	1.0E-02	5.8E-03	1.1E-03	3.0E-04	8.0E-05	4.6E-04	1.2E-03
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	8.3E-02	8.8E-02	4.1E-02	4.1E-02	4.3E-04	2.6E-03	5.3E-03	3.1E-02
2	EBBEFBAABA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.5E-01	1.3E-02	1.2E-02	8.7E-03	6.7E-03	9.3E-04	6.2E-04	3.1E-03	6.7E-03
				3.7E+05	1.3E+04	1.4E+04	3.5E-01	1.6E-01	1.6E-01	7.3E-02	5.5E-02	4.7E-05	4.1E-03	6.7E-03	4.2E-02
4	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	2.0E-02	1.6E-02	8.5E-03	1.8E-03	6.2E-04	1.7E-04	7.9E-04	1.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	7.9E-02	8.4E-02	3.9E-02	3.7E-02	3.8E-04	2.4E-03	4.7E-03	2.8E-02
5	EABEFBAABB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.7E-01	3.5E-02	2.8E-02	1.9E-02	7.0E-03	1.4E-03	5.1E-04	2.8E-03	7.2E-03
				3.7E+05	1.3E+04	1.4E+04	2.3E-01	2.4E-01	2.7E-01	1.7E-01	1.7E-01	2.7E-03	1.0E-02	2.0E-02	1.3E-01
7	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01

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* A listing of source terms for all bins is available on computer media

other groupings are called generalized APBs. These generalized APBs are generated by sorting all of the bins from the ten PDSs on attributes of the accident. The generalized bins are composed of essentially five characteristics: the occurrence of core damage, the occurrence of vessel breach, the pressure at vessel breach, the location of containment failure, and the timing of containment failure with respect to vessel breach. A description of these reduced bins is presented in section 2.4.3.

Figures 3.3-41 to 3.3-48 (for LLNL Hi PGA), Figures 3.3-57 to 3.3-64 (for LLNL Low PGA), Figures 3.3-74 to 3.3-81 (for EPRI Hi PGA), and Figures 3.3-90 to 3.3-97 (for EPRI Low PGA) show the variation of the exceedance frequency with release fraction for the I, Cs, Sr, and La radionuclide classes for the eight generalized APBs that have non-zero releases. The bin descriptions are identical to those in Section 3.3.1.10.

3.3.3.9 Summary

When all the types of seismic initiated accidents at Peach Bottom are considered together, the exceedance frequency plots shown in Figure 3.3-49 (for LLNL Hi PGA), 3.3-65 (for LLNL Low PGA), 3.3-66 (for LLNL Hi and Low PGA combined), 3.3-82 (for EPRI Hi PGA), 3.3-98 (for EPRI Low PGA), and 3.3-99 (for EPRI Hi and Low PGA combined) are obtained. A plot is not shown for the noble gases since almost all of the noble gases (Xe and Kr) in the core are eventually released to the environment whether the containment fails or not. From the combined plots (Figures 3.3-66 and 3.3-99), the mean frequency of exceeding a release fraction of 0.10 for I and Cs is on the order of 10^{-6}/year and for Te and Sr it is on the order of 10^{-7}/year. The second sheet of figures shows the release fractions for Ru, La, Ce, and Ba, which are often treated together as aerosol species. The mean frequency of exceeding a release fraction of 0.01 for Ru, La, and Ce is on the order of 10^{-7}/year. The releases for the barium class are slightly higher than those for the other three aerosol radionuclide classes.

3.3.3.10 Sensitivity Analysis Results

Two different sensitivities were performed for the LLNL and EPRI hazard curves. For the LLNL curve, a sensitivity investigated the effects of eliminating the initial containment failure as a result of the seismic event in PDSs 1, 2, and 3. For the EPRI curve, a sensitivity was performed on the effects of increasing the evacuation speed back to normal for the low PGA case. The EPRI sensitivity does not affect the source term results; the effects show up in the MACCS calculation output and are first presented in section 4.3.5.

The LLNL results do affect the source term because the dominant APBs for these three PDSs are changed by the elimination of the initial containment failure. Only the mean source term results are shown, in Tables 3.3-21 to 3.3-23 for PDSs 1, 2, and 3 respectively.

Table 3.3-21
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 1 - FSB RPV - No CF at T=0

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01
2	AABDGBAACB	4.0E+03	3.0E+01	0.0E+00	1.3E+04	1.8E+02	7.5E-01	3.4E-02	2.7E-02	1.3E-02	4.0E-03	1.8E-03	4.1E-04	1.3E-03	4.3E-03
				0.0E+00	1.3E+04	1.4E+04	2.5E-01	7.5E-02	7.0E-02	4.0E-02	3.7E-02	3.2E-04	2.1E-03	4.2E-03	2.7E-02
3	AABEFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.6E-01	4.4E-02	3.4E-02	2.1E-02	7.1E-03	1.5E-03	5.3E-04	3.0E-03	7.3E-03
				3.7E+05	1.3E+04	1.4E+04	2.4E-01	2.6E-01	2.9E-01	1.6E-01	1.6E-01	2.1E-03	9.1E-03	1.8E-02	1.2E-01
4	ABBDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.1E-01	5.2E-02	5.0E-02	4.0E-02	3.0E-02	4.8E-03	2.7E-03	1.3E-02	3.1E-02
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	3.5E-01	3.6E-01	1.7E-01	1.3E-01	2.1E-04	9.5E-03	1.5E-02	9.5E-02
5	ABBDGBAACB	4.0E+03	3.0E+01	0.0E+00	1.3E+04	1.8E+02	7.3E-01	2.7E-02	2.5E-02	1.7E-02	8.5E-03	1.9E-03	5.8E-04	1.9E-03	8.8E-03
				0.0E+00	1.3E+04	1.4E+04	2.7E-01	8.3E-02	7.0E-02	2.5E-02	1.6E-02	5.1E-04	2.2E-03	3.1E-03	1.4E-02
6	ABBEFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.4E-01	4.4E-02	4.0E-02	3.2E-02	2.3E-02	3.1E-03	1.9E-03	9.7E-03	2.3E-02
				3.7E+05	1.3E+04	1.4E+04	3.6E-01	4.0E-01	4.2E-01	2.0E-01	1.5E-01	4.6E-04	1.1E-02	1.8E-02	1.2E-01
7	AABDEBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.6E-01	3.7E-02	2.9E-02	1.6E-02	5.3E-03	1.9E-03	4.5E-04	1.4E-03	5.6E-03
				3.7E+05	1.3E+04	1.4E+04	2.4E-01	2.8E-01	3.1E-01	1.9E-01	1.9E-01	2.9E-03	1.1E-02	2.2E-02	1.4E-01
8	AABEGBAACB	4.0E+03	3.0E+01	0.0E+00	1.3E+04	1.8E+02	7.3E-01	3.1E-02	2.3E-02	1.1E-02	2.8E-03	6.1E-04	1.8E-04	9.6E-04	3.0E-03
				0.0E+00	1.3E+04	1.4E+04	2.7E-01	7.8E-02	7.3E-02	4.3E-02	4.1E-02	3.0E-04	2.3E-03	4.6E-03	3.0E-02
9	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	8.0E-01	1.9E-02	1.5E-02	8.4E-03	1.9E-03	6.0E-04	1.7E-04	8.9E-04	2.0E-03
				3.7E+05	1.3E+04	1.4E+04	2.0E-01	7.5E-02	8.1E-02	4.1E-02	4.2E-02	5.2E-04	2.9E-03	5.9E-03	3.3E-02
10	ABBEGBAACB	4.0E+03	3.0E+01	0.0E+00	1.3E+04	1.8E+02	7.1E-01	3.0E-02	2.6E-02	1.8E-02	8.5E-03	1.1E-03	4.3E-04	1.9E-03	8.7E-03
				0.0E+00	1.3E+04	1.4E+04	2.9E-01	9.1E-02	7.6E-02	3.0E-02	2.1E-02	5.8E-04	2.7E-03	3.9E-03	1.8E-02
11	ABBDEBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.4E-01	2.6E-02	2.3E-02	1.6E-02	8.0E-03	1.8E-03	5.5E-04	1.8E-03	8.3E-03
				3.7E+05	1.3E+04	1.4E+04	2.6E-01	3.5E-01	3.6E-01	2.1E-01	1.7E-01	2.3E-03	1.7E-02	2.5E-02	1.4E-01
12	AABEEBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.5E-01	3.5E-02	2.6E-02	1.5E-02	4.7E-03	9.0E-04	2.8E-04	1.4E-03	4.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.5E-01	2.9E-01	3.1E-01	1.9E-01	1.9E-01	2.7E-03	1.1E-02	2.2E-02	1.5E-01
13	ABBCFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.2E-01	4.6E-02	3.9E-02	1.3E-02	3.7E-03	3.6E-03	6.5E-04	6.5E-04	4.6E-03
				3.7E+05	1.3E+04	1.4E+04	3.8E-01	4.0E-01	4.1E-01	2.4E-01	1.9E-01	1.1E-03	1.4E-02	2.1E-02	1.6E-01
14	ABBEEBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.1E-01	2.9E-02	2.5E-02	1.6E-02	7.3E-03	9.1E-04	3.6E-04	1.6E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	3.8E-01	3.9E-01	2.4E-01	2.0E-01	2.8E-03	2.0E-02	3.0E-02	1.7E-01
15	ABBDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.4E-01	2.8E-02	2.7E-02	2.0E-02	1.7E-02	2.7E-03	1.6E-03	7.7E-03	1.7E-02
				3.7E+05	1.3E+04	1.4E+04	2.6E-01	1.3E-01	1.3E-01	7.0E-02	6.5E-02	7.5E-05	5.9E-03	9.5E-03	5.4E-02

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* A listing of source terms for all bins is available on computer media

Table 3.3-22
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 2 - FSB LLOCA - No CF at T=0

		Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
Order	Bin						NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	8.0E-01	1.9E-02	1.5E-02	8.4E-03	1.9E-03	6.0E-04	1.7E-04	8.9E-04	2.0E-03
				3.7E+05	1.3E+04	1.4E+04	2.0E-01	7.5E-02	8.1E-02	4.1E-02	4.2E-02	5.2E-04	2.9E-03	5.9E-03	3.3E-02
2	AABDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	4.6E-02	3.7E-02	2.2E-02	7.1E-03	1.8E-03	6.0E-04	3.0E-03	7.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	2.5E-01	2.7E-01	1.6E-01	1.5E-01	2.2E-03	8.8E-03	1.8E-02	1.1E-01
3	AABDHBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.6E-01	2.0E-02	1.6E-02	7.8E-03	3.2E-03	1.1E-03	3.2E-04	1.4E-03	3.4E-03
				3.7E+05	1.3E+04	1.4E+04	2.4E-01	4.2E-02	3.5E-02	2.5E-02	2.6E-02	1.1E-04	1.5E-03	3.0E-03	2.0E-02
4	AABEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.9E-01	1.8E-02	1.4E-02	8.2E-03	2.1E-03	5.2E-04	1.6E-04	1.0E-03	2.2E-03
				3.7E+05	1.3E+04	1.4E+04	2.1E-01	8.5E-02	9.1E-02	4.2E-02	4.2E-02	5.2E-04	2.9E-03	5.8E-03	3.3E-02
5	ABBDFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.4E-01	2.8E-02	2.7E-02	2.0E-02	1.7E-02	2.7E-03	1.6E-03	7.7E-03	1.7E-02
				3.7E+05	1.3E+04	1.4E+04	2.6E-01	1.3E-01	1.3E-01	7.0E-02	6.5E-02	7.5E-05	5.9E-03	9.5E-03	5.4E-02
6	AABDEBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.8E-01	1.7E-02	1.3E-02	6.9E-03	2.8E-03	9.6E-04	2.5E-04	1.0E-03	2.9E-03
				3.7E+05	1.3E+04	1.4E+04	2.2E-01	1.2E-01	1.2E-01	7.0E-02	7.5E-02	7.1E-04	4.2E-03	8.7E-03	5.7E-02
7	ABBEFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.5E-01	2.4E-02	2.2E-02	1.5E-02	1.2E-02	1.6E-03	1.1E-03	5.4E-03	1.2E-02
				3.7E+05	1.3E+04	1.4E+04	3.5E-01	1.6E-01	1.7E-01	8.2E-02	6.6E-02	2.1E-04	5.7E-03	9.0E-03	5.4E-02
8	AABDCBAACA	4.0E+03	3.0E+01	3.2E+06	1.3E+04	3.6E+03	7.2E-01	2.9E-03	2.4E-03	1.5E-03	5.1E-04	1.1E-04	2.5E-05	8.4E-05	5.3E-04
				2.4E+05	1.7E+04	2.2E+04	2.8E-01	1.6E-02	2.4E-03	1.1E-03	1.4E-03	7.1E-05	8.5E-05	1.7E-04	1.1E-03
9	AABEFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.6E-01	4.4E-02	3.4E-02	2.1E-02	7.1E-03	1.5E-03	5.3E-04	3.0E-03	7.3E-03
				3.7E+05	1.3E+04	1.4E+04	2.4E-01	2.6E-01	2.9E-01	1.6E-01	1.6E-01	2.1E-03	9.1E-03	1.8E-02	1.2E-01
10	ABBDFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.1E-01	5.2E-02	5.0E-02	4.0E-02	3.0E-02	4.8E-03	2.7E-03	1.3E-02	3.1E-02
				3.7E+05	1.3E+04	1.4E+04	2.9E-01	3.5E-01	3.6E-01	1.7E-01	1.3E-01	2.1E-04	9.5E-03	1.5E-02	9.5E-02
11	ABBEFBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.4E-01	4.4E-02	4.0E-02	3.2E-02	2.3E-02	3.1E-03	1.9E-03	9.7E-03	2.3E-02
				3.7E+05	1.3E+04	1.4E+04	3.6E-01	4.0E-01	4.2E-01	2.0E-01	1.5E-01	4.6E-04	1.1E-02	1.8E-02	1.2E-01
12	ABBCFBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	6.2E-01	3.0E-02	2.6E-02	5.5E-03	5.5E-04	5.4E-04	1.3E-04	1.3E-04	7.6E-04
				3.7E+05	1.3E+04	1.4E+04	3.8E-01	1.9E-01	2.0E-01	8.2E-02	4.1E-02	1.2E-06	1.5E-03	2.4E-03	2.8E-02
13	AABDEBAACB	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.6E-01	3.7E-02	2.9E-02	1.6E-02	5.3E-03	1.9E-03	4.5E-04	1.4E-03	5.6E-03
				3.7E+05	1.3E+04	1.4E+04	2.4E-01	2.3E-01	3.1E-01	1.9E-01	1.9E-01	2.9E-03	1.1E-02	2.2E-02	1.4E-01
14	ABBDABAACB	4.0E+03	3.0E+01	3.2E+06	1.3E+04	3.6E+03	8.3E-01	1.5E-02	1.3E-02	1.1E-02	7.0E-03	1.6E-03	6.2E-04	2.5E-03	7.2E-03
				2.4E+05	1.7E+04	2.2E+04	1.7E-01	1.7E-01	1.8E-01	9.0E-02	5.6E-02	8.2E-05	4.6E-03	6.2E-03	3.3E-02
15	AABEHBAACA	4.0E+03	3.0E+01	6.4E+07	1.3E+04	1.8E+02	7.5E-01	1.7E-02	1.3E-02	6.7E-03	2.6E-03	5.1E-04	2.0E-04	1.2E-03	2.7E-03
				3.7E+05	1.3E+04	1.4E+04	2.5E-01	4.3E-02	3.4E-02	2.4E-02	2.6E-02	1.1E-04	1.5E-03	3.0E-03	2.0E-02

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* A listing of source terms for all bins is available on computer media

Table 3 3-23
Mean Source Terms for Peach Bottom
Seismic Initiators - PDS 3 - FSB LLOCA - No CF at T=0

Order	Bin	Warning Time (s)	Elevation (m)	Release Energy (W)	Release Start (s)	Release Duration (s)	Release Fractions								
							NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
Mean Source Terms for Fifteen Most Probable Bins*															
1	AABDFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 8E-01	4 6E-02	3 7E-02	2 2E-02	7 1E-03	1 8E-03	6 0E-04	3 0E-03	7 4E-03
				3 7E+05	1 3E+04	1 4E+04	2 2E-01	2 5E-01	2 7E-01	1 6E-01	1 5E-01	2 2E-03	8 8E-03	1 8E-02	1 1E-01
2	AABDGBAACB	4 0E+03	3 0E+01	0 0E+00	1 3E+04	1 8E+02	7 5E-01	3 4E-02	2 7E-02	1 3E-02	4 0E-03	1 8E-03	4 1E-04	1 3E-03	4 3E-03
				0 0E+00	1 3E+04	1 4E+04	2 5E-01	7 5E-02	7 0E-02	4 0E-02	3 7E-02	3 2E-04	2 1E-03	4 2E-03	2 7E-02
3	AABEFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 6E-01	4 4E-02	3 4E-02	2 1E-02	7 1E-03	1 5E-03	5 3E-04	3 0E-03	7 3E-03
				3 7E+05	1 3E+04	1 4E+04	2 4E-01	2 6E-01	2 9E-01	1 6E-01	1 6E-01	2 1E-03	9 1E-03	1 8E-02	1 2E-01
4	ABBDFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 1E-01	5 2E-02	5 0E-02	4 0E-02	3 0E-02	4 8E-03	2 7E-03	1 3E-02	3 1E-02
				3 7E+05	1 3E+04	1 4E+04	2 9E-01	3 5E-01	3 6E-01	1 7E-01	1 3E-01	2 1E-04	9 5E-03	1 5E-02	9 5E-02
5	ABBDGBAACB	4 0E+03	3 0E+01	0 0E+00	1 3E+04	1 8E+02	7 3E-01	2 7E-02	2 5E-02	1 7E-02	8 5E-03	1 9E-03	5 8E-04	1 9E-03	8 8E-03
				0 0E+00	1 3E+04	1 4E+04	2 7E-01	8 3E-02	7 0E-02	2 5E-02	1 6E-02	5 1E-04	2 2E-03	3 1E-03	1 4E-02
6	ABBEFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	6 4E-01	4 4E-02	4 0E-02	3 2E-02	2 3E-02	3 1E-03	1 9E-03	9 7E-03	2 3E-02
				3 7E+05	1 3E+04	1 4E+04	3 6E-01	4 0E-01	4 2E-01	2 0E-01	1 5E-01	4 6E-04	1 1E-02	1 8E-02	1 2E-01
7	AABDEBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 6E-01	3 7E-02	2 9E-02	1 6E-02	5 3E-03	1 9E-03	4 5E-04	1 4E-03	5 6E-03
				3 7E+05	1 3E+04	1 4E+04	2 4E-01	2 8E-01	3 1E-01	1 9E-01	1 9E-01	2 9E-03	1 1E-02	2 2E-02	1 4E-01
8	AABEGBAACB	4 0E+03	3 0E+01	0 0E+00	1 3E+04	1 8E+02	7 3E-01	3 1E-02	2 3E-02	1 1E-02	2 8E-03	6 1E-04	1 8E-04	9 6E-04	3 0E-03
				0 0E+00	1 3E+04	1 4E+04	2 7E-01	7 8E-02	7 3E-02	4 3E-02	4 1E-02	3 0E-04	2 3E-03	4 6E-03	3 0E-02
9	AABDFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	8 0E-01	1 9E-02	1 5E-02	8 4E-03	1 9E-03	6 0E-04	1 7E-04	8 9E-04	2 0E-03
				3 7E+05	1 3E+04	1 4E+04	2 0E-01	7 5E-02	8 1E-02	4 1E-02	4 2E-02	5 2E-04	2 9E-03	5 9E-03	3 3E-02
10	ABBEGBAACB	4 0E+03	3 0E+01	0 0E+00	1 3E+04	1 8E+02	7 1E-01	3 0E-02	2 6E-02	1 8E-02	8 5E-03	1 1E-03	4 3E-04	1 9E-03	8 7E-03
				0 0E+00	1 3E+04	1 4E+04	2 9E-01	9 1E-02	7 6E-02	3 0E-02	2 1E-02	5 8E-04	2 7E-03	3 9E-03	1 8E-02
11	ABBDEBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 4E-01	2 6E-02	2 3E-02	1 6E-02	8 0E-03	1 8E-03	5 5E-04	1 8E-03	8 3E-03
				3 7E+05	1 3E+04	1 4E+04	2 6E-01	3 5E-01	3 6E-01	2 1E-01	1 7E-01	2 3E-03	1 7E-02	2 5E-02	1 4E-01
12	AABEEBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 5E-01	3 5E-02	2 6E-02	1 5E-02	4 7E-03	9 0E-04	2 8E-04	1 4E-03	4 9E-03
				3 7E+05	1 3E+04	1 4E+04	2 5E-01	2 9E-01	3 1E-01	1 9E-01	1 9E-01	2 7E-03	1 1E-02	2 2E-02	1 5E-01
13	ABBCFBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	6 2E-01	4 6E-02	3 9E-02	1 3E-02	3 7E-03	3 6E-03	6 5E-04	6 5E-04	4 6E-03
				3 7E+05	1 3E+04	1 4E+04	3 8E-01	4 0E-01	4 1E-01	2 4E-01	1 9E-01	1 1E-03	1 4E-02	2 1E-02	1 6E-01
14	ABBEEBAACB	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 1E-01	2 9E-02	2 5E-02	1 6E-02	7 3E-03	9 1E-04	3 6E-04	1 6E-03	7 4E-03
				3 7E+05	1 3E+04	1 4E+04	2 9E-01	3 8E-01	3 9E-01	2 4E-01	2 0E-01	2 8E-03	2 0E-02	3 0E-02	1 7E-01
15	ABBDFBAACA	4 0E+03	3 0E+01	6 4E+07	1 3E+04	1 8E+02	7 4E-01	2 8E-02	2 7E-02	2 0E-02	1 7E-02	2 7E-03	1 6E-03	7 7E-03	1 7E-02
				3 7E+05	1 3E+04	1 4E+04	2 6E-01	1 3E-01	1 3E-01	7 0E-02	6 5E-02	7 5E-05	5 9E-03	9 5E-03	5 4E-02

---

* A listing of source terms for all bins is available on computer media

3.4 Partitioning of the Source Terms for the Consequence Analysis

The first subsection discusses the partitioning process in some detail in the course of presenting the partitioning results for internal initiators. Partitioning results for fire initiators are given in Section 3.4.2. The partitioning results for the seismic initiators are presented in Sections 3.4.3 and 3.4.4 for the analyses utilizing the LLNL and EPRI hazard distributions, respectively.

3.4.1 Results for Internal Initiators

The accident progression analysis and the subsequent source term analysis resulted in the generation of 66,340 source terms for internal initiators. It is not computationally possible to perform a calculation with the MACCS consequence model[4] for each of these source terms. Therefore, the interface between the source term analysis and the consequence analysis is formed by grouping this large number of source terms into a much smaller number of source term groups. These groups are defined so that the source terms within them have similar properties and a frequency-weighted mean source term is determined for each group. Then, a single MACCS calculation is performed for each mean source term. This grouping of the source terms is performed with the PARTITION program,[5] and the process is referred to as "partitioning the source terms" or just "partitioning."

The partitioning process involves the following steps: definition of an early health effect weight (EH) for each source term, definition of a chronic health effect weight (CH) for each source term, subdivision (partitioning) of the source terms on the basis of EH and CH, a further subdivision on the basis of evacuation timing, and calculation of frequency-weighted mean source terms. The partitioning process is described in detail in Volume 1 of this report on Methodology and in the user's manual for the PARTITION program.[5] This section describes the details of the partitioning process for source terms generated in the source term analysis for internal initiators.

The early health effect weight EH is based on converting the radionuclide release associated with a source term into an equivalent I-131 release and then estimating the number of early fatalities that would result from this equivalent I-131 release. This estimated number of early fatalities is the early health effect weight EH. The relationship between early fatalities and equivalent I-131 releases is shown in Figure B.4-1 of Appendix B and is based on site-specific MACCS calculations for different-sized releases of I-131.

The chronic health effect weight CH is based on an assumed linear relationship between cancer fatalities due to a radionuclide and the amount of that radionuclide released. Specifically, a site-specific MACCS calculation is performed for a fixed release of each of the 60 radionuclides included in the NUREG-1150 consequence calculations. The results of these calculations and the assumed linear relationship between the amount released and cancer fatalities for each radionuclide are then used to estimate the total number of chronic fatalities associated with a source term. This estimated number of chronic fatalities is the chronic health effect weight CH. The results of the MACCS calculations used in the determination of CH are shown in Table B.4-1 of Appendix B. Further, the input file for PARTITION containing the site-specific data used in the calculation of EH and CH is shown in Table B.4-2 of Appendix B.

The site-specific MACCS calculations that underlie the early and chronic health effect weights were performed with very conservative assumptions with respect to the energy and timing of the releases and also with respect to the emergency responses taken. As a result, these weights should be regarded as a measure of the potential of a source term to cause early and chronic fatalities rather than as an estimate of the fatalities that would actually result from a source term.

The partitioning process treats the cases for EH>0 and CH>0 and for EH=0 and CH>0 separately. Table 3.4-1 shows the division of the source terms into these two cases.

The case for EH>0 and CH>0 is treated first by PARTITION. As shown in Table 3.4-1, log CH ranges from -0.1153 to 5.2730 and log EH ranges from -0.6382 to 2.6463. Figure 3.4-1 shows a plot of the pairs (CH, EH) for the 46,088 source terms for which both EH and CH are nonzero. The partitioning process is based on laying a grid on the (CH, EH) space shown in Figure 3.4-1 and then pooling cells that have either a small frequency or contain a small number of source terms. Specifically, the grid is selected so that the ratio between the maximum and minimum value for CH in any cell and also the ratio between the maximum and minimum value for EH in any cell will be less than a specified value. In this analysis, the maximum allowable ratio was selected to be 4.0, which resulted in a loguniform division of the range of CH into nine intervals and a similar division of the range of EH into six intervals. The result of placing the selected grid on the (CH, EH) space is also shown in Figure 3.4-1.

A summary of the partitioning process for EH>0 and CH>0 is given in Table 3.4-2. The table is divided into three parts. The first page is labeled "BEFORE PARTITIONING" and shows the distribution of the source terms before the partitioning process. As in Figure 3.4-1, the abscissa and ordinate correspond to CH and EH, respectively, with the ranges given in Table 3.4-1. The top plot shows the cell counts, and the bottom plot shows the fraction of the frequency in each cell. The second page of Table 3.4-2 is labeled "AFTER PARTITIONING" and shows the distribution of the source terms after the partitioning process. The partitioning process does not result in the loss of any source terms; rather, cells with a small number of source terms or a small frequency are pooled with other cells. Thus, the total number of source terms is not changed. The third page of this table is denoted "LABELING AFTER PARTITIONING" and shows the designators that will be used in the identification of source terms derived from the partitioning process.

Table 3.4-1
Summary of Early and Chronic Health Effect Weights for Internal Initiators

	Number of Source Terms	Percent of Total Frequency
EH>0 AND CH>0	46088	66.59
EH=0 AND CH>0	19370	32.62
EH=0 AND CH=0	882	0.80
TOTAL	66340	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.2730
RANGE LOG10(EH) = -0.6382 TO 2.6463

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -3.7519 TO 3.5720

Table 3.4-2
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Internal Initiators

BEFORE PARTITIONING:

CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 46088:

```
         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      |  319 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |  160 |   49 |  739 | 1592 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |  609 | 2195 | 2099 | 3731 |  510 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |   22 |  629 | 2598 | 4016 | 4530 | 1380 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |   62 |  288 |  818 | 2392 | 3770 | 3227 | 1953 |   47 |      |
     +------+------+------+------+------+------+------+------+------+
  6  |  138 |  472 | 1011 | 2138 | 2407 | 1829 |  358 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

```
         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 0.07 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      | 0.48 | 0.03 | 1.00 | 1.54 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      | 0.52 | 3.36 | 3.13 | 9.05 | 1.09 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      | 0.01 | 0.49 | 3.11 | 5.30 | 6.10 |21.12 |      |
     +------+------+------+------+------+------+------+------+------+
  5  | 0.02 | 0.13 | 0.28 | 1.30 | 6.74 |16.29 | 6.47 | 0.12 |      |
     +------+------+------+------+------+------+------+------+------+
  6  | 0.03 | 0.58 | 0.93 | 3.49 | 4.06 | 1.96 | 1.18 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

Table 3.4-2 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Internal Initiators

```
AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 46088:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 319  |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |      |      | 1089 | 1642 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |      | 2739 | 2148 | 3841 |      |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |      |      | 3147 | 4016 | 4530 | 1427 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |      |      |      |      | 5393 | 3227 | 2085 |      |      |
     +------+------+------+------+------+------+------+------+------+
  6  |      |      |      | 6023 | 2407 | 2055 |      |      |      |
     +------+------+------+------+------+------+------+------+------+


 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 0.07 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |      |      | 1.98 | 1.55 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |      | 4.04 | 3.17 | 9.15 |      |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |      |      | 3.72 | 5.30 | 6.10 |21.24 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |      |      |      |      | 7.78 |16.29 | 6.75 |      |      |
     +------+------+------+------+------+------+------+------+------+
  6  |      |      |      | 5.94 | 4.06 | 2.86 |      |      |      |
     +------+------+------+------+------+------+------+------+------+
```

Table 3.4-2 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Internal Initiators

LABELING AFTER PARTITIONING:

	1	2	3	4	5	6	7	8	9
1									PB-15
2								PB-12	PB-16
3						PB-05	PB-09	PB-13	
4					PB-02	PB-06	PB-10	PB-14	
5					PB-03	PB-07	PB-11		
6				PB-01	PB-04	PB-08			

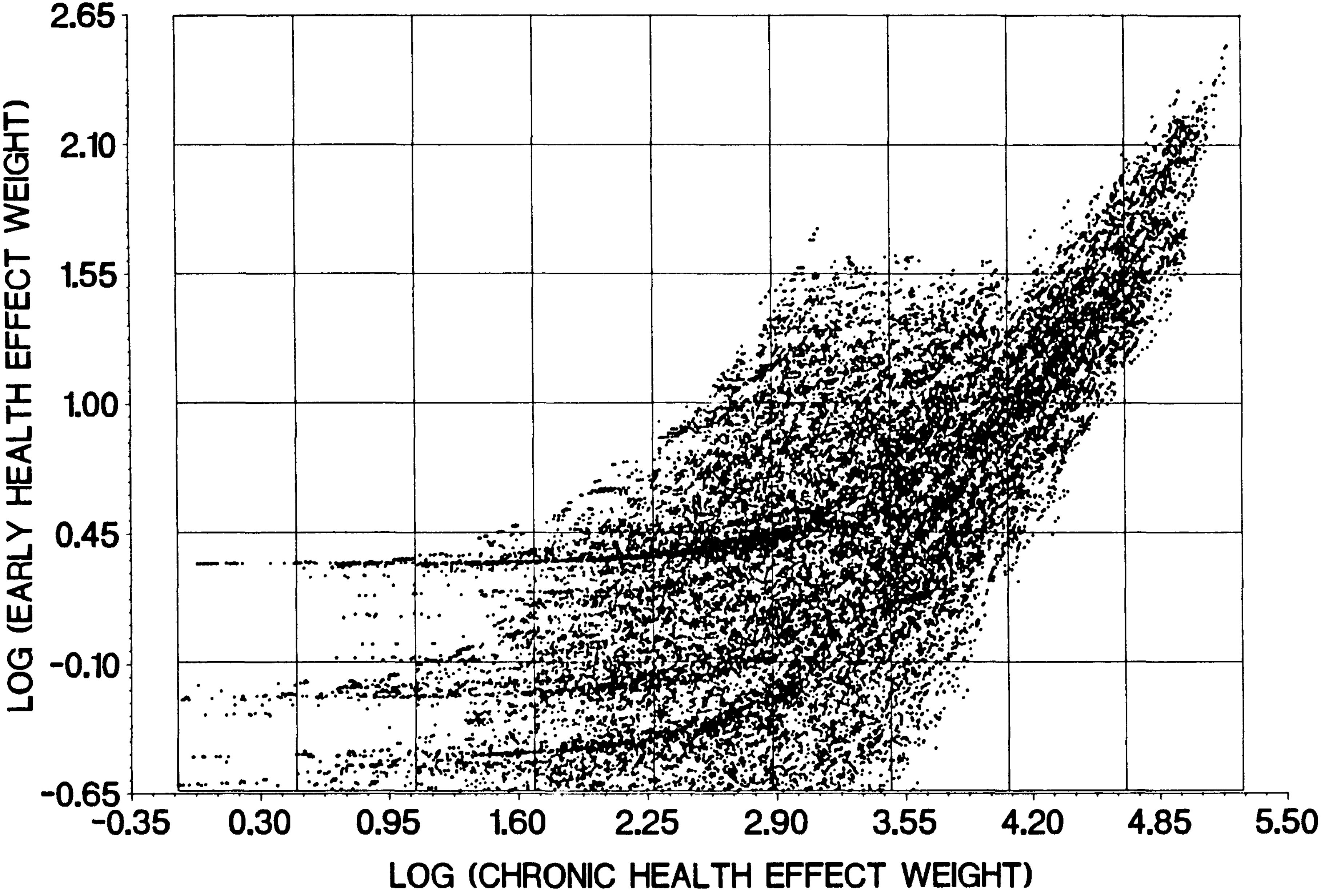

Figure 3.4-1. Distribution of Nonzero Early and Chronic Health Effect Weights for Internal Initiators

A summary of the partitioning process for EH=0 and CH>0 is given in Table 3.4-3, which is structured analogously to Table 3.4-2 but has only one dimension instead of two. As indicated in Table 3.4-1, log(CH) ranges from -3.7519 to 3.5720. The cells shown in Table 3.4-3 are based on a loguniform division of the range of CH into eight intervals.

At this point, the result of partitioning is 19 groups of source terms as shown in Tables 3.4-2 and 3.4-3 plus one group for the EH=0 and CH=0 APBs for a total of 20 groups. These source term groups are now further subdivided on the basis of evacuation timing, except for the EH=0 and CH=0 group. Specifically, each group of source terms is subdivided into three subgroups:

Subgroup 1: Evacuation starts at least 30 minutes before the release begins;

Subgroup 2: Evacuation starts between 30 minutes before and 1 hour after the release begins;

Subgroup 3: Evacuation starts more than 1 hour after the release begins.

This sorting of source terms is based on the warning time and the release start time associated with a source term and on the site-specific evacuation delay time. By definition, the evacuation delay is the time interval between the time the warning is given and the time the evacuation actually begins. The evacuation delay time for Peach Bottom is 1.5 hr. Additional discussion of evacuation delay time is given in Volume 2, Part 7 of this report on MACCS Input.

Once the source term groups shown in Tables 3.4-2 and 3.4-3 are sorted into subgroups on the basis of evacuation timing, a frequency-weighted mean source term is calculated for each populated subgroup. In the consequence analysis, a full MACCS calculation is performed for the mean source term for each source term subgroup. The mean source terms obtained in this analysis are shown in Table 3.4-4. This table contains frequency-weighted mean source terms for both the source term groups and subgroups. In the table, PB-I and PB-I-J are used to label the mean source terms derived from source term groups and subgroups, respectively, where I designates the source term group and J designates the source term subgroup. It is the source terms for the subgroups, PB-I-J in Table 3.4-4, that are actually used for the risk calculations.

Although not part of the source term definition, Table 3.4-4 also contains the mean frequency for the source term group, the conditional probability of the source term subgroups, and the mean value for the difference between the time at which release starts and the time at which evacuation starts (labeled dEvac in the table). A positive value of dEvac indicates that the evacuation starts before the release and a negative value of dEvac indicates that the evacuation starts after the release. The mean frequency

Table 3.4-3
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Internal Initiators

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 19370:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  | 1010 | 3420 | 2354 | 2657 | 1923 | 2254 | 3873 | 1879 |
      +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  | 3.04 |18.23 |13.50 |29.28 |11.35 | 8.45 |10.61 | 5.54 |
      +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 19370:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |      | 5455 |      | 5865 |      |      | 8050 |      |
      +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |      |25.95 |      |49.04 |      |      |25.01 |      |
      +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |      | PB-17|      | PB-18|      |      | PB-19|      |
      +------+------+------+------+------+------+------+------+
```

Table 3.4-4

Mean Source Terms Resulting from Partitioning for Internal Initiators - Peach Bottom

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB-01	1.7E-07		1.5E+04	1.3E+03	30.	1.8E+07	2.1E+04	4.3E+03	8.9E-01	2.4E-03	2.1E-04	1.1E-04	4.2E-05	1.2E-05	3.5E-06	8.0E-06	4.4E-05
						3.2E+05	2.6E+04	1.4E+04	4.2E-02	7.8E-03	3.7E-04	2.3E-04	3.6E-05	6.5E-06	2.6E-06	3.9E-06	3.2E-05
PB-01-1		0.584	1.3E+04	6.1E+03	30.	3.1E+07	2.4E+04	9.2E+02	8.9E-01	4.0E-03	2.3E-04	9.9E-05	2.7E-05	1.5E-05	4.3E-06	6.5E-06	3.0E-05
						4.3E+05	2.5E+04	1.5E+04	6.2E-02	7.1E-03	4.6E-04	3.0E-04	3.5E-05	2.6E-07	1.2E-06	2.2E-06	2.7E-05
PB-01-2		0.000															
PB-01-3		0.416	1.7E+04	-5.4E+03	30.	2.2E+05	1.7E+04	9.0E+03	8.8E-01	2.3E-04	1.9E-04	1.3E-04	6.2E-05	7.5E-06	2.5E-06	1.0E-05	6.3E-05
						1.7E+05	2.6E+04	1.2E+04	1.4E-02	8.8E-03	2.5E-04	1.2E-04	3.7E-05	1.5E-05	4.7E-06	6.2E-06	3.9E-05
PB-02	1.1E-07		1.3E+04	8.3E+02	30.	7.3E+06	1.9E+04	4.8E+03	9.0E-01	3.9E-02	1.2E-03	7.4E-04	3.6E-04	5.4E-05	1.9E-05	7.5E-05	3.6E-04
						2.0E+05	2.4E+04	1.1E+04	8.8E-02	1.1E-01	1.2E-03	3.2E-04	2.3E-04	6.0E-05	2.2E-05	3.5E-05	2.1E-04
PB-02-1		0.488	8.5E+03	7.4E+03	30.	1.5E+07	2.1E+04	4.3E+02	8.4E-01	7.8E-02	7.2E-04	4.0E-04	1.8E-04	4.7E-05	1.7E-05	6.3E-05	1.8E-04
						3.1E+05	2.2E+04	1.4E+04	1.4E-01	8.7E-02	9.5E-04	4.3E-04	3.7E-04	7.6E-06	2.4E-05	4.9E-05	3.1E-04
PB-02-2		0.000															
PB-02-3		0.512	1.7E+04	-5.4E+03	30.	2.5E+05	1.7E+04	9.0E+03	9.6E-01	1.9E-03	1.7E-03	1.1E-03	5.3E-04	6.0E-05	2.1E-05	8.7E-05	5.3E-04
						1.0E+05	2.6E+04	6.8E+03	3.5E-02	1.3E-01	1.5E-03	2.0E-04	1.1E-04	1.1E-04	2.0E-05	2.0E-05	1.1E-04
PB-03	2.3E-07		1.4E+04	7.9E+02	30.	9.5E+06	2.0E+04	4.8E+03	8.6E-01	1.1E-02	1.4E-03	5.6E-04	2.6E-04	4.1E-05	1.4E-05	2.8E-05	2.2E-04
						3.5E+05	2.5E+04	1.0E+04	8.4E-02	3.3E-02	1.1E-03	5.2E-04	5.4E-04	1.1E-05	2.3E-05	3.9E-05	4.0E-04
PB-03-1		0.509	1.1E+04	6.8E+03	30.	1.9E+07	2.3E+04	6.8E+02	8.8E-01	1.8E-02	1.4E-03	8.0E-04	4.9E-04	7.2E-05	2.7E-05	5.3E-05	4.0E-04
						5.4E+05	2.4E+04	1.5E+04	8.6E-02	2.9E-02	1.1E-03	6.0E-04	7.0E-04	8.7E-06	3.0E-05	5.4E-05	5.3E-04
PB-03-2		0.000															
PB-03-3		0.491	1.7E+04	-5.4E+03	30.	2.4E+05	1.7E+04	9.0E+03	8.3E-01	2.3E-03	1.4E-03	3.1E-04	2.5E-05	9.4E-06	8.3E-07	2.9E-06	3.0E-05
						1.5E+05	2.6E+04	5.2E+03	8.1E-02	3.7E-02	1.1E-03	4.4E-04	3.6E-04	1.4E-05	1.5E-05	2.3E-05	2.7E-04
PB-04	1.2E-07		1.8E+04	3.8E+03	30.	2.7E+07	2.7E+04	2.5E+03	8.4E-01	3.1E-03	9.4E-04	3.7E-04	1.1E-04	6.2E-05	1.7E-05	2.5E-05	1.2E-04
						1.3E+06	2.9E+04	1.3E+04	1.2E-01	1.4E-02	3.2E-03	2.0E-03	8.4E-04	1.3E-05	3.8E-05	7.0E-05	5.8E-04
PB-04-1		0.829	1.8E+04	5.7E+03	30.	3.3E+07	2.9E+04	1.1E+03	9.0E-01	3.7E-03	1.1E-03	4.4E-04	1.3E-04	7.4E-05	2.0E-05	3.0E-05	1.4E-04
						1.5E+06	3.0E+04	1.5E+04	5.3E-02	1.6E-02	2.9E-03	2.1E-03	7.7E-04	2.4E-06	3.7E-05	7.2E-05	5.4E-04
PB-04-2		0.000															
PB-04-3		0.171	1.7E+04	-5.4E+03	30.	6.4E+04	1.7E+04	9.0E+03	5.7E-01	1.8E-04	1.2E-04	3.7E-05	1.5E-06	8.4E-07	6.7E-08	1.9E-07	2.2E-06
						4.5E+03	2.6E+04	7.4E+03	4.3E-01	5.3E-03	4.5E-03	1.8E-03	1.2E-03	6.3E-05	4.3E-05	6.2E-05	7.6E-04
PB-05	1.2E-07		1.6E+04	2.8E+03	30.	1.6E+07	2.4E+04	3.0E+03	6.7E-01	3.7E-02	2.6E-03	1.7E-03	1.1E-03	2.0E-04	8.2E-05	4.2E-04	1.1E-03
						9.7E+05	2.7E+04	1.3E+04	3.3E-01	5.0E-01	4.3E-03	1.8E-03	1.6E-03	1.7E-04	1.3E-04	2.0E-04	1.2E-03
PB-05-1		0.718	1.5E+04	5.9E+03	30.	2.2E+07	2.7E+04	6.5E+02	6.3E-01	5.0E-02	2.3E-03	1.3E-03	9.1E-04	2.1E-04	9.0E-05	4.8E-04	8.7E-04
						1.1E+06	2.7E+04	1.4E+04	3.7E-01	5.3E-01	5.0E-03	1.8E-03	1.9E-03	7.6E-07	1.1E-04	1.9E-04	1.5E-03
PB-05-2		0.000															
PB-05-3		0.282	1.7E+04	-5.4E+03	30.	9.8E+05	1.7E+04	9.0E+03	7.8E-01	3.3E-03	3.3E-03	2.7E-03	1.5E-03	1.8E-04	6.2E-05	2.6E-04	1.5E-03
						5.4E+05	2.6E+04	1.0E+04	2.2E-01	4.2E-01	2.4E-03	1.8E-03	9.0E-04	5.9E-04	1.7E-04	2.4E-04	7.0E-04

Table 3.4-4 (Continued)
Mean Source Terms Resulting from Partitioning for Internal Initiators - Peach Bottom

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB-06	1.5E-07		1.1E+04	3.0E+03	30.	1.7E+07	2.0E+04	2.0E+03	8.0E-01	1.3E-02	3.1E-03	1.8E-03	1.0E-03	2.5E-04	9.6E-05	2.5E-04	1.0E-03
						6.1E+05	2.2E+04	1.4E+04	1.9E-01	1.1E-01	8.6E-03	4.8E-03	5.4E-03	2.5E-05	2.3E-04	4.2E-04	3.9E-03
PB-06-1		0.838	1.0E+04	4.6E+03	30.	2.0E+07	2.0E+04	7.0E+02	8.5E-01	1.5E-02	3.2E-03	1.9E-03	1.1E-03	2.9E-04	1.1E-04	3.0E-04	1 2E-03
						6.6E+05	2.1E+04	1.5E+04	1.5E-01	1.0E-01	8.1E-03	4.8E-03	5.4E-03	4.7E-06	2.4E-04	4.5E-04	3.9E-03
PB-06-2		0.000															
PB-06-3		0.162	1.7E+04	-5.4E+03	30.	7.3E+05	1.7E+04	9.0E+03	5.5E-01	4.0E-03	2.3E-03	1.3E-03	2.1E-04	5.1E-05	8.9E-06	3.3E-05	2.3E-04
						3.7E+05	2.6E+04	1.1E+04	4.4E-01	1.4E-01	1.1E-02	5.2E-03	5.1E-03	1.3E-04	1.8E-04	2.8E-04	3.5E-03
PB-07	4.7E-07		2.2E+04	2.8E+03	30.	7.4E+06	3.0E+04	3.5E+03	7.8E-01	2.8E-03	1.7E-03	5.9E-04	2.4E-04	1.1E-04	3.1E-05	4.7E-05	2.5E-04
						1.2E+06	3.4E+04	1.2E+04	2.1E-01	9.4E-02	1.5E-02	6.0E-03	3.4E-03	2.4E-05	1.1E-04	2.2E-04	2.3E-03
PB-07-1		0.689	2.4E+04	6.5E+03	30.	1.1E+07	3.6E+04	9.8E+02	7.8E-01	3.0E-03	1.8E-03	6.5E-04	3.2E-04	1.5E-04	4.4E-05	6.3E-05	3.3E-04
						1.7E+06	3.7E+04	1.5E+04	2.0E-01	1.1E-01	1.7E-02	5.5E-03	1.9E-03	2.4E-05	8.6E-05	1.7E-04	1.6E-03
PB-07-2		0.000															
PB-07-3		0.311	1.7E+04	-5.4E+03	30.	7.7E+04	1.7E+04	9.0E+03	7.6E-01	2.3E-03	1.6E-03	4.5E-04	6.2E-05	1.7E-05	2.6E-06	1.0E-05	7.0E-05
						4.3E+04	2.6E+04	6.8E+03	2.4E-01	5.6E-02	1.1E-02	7.0E-03	6.7E-03	2.5E-05	1.7E-04	3.3E-04	3.9E-03
PB-08	8.3E-08		2.5E+04	6.1E+03	30.	1.0E+07	3.7E+04	2.3E+03	8.0E-01	3.1E-03	2.7E-03	1.3E-03	4.8E-04	1.2E-04	5.5E-05	1.0E-04	5.0E-04
						1.5E+06	3.9E+04	1.5E+04	1.7E-01	2.5E-02	1.7E-02	4.7E-03	3.7E-03	1.5E-04	2.1E-04	3.8E-04	2.8E-03
PB-08-1		0.909	2.6E+04	7.2E+03	30.	1.1E+07	3.9E+04	1.6E+03	8.5E-01	3.3E-03	3.0E-03	1.4E-03	5.3E-04	1.3E-04	6.1E-05	1.1E-04	5.5E-04
						1.6E+06	4.0E+04	1.5E+04	1.3E-01	2.6E-02	1.7E-02	5.0E-03	4.0E-03	1.6E-04	2.3E-04	4.2E-04	3.0E-03
PB-08-2		0.000															
PB-08-3		0.091	1.7E+04	-5.4E+03	30.	7.1E+04	1.7E+04	9.0E+03	3.2E-01	1.0E-03	5.9E-04	1.8E-04	4.9E-06	6.7E-07	6.1E-08	1.0E-07	1.1E-05
						2.5E+04	2.6E+04	1.1E+04	6.3E-01	1.6E-02	1.3E-02	2.1E-03	2.8E-04	1.2E-05	1.1E-05	1.5E-05	2.7E-04
PB-09	9.2E-08		1.5E+04	2.9E+03	30.	2.4E+07	2.4E+04	2.1E+03	7.8E-01	9.5E-03	7.6E-03	3.9E-03	1.5E-03	3.9E-04	1.3E-04	5.2E-04	1.5E-03
						1.2E+06	2.6E+04	1.4E+04	2.2E-01	3.6E-01	3.0E-02	2.8E-02	4.2E-02	8.0E-04	3.4E-03	6.0E-03	3.3E-02
PB-09-1		0.826	1.5E+04	4.6E+03	30.	2.9E+07	2.5E+04	7.0E+02	8.8E-01	1.1E-02	8.9E-03	4.6E-03	1.8E-03	4.7E-04	1.5E-04	6.1E-04	1.8E-03
						1.3E+06	2.6E+04	1.4E+04	1.2E-01	3.0E-01	2.9E-02	2.9E-02	4.5E-02	9.1E-04	3.7E-03	6.5E-03	3.6E-02
PB-09-2		0.000															
PB-09-3		0.174	1.7E+04	-5.4E+03	30.	1.4E+06	1.7E+04	9.0E+03	3.0E-01	1.8E-03	1.1E-03	5.2E-04	1.8E-04	3.0E-05	1.6E-05	9.5E-05	1.9E-04
						7.3E+05	2.6E+04	1.2E+04	7.0E-01	6.0E-01	3.3E-02	2.3E-02	2.5E-02	2.8E-04	2 0E-03	3.3E-03	2.1E-02
PB-10	1.8E-07		1.6E+04	4.6E+03	30.	2.6E+07	2.6E+04	1.2E+03	7.7E-01	1.2E-02	9.7E-03	6.9E-03	3.8E-03	5.1E-04	2.9E-04	1.0E-03	3.3E-03
						1.5E+06	2.7E+04	1.4E+04	2.3E-01	1.1E-01	4.2E-02	2.0E-02	1.9E-02	7.6E-05	1.3E-03	2.2E-03	1.5E-02
PB-10-1		0.946	1.6E+04	5.1E+03	30.	2.8E+07	2.6E+04	7.6E+02	7.7E-01	1.3E-02	1.0E-02	7.2E-03	4.0E-03	5.3E-04	3.0E-04	1.1E-03	3.5E-03
						1.4E+06	2.7E+04	1.4E+04	2.2E-01	1.1E-01	4.2E-02	2.0E-02	2.0E-02	5.3E-05	1.3E-03	2.2E-03	1.5E-02
PB-10-2		0.000															
PB-10-3		0.054	1.7E+04	-5.4E+03	30.	3.0E+06	1.7E+04	9.0E+03	6.8E-01	4.4E-03	2.5E-03	1.4E-03	1.4E-04	4.7E-05	7.1E-06	2.8E-05	1.6E-04
						2.6E+06	2.6E+04	1.0E+04	3.2E-01	1.0E-01	3.9E-02	1.5E-02	1.2E-02	4.8E-04	1 1E-03	1.9E-03	1.0E-02

Table 3.4-4 (Continued)
Mean Source Terms Resulting from Partitioning for Internal Initiators - Peach Bottom

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB-11	2.0E-07		2.1E+04	4.7E+03	30.	3.9E+07	3.1E+04	1.2E+03	7.3E-01	4.0E-03	3.5E-03	1.3E-03	4.4E-04	2.5E-04	7.4E-05	1.6E-04	4.9E-04
						2.1E+06	3.2E+04	1.4E+04	2.6E-01	4.6E-02	4.0E-02	1.6E-02	6.9E-03	1.8E-05	4.1E-04	7.5E-04	4.5E-03
PB-11-1		0.974	2.1E+04	5.0E+03	30.	4.0E+07	3.1E+04	9.4E+02	7.3E-01	4.1E-03	3.6E-03	1.3E-03	4.5E-04	2.5E-04	7.6E-05	1.7E-04	5.0E-04
						2.1E+06	3.2E+04	1.4E+04	2.6E-01	4.6E-02	4.0E-02	1.7E-02	7.1E-03	1.7E-05	4.2E-04	7.7E-04	4.6E-03
PB-11-2		0.000															
PB-11-3		0.026	1.7E+04	-5.4E+03	30.	4.0E+06	1.7E+04	9.0E+03	6.9E-01	1.7E-03	1.2E-03	5.8E-04	1.3E-04	2.2E-05	5.3E-06	2.1E-05	1.4E-04
						2.0E+06	2.6E+04	1.3E+04	3.0E-01	4.1E-02	3.7E-02	1.1E-02	1.4E-03	7.1E-05	5.0E-05	7.2E-05	8 7E-04
PB-12	5.7E-08		1.7E+04	4.7E+03	30.	3.2E+07	2.7E+04	1.2E+03	6.9E-01	1.0E-02	9.8E-03	8.0E-03	6.2E-03	4.0E-03	1.0E-03	1.6E-03	6.2E-03
						1.9E+06	2.8E+04	1.5E+04	3.1E-01	3.6E-01	3.7E-01	1.6E-01	1.3E-01	1.4E-03	1.1E-02	2.0E-02	1.0E-01
PB-12-1		0.988	1.7E+04	4.8E+03	30.	3.2E+07	2.7E+04	1.1E+03	6.9E-01	1.0E-02	9.7E-03	8.0E-03	6.3E-03	4.0E-03	1.0E-03	1.7E-03	6.3E-03
						1.8E+06	2.8E+04	1.5E+04	3.1E-01	3.6E-01	3.7E-01	1.6E-01	1.3E-01	1.4E-03	1.1E-02	2.0E-02	9.9E-02
PB-12-2		0.000															
PB-12-3		0.012	1.7E+04	-5.4E+03	30.	5.4E+06	1.7E+04	9.0E+03	5.2E-01	2.5E-02	1.7E-02	9.4E-03	1.3E-03	3.4E-04	8.4E-05	3.8E-04	1.6E-03
						2.1E+06	2.6E+04	1.4E+04	4.8E-01	2.7E-01	2.2E-01	1.9E-01	2.2E-01	4.7E-03	2.4E-02	4.0E-02	1.9E-01
PB-13	2.6E-07		1.8E+04	4.5E+03	30.	2.6E+07	2.7E+04	1.3E+03	6.8E-01	1.4E-02	1.3E-02	7.8E-03	3.7E-03	1.4E-03	4.4E-04	1.0E-03	3.6E-03
						1.7E+06	2.9E+04	1.4E+04	3.2E-01	2.2E-01	2.0E-01	1.0E-01	8.9E-02	4.7E-04	5.7E-03	1.0E-02	6.3E-02
PB-13-1		0.943	1.8E+04	5.1E+03	30.	2.8E+07	2.8E+04	8.0E+02	6.9E-01	1.5E-02	1.4E-02	8.1E-03	3.9E-03	1.4E-03	4.7E-04	1.1E-03	3.7E-03
						1.6E+06	2.9E+04	1.4E+04	3.1E-01	2.2E-01	2.0E-01	1.0E-01	8.9E-02	4.9E-04	5.9E-03	1.1E-02	6.4E-02
PB-13-2		0.000															
PB-13-3		0.057	1.7E+04	-5.4E+03	30.	5.2E+06	1.7E+04	9.0E+03	5.4E-01	6.2E-03	4.7E-03	2.3E-03	7.9E-04	1.1E-04	3.3E-05	1.3E-04	8.1E-04
						3.0E+06	2.6E+04	1.2E+04	4.6E-01	2.3E-01	2.0E-01	9.1E-02	8.1E-02	1.5E-04	2.6E-03	5.0E-03	5.3E-02
PB-14	6.1E-07		2.7E+04	6.8E+03	30.	1.2E+07	3.9E+04	1.0E+03	7.3E-01	2.7E-03	2.8E-03	1.5E-03	9.2E-04	8.5E-04	1.2E-04	1.2E-04	1.1E-03
						2.0E+06	4.0E+04	1.4E+04	2.7E-01	1.1E-01	1.3E-01	5.6E-02	1.5E-02	5.2E-07	2.9E-04	5.4E-04	1.1E-02
PB-14-1		0.990	2.7E+04	6.9E+03	30.	1.2E+07	4.0E+04	9.5E+02	7.3E-01	2.7E-03	2.8E-03	1.6E-03	9.3E-04	8.6E-04	1.2E-04	1.2E-04	1.1E-03
						1.9E+06	4.1E+04	1.4E+04	2.7E-01	1.1E-01	1.3E-01	5.6E-02	1.4E-02	2.0E-07	2.8E-04	5.3E-04	1.1E-02
PB-14-2		0.000															
PB-14-3		0.010	1.7E+04	-5.4E+03	30.	6.0E+06	1.7E+04	9.0E+03	5.7E-01	2.0E-03	1.4E-03	3.3E-04	1.2E-05	7.4E-06	1.9E-07	2.7E-07	1.8E-05
						6.7E+06	2.6E+04	7.1E+03	4.3E-01	1.3E-01	1.2E-01	5.0E-02	4.1E-02	3.1E-05	9.1E-04	1.8E-03	2.2E-02
PB-15	2.1E-09		1.5E+04	3.2E+03	30.	1.2E+07	2.3E+04	2.8E+03	5.6E-01	9.8E-03	1.0E-02	1.6E-02	2.1E-02	2.9E-03	2.2E-03	5.0E-03	2.1E-02
						2.3E+06	2.6E+04	1.3E+04	4.4E-01	5.0E-01	5.4E-01	5.9E-01	6.8E-01	9.4E-03	6.4E-02	1.1E-01	6.0E-01
PB-15-1		0.752	1.4E+04	6.0E+03	30.	1.4E+07	2.5E+04	7.0E+02	6.6E-01	8.5E-03	9.4E-03	1.9E-02	2.6E-02	3.5E-03	2.8E-03	5.4E-03	2.6E-02
						1.5E+06	2.6E+04	1.4E+04	3.4E-01	4.9E-01	5.4E-01	6.1E-01	7.2E-01	9.3E-03	6.2E-02	1.2E-01	6.2E-01
PB-15-2		0.000															
PB-15-3		0.248	1.7E+04	-5.4E+03	30.	6.4E+06	1.7E+04	9.0E+03	2.4E-01	1.4E-02	1.2E-02	8.5E-03	5.2E-03	1.1E-03	4.7E-04	3.6E-03	5.2E-03
						4.7E+06	2.6E+04	1.1E+04	7.6E-01	5.4E-01	5.2E-01	5.4E-01	5.7E-01	9.7E-03	7.0E-02	1.1E-01	5.4E-01

Table 3.4-4 (Concluded)
Mean Source Terms Resulting from Partitioning for Internal Initiators - Peach Bottom

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB-16	4.5E-08		2.0E+04	5.5E+03	30.	1.4E+07	3.1E+04	1.9E+03	5.0E-01	1.2E-02	1.2E-02	1.0E-02	8.9E-03	1.1E-03	8.0E-04	1.5E-03	7.7E-03
						1.8E+06	3.3E+04	1.5E+04	5.0E-01	5.1E-01	5.2E-01	3.2E-01	3.0E-01	1.7E-03	2.0E-02	3.8E-02	2.4E-01
PB-16-1		0.957	2.0E+04	6.0E+03	30.	1.4E+07	3.2E+04	1.6E+03	5.1E-01	1.2E-02	1.2E-02	1.0E-02	9.3E-03	1.1E-03	8.4E-04	1.5E-03	8.0E-03
						1.7E+06	3.3E+04	1.5E+04	4.9E-01	5.1E-01	5.2E-01	3.2E-01	3.0E-01	1.6E-03	2.0E-02	3.9E-02	2.4E-01
PB-16-2		0.000															
PB-16-3		0.043	1.7E+04	-5.4E+03	30.	6.4E+06	1.7E+04	9.0E+03	3.1E-01	1.0E-02	8.2E-03	4.4E-03	1.4E-03	2.2E-04	6.1E-05	2.4E-04	1.5E-03
						3.1E+06	2.6E+04	1.3E+04	6.9E-01	4.5E-01	4.6E-01	2.9E-01	2.8E-01	4.1E-03	1.4E-02	2.8E-02	2.0E-01
PB-17	3.7E-07		8.9E+03	1.3E+04	30.	2.6E+05	2.7E+04	9.0E+03	2.0E-03	1.6E-06	2.9E-09	1.3E-09	1.1E-09	1.0E-10	5.0E-11	8.5E-11	8.2E-10
						1.4E+05	3.6E+04	2.2E+04	2.0E-03	1.6E-06	2.9E-09	1.3E-09	1.1E-09	1.0E-10	5.0E-11	8.5E-11	8.2E-10
PB-17-1		1.000	8.9E+03	1.3E+04	30.	2.6E+05	2.7E+04	9.0E+03	2.0E-03	1.6E-06	2.9E-09	1.3E-09	1.1E-09	1.0E-10	5.0E-11	8.5E-11	8.2E-10
						1.4E+05	3.6E+04	2.2E+04	2.0E-03	1.6E-06	2.9E-09	1.3E-09	1.1E-09	1.0E-10	5.0E-11	8.5E-11	8.2E-10
PB-17-2		0.000															
PB-17-3		0.000															
PB-18	6.9E-07		9.9E+03	1.3E+04	30.	2.8E+05	2.8E+04	8.5E+03	7.8E-02	2.5E-04	3.3E-07	1.3E-06	1.7E-07	1.7E-07	4.1E-08	4.2E-08	2.0E-07
						1.4E+05	3.7E+04	2.1E+04	3.0E-02	2.4E-04	4.7E-08	1.0E-06	8.3E-08	6.8E-08	1.7E-08	1.7E-08	8.8E-08
PB-18-1		1.000	9.9E+03	1.3E+04	30.	2.8E+05	2.8E+04	8.5E+03	7.8E-02	2.5E-04	3.3E-07	1.3E-06	1.7E-07	1.7E-07	4.1E-08	4.2E-08	2.0E-07
						1.4E+05	3.7E+04	2.1E+04	3.0E-02	2.4E-04	4.7E-08	1.0E-06	8.3E-08	6.8E-08	1.7E-08	1.7E-08	8.8E-08
PB-18-2		0.000															
PB-18-3		0.000															
PB-19	3.5E-07		2.5E+04	7.7E+03	30.	6.9E+06	3.8E+04	2.4E+03	6.8E-01	1.8E-03	1.1E-03	5.2E-04	1.6E-04	7.1E-05	1.8E-05	2.7E-05	1.6E-04
						9.5E+05	4.1E+04	1.5E+04	7.4E-02	4.5E-03	1.4E-03	5.2E-04	1.9E-04	5.3E-06	9.5E-06	1.7E-05	1.5E-04
PB-19-1		0.930	2.6E+04	8.6E+03	30.	7.5E+06	4.0E+04	1.9E+03	7.1E-01	2.0E-03	1.2E-03	5.5E-04	1.7E-04	7.7E-05	2.0E-05	2.9E-05	1.7E-04
						1.0E+06	4.2E+04	1.5E+04	7.8E-02	4.5E-03	1.5E-03	5.5E-04	2.0E-04	5.2E-06	1.0E-05	1.8E-05	1.6E-04
PB-19-2		0.000															
PB-19-3		0.070	1.7E+04	-5.4E+03	30.	0.0E+00	1.7E+04	9.0E+03	2.6E-01	3.4E-04	1.6E-04	9.4E-05	1.6E-06	2.2E-07	3.5E-08	3.9E-08	3.3E-06
						0.0E+00	2.6E+04	1.3E+04	1.1E-02	5.3E-03	6.7E-04	2.4E-04	7.0E-06	7.6E-06	2.4E-06	2.4E-06	1.7E-05

for a source term group is obtained by summing the frequencies of all source terms assigned to the group and then dividing by the sample size (200 in this analysis). The conditional probability of a subgroup is obtained by summing the frequencies of all source terms assigned to the subgroup and then dividing the resultant sum by the total frequency of all source terms in the associated source term group. Some source term subgroups are unpopulated; a mean source term does not appear for these subgroups in Table 3.4-4. To calculate the frequency-weighted mean source terms appearing in Table 3.4-4, each source term is weighted by the ratio between its frequency and the total frequency associated with the particular source term group or subgroup under consideration.

The highest release fractions are associated with group PB-15, as would be expected from Figure 3.4-1 and Table 3.4-2. The dominant accidents in this group are very long-term station blackouts and ATWS CV sequences associated with PDSs 5 and 8, the dominant PDSs. The characteristics of these bins are that vessel breach occurs at high pressure with no injection before or after, containment fails at VB by drywell rupture or meltthrough, a low DCH event occurs, and the CCI is dry. The frequency for this group, however, is fairly low; relatively few source terms fall in the grid represented by group PB-15, and they are not exceptionally frequent. The most likely source term groups are PB-18, PB-14, PB-07, and PB-17. Of these four groups, both PB-14 and PB-07 have the potential to cause early fatalities, however, the early health effect weights associated with these groups is relatively low.

3.4.2 Sensitivity Analysis for Internal Initiators

The drywell shell meltthrough sensitivity was the only internal event initiator sensitivity performed and the sensitivity analysis was not carried past the APET.

3.4.3 Results for Fire Initiators

This section presents the results of partitioning the source terms for fire initiators. The partitioning process, which is described in Section 3.4.1, does not result in the loss of any source terms; rather, cells with a small number of source terms or a small frequency are pooled with other cells. The accident progression analysis and the subsequent source term analysis for fire initiated accidents resulted in the generation of 16,973 source terms. Table 3.4-5 shows the number of these source terms with EH>0 and CH>0 and the number with EH=0 and CH>0.

Figure 3.4-2 shows a plot of the pairs (CH, EH) for the 12,434 source terms for which both EH and CH are nonzero. A summary of the partitioning process for EH>0 and CH>0 is given in Table 3.4-6. A summary of the partitioning process for the 4,539 source terms for which EH=0 and CH>0 is given in Table 3.4-7.

The 22 groups of source terms that result from partitioning are further subdivided on the basis of evacuation timing into three subgroups as for

Table 3.4-5
Summary of Early and Chronic Health Effect Weights
for Fire Initiators

	Number of Source Terms	Percent of Total Frequency
EF>0 AND CF>0	12434	68.28
EF=0 AND CF>0	4539	31.72
EF=0 AND CF=0	0	0.00
TOTAL	16973	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = 0.0203 TO 5.1951
RANGE LOG10(EH) = -0.6377 TO 2.5104

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -3.7519 TO 3.5647

Table 3.4-6
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Fire Initiators

---

BEFORE PARTITIONING:

```
 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 12434:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      |  199 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |    2 |  112 |   48 |  207 |  745 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |  279 |  428 |  501 | 1174 |  256 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |   13 |  342 |  651 |  985 |  899 |  497 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |   33 |  108 |  376 |  821 | 1112 |  594 |  492 |   25 |      |
     +------+------+------+------+------+------+------+------+------+
  6  |   65 |  195 |  296 |  380 |  249 |  251 |   99 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

```
 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 0.89 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      | 0.00 | 0.30 | 0.08 | 0.93 |12.19 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      | 0.62 | 2.29 | 2.01 |14.31 | 2.31 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      | 0.01 | 0.91 | 1.34 | 2.36 |10.08 |10.28 |      |
     +------+------+------+------+------+------+------+------+------+
  5  | 0.13 | 0.06 | 0.53 | 1.03 | 4.13 | 2.01 |21.58 | 1.90 |      |
     +------+------+------+------+------+------+------+------+------+
  6  | 0.02 | 0.13 | 0.19 | 0.51 | 0.94 | 4.40 | 1.52 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

Table 3.4-6 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Fire Initiators

---

```
AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 12434:

          1      2      3      4      5      6      7      8      9
       +------+------+------+------+------+------+------+------+------+
    1  |      |      |      |      |      |      |      |      |      |
       +------+------+------+------+------+------+------+------+------+
    2  |      |      |      |      |      |      |      |      | 1032 |
       +------+------+------+------+------+------+------+------+------+
    3  |      |      |      |      |      |  691 |  543 | 1244 |  304 |
       +------+------+------+------+------+------+------+------+------+
    4  |      |      |      |      |  971 |  998 |  899 |  497 |      |
       +------+------+------+------+------+------+------+------+------+
    5  |      |      | 1050 | 1327 | 1112 |  594 |  492 |   25 |      |
       +------+------+------+------+------+------+------+------+------+
    6  |      |      |      |      |  305 |  251 |   99 |      |      |
       +------+------+------+------+------+------+------+------+------+


 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8      9
       +------+------+------+------+------+------+------+------+------+
    1  |      |      |      |      |      |      |      |      |      |
       +------+------+------+------+------+------+------+------+------+
    2  |      |      |      |      |      |      |      |      |13.30 |
       +------+------+------+------+------+------+------+------+------+
    3  |      |      |      |      |      | 3.01 | 2.09 |14.50 | 2.83 |
       +------+------+------+------+------+------+------+------+------+
    4  |      |      |      |      | 2.20 | 2.36 |10.08 |10.28 |      |
       +------+------+------+------+------+------+------+------+------+
    5  |      |      | 1.06 | 1.73 | 4.13 | 2.01 |21.58 | 1.90 |      |
       +------+------+------+------+------+------+------+------+------+
    6  |      |      |      |      | 1.02 | 4.40 | 1.52 |      |      |
       +------+------+------+------+------+------+------+------+------+
```

Table 3.4-6 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Fire Initiators

---

LABELING AFTER PARTITIONING:

```
        1      2      3      4      5      6      7      8      9
    +------+------+------+------+------+------+------+------+------+
  1 |      |      |      |      |      |      |      |      |      |
    +------+------+------+------+------+------+------+------+------+
  2 |      |      |      |      |      |      |      |      |PBF-17|
    +------+------+------+------+------+------+------+------+------+
  3 |      |      |      |      |      |PBF-06|PBF-10|PBF-14|PBF-18|
    +------+------+------+------+------+------+------+------+------+
  4 |      |      |      |      |PBF-03|PBF-07|PBF-11|PBF-15|      |
    +------+------+------+------+------+------+------+------+------+
  5 |      |      |PBF-01|PBF-02|PBF-04|PBF-08|PBF-12|PBF-16|      |
    +------+------+------+------+------+------+------+------+------+
  6 |      |      |      |      |PBF-05|PBF-09|PBF-13|      |      |
    +------+------+------+------+------+------+------+------+------+
```

Table 3.4-7

Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Fire Initiators

---

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  4539:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |  375 | 1377 |  860 |  820 |  348 |  149 |  354 |  256 |
      +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  | 6.61 |14.21 |13.08 |17.16 | 9.60 | 6.85 |12.01 |20.47 |
      +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  4539:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |      | 2283 |      | 1562 |      |      |      |  694 |
      +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |      |26.18 |      |35.14 |      |      |      |38.68 |
      +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
   1  |      |PBF-19|      |PBF-20|      |      |      |PBF-21|
      +------+------+------+------+------+------+------+------+
```

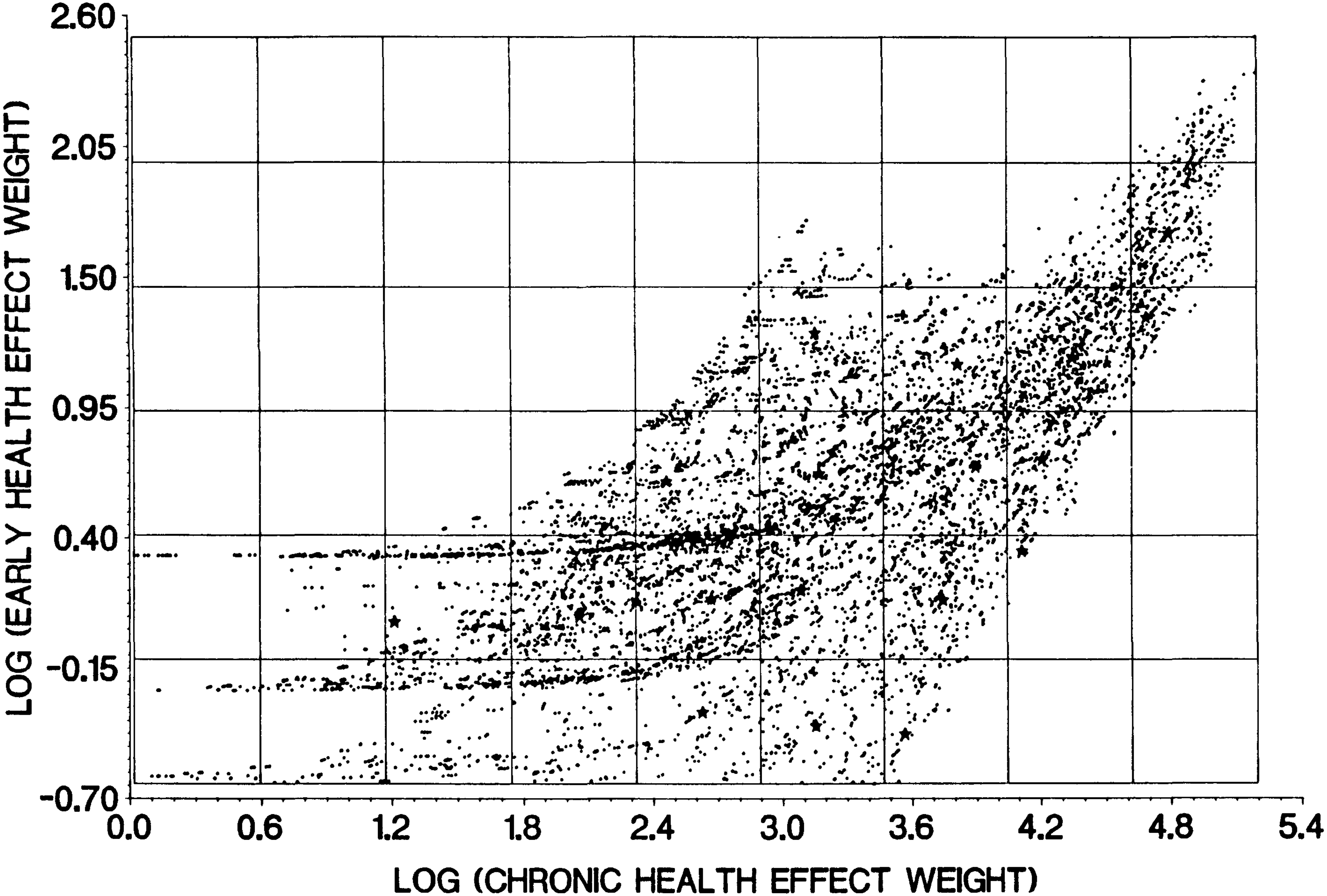

Figure 3.4-2. Distribution of Nonzero Early and Chronic Health Effect Weights for Fire Initiators

internal initiators. Frequency-weighted mean source terms are calculated for each populated subgroup. The mean source terms obtained in this analysis are shown in Table 3.4-8. This table contains frequency-weighted mean source terms for both the source term groups and subgroups. In the table PBF-I and PBF-I-J are used to label the mean source term groups and subgroups, respectively, where I designates the source term group and J designates the source term subgroup. It is the source term subgroups, PBF-I-J in Table 3.4-8, that are actually used for the risk calculations. Table 3.4-8 is analogous to Table 3.4-4 for internal initiators.

The highest release fractions are associated with group PBF-17, as would be expected from Figure 3.4-2 and Table 3.4-6. The dominant accidents in this group are long-term station blackouts that have early containment failures. The frequency for this group, however, is fairly high compared to the results for the internal initiators; the characteristics of the fire sequences allow for smaller variation of accident progression outcomes and the relative seriousness of the accidents is increased by the inability to recover AC power. The most likely source term groups are PBF-12, PBF-21, PBF-20, and PBF-14. Of these four groups, both PBF-12 and PBF-14 have the potential to cause early fatalities, however, while the early health effect weight associated with group PBF-12 is relatively low, the weight associated with PBF-14 is high.

3.4.4 Sensitivity Analysis for Fire Initiators

The drywell shell meltthrough sensitivity was the only fire initiator sensitivity performed and the sensitivity analysis was not carried past the APET.

3.4.5 Results for Seismic Initiators: LLNL Hazard Curve

This section presents the results of partitioning the source terms for seismic initiators based on the LLNL hazard distributions. The partitioning process is described in Section 3.4.1. The partitioning process does not result in the loss of any source terms; rather, cells with a small number of source terms or a small frequency are pooled with other cells. Because of the differences in the evacuation of the surrounding population for large earthquakes, the consequence analysis was performed separately for seisms with PGA less than 0.6 g and greater than 0.6 g. Thus partitioning of the high acceleration and low acceleration earthquakes was performed separately.

As mentioned before, for Peach Bottom the accident progression analysis and source term analysis did not need to be performed separately because no variables were sampled differently for the two seismic levels. This is different than for the Surry plant where, because of grouping of the PDSs into PDSGs, the split fractions were different for the high and low PGA cases. No split fractions for Peach Bottom depended upon the seismic PGA level. The only difference in the two cases for Peach Bottom is the

Table 3.4-8

Mean Source Terms Resulting from Partitioning for Fire Initiators - Peach Bottom

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBF-01	1.4E-07		4.0E+03	8.8E+03	30.	1.1E+07	1.8E+04	2.7E+02	8.8E-01	7.9E-03	7.6E-05	5.2E-05	2.8E-05	7.1E-06	2.2E-06	3.7E-06	2.5E-05
						1.0E+05	1.8E+04	1.5E+04	6.7E-02	2.0E-03	1.9E-05	7.3E-06	2.8E-06	1.2E-07	1.3E-07	2.6E-07	2.4E-06
PBF-01-1		1.000	4.0E+03	8.8E+03	30.	1.1E+07	1.8E+04	2.7E+02	8.8E-01	7.9E-03	7.6E-05	5.2E-05	2.8E-05	7.1E-06	2.2E-06	3.7E-06	2.5E-05
						1.0E+05	1.8E+04	1.5E+04	6.7E-02	2.0E-03	1.9E-05	7.3E-06	2.8E-06	1.2E-07	1.3E-07	2.6E-07	2.4E-06
PBF-01-2		0.000															
PBF-01-3		0.000															
PBF-02	2.3E-07		7.5E+03	8.4E+03	30.	7.3E+06	2.1E+04	1.4E+03	8.6E-01	1.4E-02	6.2E-04	2.5E-04	1.2E-04	1.1E-05	7.8E-06	1.4E-05	9.9E-05
						2.6E+05	2.3E+04	1.6E+04	7.8E-02	1.7E-02	1.2E-04	4.8E-05	3.4E-05	2.2E-07	1.4E-06	2.5E-06	2.6E-05
PBF-02-1		1.000	7.5E+03	8.4E+03	30.	7.3E+06	2.1E+04	1.4E+03	8.6E-01	1.4E-02	6.2E-04	2.5E-04	1.2E-04	1.1E-05	7.8E-06	1.4E-05	9.9E-05
						2.6E+05	2.3E+04	1.6E+04	7.8E-02	1.7E-02	1.2E-04	4.8E-05	3.4E-05	2.2E-07	1.4E-06	2.5E-06	2.6E-05
PBF-02-2		0.000															
PBF-02-3		0.000															
PBF-03	3.0E-07		5.1E+03	7.3E+03	30.	1.2E+07	1.8E+04	3.0E+02	8.9E-01	5.9E-02	1.1E-03	1.1E-03	4.0E-04	6.7E-05	3.1E-05	7.4E-05	3.8E-04
						2.3E+05	1.8E+04	1.4E+04	1.1E-01	4.3E-02	7.3E-04	3.8E-04	2.0E-04	4.9E-06	1.1E-05	2.1E-05	1.6E-04
PBF-03-1		1.000	5.1E+03	7.3E+03	30.	1.2E+07	1.8E+04	3.0E+02	8.9E-01	5.9E-02	1.1E-03	1.1E-03	4.0E-04	6.7E-05	3.1E-05	7.4E-05	3.8E-04
						2.3E+05	1.8E+04	1.4E+04	1.1E-01	4.3E-02	7.3E-04	3.8E-04	2.0E-04	4.9E-06	1.1E-05	2.1E-05	1.6E-04
PBF-03-2		0.000															
PBF-03-3		0.000															
PBF-04	5.6E-07		1.8E+04	8.3E+03	30.	5.9E+06	3.1E+04	3.9E+03	9.2E-01	1.3E-02	1.5E-03	1.1E-03	7.1E-04	9.3E-05	3.9E-05	7.1E-05	5.7E-04
						9.0E+05	3.5E+04	1.7E+04	5.1E-02	7.4E-02	1.2E-03	9.1E-04	1.7E-03	2.6E-06	8.5E-05	1.3E-04	1.1E-03
PBF-04-1		1.000	1.8E+04	8.3E+03	30.	5.9E+06	3.1E+04	3.9E+03	9.2E-01	1.3E-02	1.5E-03	1.1E-03	7.1E-04	9.3E-05	3.9E-05	7.1E-05	5.7E-04
						9.0E+05	3.5E+04	1.7E+04	5.1E-02	7.4E-02	1.2E-03	9.1E-04	1.7E-03	2.6E-06	8.5E-05	1.3E-04	1.1E-03
PBF-04-2		0.000															
PBF-04-3		0.000															
PBF-05	1.4E-07		1.7E+04	8.4E+03	30.	6.7E+06	3.1E+04	2.0E+03	8.4E-01	6.4E-03	8.3E-04	4.6E-04	2.8E-04	7.4E-05	3.1E-05	5.0E-05	2.5E-04
						1.4E+06	3.3E+04	1.6E+04	1.1E-01	2.2E-02	2.8E-03	1.5E-03	8.9E-04	1.2E-05	8.3E-05	1.4E-04	7.1E-04
PBF-05-1		1.000	1.7E+04	8.4E+03	30.	6.7E+06	3.1E+04	2.0E+03	8.4E-01	6.4E-03	8.3E-04	4.6E-04	2.8E-04	7.4E-05	3.1E-05	5.0E-05	2.5E-04
						1.4E+06	3.3E+04	1.6E+04	1.1E-01	2.2E-02	2.8E-03	1.5E-03	8.9E-04	1.2E-05	8.3E-05	1.4E-04	7.1E-04
PBF-05-2		0.000															
PBF-05-3		0.000															

Table 3 4-8 (Continued)
Mean Source Terms Resulting from Partitioning for Fire Initiators - Peach Bottom

Source Term	Freq (1/yr)	Cond Prob	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBF-06	4 1E-07		1 4E+04	6 4E+03	30	1 0E+07	2 6E+04	5 4E+02	7 2E-01	4 8E-02	2 2E-03	1 4E-03	1 0E-03	2 6E-04	1 1E-04	7 6E-04	1 0E-03
						8 8E+05	2 6E+04	1 4E+04	2 8E-01	5 0E-01	5 3E-03	1 3E-03	6 3E-04	1 1E-06	4 8E-05	3 9E-05	4 7E-04
PBF-06-1		1 000	1 4E+04	6 4E+03	30	1 0E+07	2 6E+04	5 4E+02	7 2E-01	4 8E-02	2 2E-03	1 4E-03	1 0E-03	2 6E-04	1 1E-04	7 6E-04	1 0E-03
						8 8E+05	2 6E+04	1 4E+04	2 8E-01	5 0E-01	5 3E-03	1 3E-03	6 3E-04	1 1E-06	4 8E-05	3 9E-05	4 7E-04
PBF-06-2		0 000															
PBF-06-3		0 000															
PBF-07	3 2E-07		6 3E+03	5 1E+03	30	1 1E+07	1 7E+04	5 8E+02	8 4E-01	1 5E-02	3 6E-03	2 0E-03	1 4E-03	2 8E-04	1 3E-04	3 4E-04	1 3E-03
						3 0E+05	1 7E+04	1 5E+04	1 5E-01	7 8E-02	9 1E-03	4 1E-03	2 0E-03	2 8E-06	1 4E-04	2 3E-04	1 5E-03
PBF-07-1		1 000	6 3E+03	5 1E+03	30	1 1E+07	1 7E+04	5 8E+02	8 4E-01	1 5E-02	3 6E-03	2 0E-03	1 4E-03	2 8E-04	1 3E-04	3 4E-04	1 3E-03
						3 0E+05	1 7E+04	1 5E+04	1 5E-01	7 8E-02	9 1E-03	4 1E-03	2 0E-03	2 8E-06	1 4E-04	2 3E-04	1 5E-03
PBF-07-2		0 000															
PBF-07-3		0 000															
PBF-08	2 7E-07		1 9E+04	7 4E+03	30	6 6E+06	3 2E+04	2 3E+03	9 4E-01	8 2E-03	4 5E-03	2 7E-03	1 1E-03	1 5E-04	6 3E-05	1 7E-04	1 1E-03
						1 4E+06	3 4E+04	1 6E+04	4 2E-02	7 0E-02	4 9E-03	2 7E-03	3 5E-03	1 7E-05	1 4E-04	2 5E-04	2 3E-03
PBF-08-1		1 000	1 9E+04	7 4E+03	30	6 6E+06	3 2E+04	2 3E+03	9 4E-01	8 2E-03	4 5E-03	2 7E-03	1 1E-03	1 5E-04	6 3E-05	1 7E-04	1 1E-03
						1 4E+06	3 4E+04	1 6E+04	4 2E-02	7 0E-02	4 9E-03	2 7E-03	3 5E-03	1 7E-05	1 4E-04	2 5E-04	2 3E-03
PBF-08-2		0 000															
PBF-08-3		0 000															
PBF-09	5 9E-07		2 7E+04	7 6E+03	30	6 5E+06	4 0E+04	2 1E+03	9 4E-01	1 3E-03	1 3E-03	1 0E-03	6 0E-04	1 2E-04	5 7E-05	1 1E-04	6 4E-04
						1 8E+06	4 3E+04	1 6E+04	5 9E-02	2 6E-02	9 4E-03	6 7E-03	7 6E-03	5 0E-05	2 9E-04	5 7E-04	5 0E-03
PBF-09-1		1 000	2 7E+04	7 6E+03	30	6 5E+06	4 0E+04	2 1E+03	9 4E-01	1 3E-03	1 3E-03	1 0E-03	6 0E-04	1 2E-04	5 7E-05	1 1E-04	6 4E-04
						1 8E+06	4 3E+04	1 6E+04	5 9E-02	2 6E-02	9 4E-03	6 7E-03	7 6E-03	5 0E-05	2 9E-04	5 7E-04	5 0E-03
PBF-09-2		0 000															
PBF-09-3		0 000															
PBF-10	2 8E-07		1 6E+04	6 0E+03	30	9 6E+06	2 8E+04	5 7E+02	8 0E-01	2 0E-02	1 4E-02	1 1E-02	3 6E-03	1 7E-03	3 8E-04	1 4E-03	3 6E-03
						1 1E+06	2 8E+04	1 4E+04	2 0E-01	2 9E-01	2 8E-02	2 6E-02	3 7E-02	1 3E-03	2 7E-03	5 3E-03	3 1E-02
PBF-10-1		1 000	1 6E+04	6 0E+03	30	9 6E+06	2 8E+04	5 7E+02	8 0E-01	2 0E-02	1 4E-02	1 1E-02	3 6E-03	1 7E-03	3 8E-04	1 4E-03	3 6E-03
						1 1E+06	2 8E+04	1 4E+04	2 0E-01	2 9E-01	2 8E-02	2 6E-02	3 7E-02	1 3E-03	2 7E-03	5 3E-03	3 1E-02
PBF-10-2		0 000															
PBF-10-3		0 000															

Table 3 4-8 (Continued)
Mean Source Terms Resulting from Partitioning for Fire Initiators - Peach Bottom

Source Term	Freq (1/yr)	Cond Prob	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBF-11	1 4E-06		2 5E+04	7 1E+03	30	7 8E+06	3 7E+04	9 0E+02	8 9E-01	2 1E-02	1 6E-02	1 3E-02	3 1E-03	3 8E-04	1 8E-04	5 9E-04	2 4E-03
						1 6E+06	3 8E+04	1 4E+04	1 1E-01	7 6E-02	3 9E-02	3 1E-02	4 6E-02	2 0E-05	2 7E-03	5 1E-03	3 4E-02
PBF-11-1		1 000	2 5E+04	7 1E+03	30	7 8E+06	3 7E+04	9 0E+02	8 9E-01	2 1E-02	1 6E-02	1 3E-02	3 1E-03	3 8E-04	1 8E-04	5 9E-04	2 4E-03
						1 6E+06	3 8E+04	1 4E+04	1 1E-01	7 6E-02	3 9E-02	3 1E-02	4 6E-02	2 0E-05	2 7E-03	5 1E-03	3 4E-02
PBF-11-2		0 000															
PBF-11-3		0 000															
PBF-12	2 9E-06		2 8E+04	7 2E+03	30	7 5E+06	4 1E+04	1 0E+03	5 9E-01	1 5E-03	1 5E-03	6 3E-04	3 6E-04	2 9E-04	4 9E-05	5 9E-05	4 1E-04
						1 9E+06	4 2E+04	1 5E+04	4 1E-01	4 8E-02	4 6E-02	2 5E-02	1 5E-02	5 9E-06	7 0E-04	1 4E-03	1 1E-02
PBF-12-1		1 000	2 8E+04	7 2E+03	30	7 5E+06	4 1E+04	1 0E+03	5 9E-01	1 5E-03	1 5E-03	6 3E-04	3 6E-04	2 9E-04	4 9E-05	5 9E-05	4 1E-04
						1 9E+06	4 2E+04	1 5E+04	4 1E-01	4 8E-02	4 6E-02	2 5E-02	1 5E-02	5 9E-06	7 0E-04	1 4E-03	1 1E-02
PBF-12-2		0 000															
PBF-12-3		0 000															
PBF-13	2 1E-07		2 9E+04	7 3E+03	30	7 6E+06	4 2E+04	9 9E+02	8 1E-01	1 7E-03	1 9E-03	1 0E-03	2 0E-04	1 2E-04	3 0E-05	3 1E-05	2 1E-04
						1 9E+06	4 3E+04	1 4E+04	1 9E-01	3 2E-02	3 5E-02	6 2E-03	5 8E-04	3 4E-07	1 2E-05	2 1E-05	3 0E-04
PBF-13-1		1 000	2 9E+04	7 3E+03	30	7 6E+06	4 2E+04	9 9E+02	8 1E-01	1 7E-03	1 9E-03	1 0E-03	2 0E-04	1 2E-04	3 0E-05	3 1E-05	2 1E-04
						1 9E+06	4 3E+04	1 4E+04	1 9E-01	3 2E-02	3 5E-02	6 2E-03	5 8E-04	3 4E-07	1 2E-05	2 1E-05	3 0E-04
PBF-13-2		0 000															
PBF-13-3		0 000															
PBF-14	2 0E-06		2 5E+04	7 0E+03	30	7 9E+06	3 7E+04	1 1E+03	6 8E-01	1 6E-02	1 5E-02	1 1E-02	8 4E-03	1 4E-03	7 7E-04	2 6E-03	8 0E-03
						1 7E+06	3 8E+04	1 5E+04	3 2E-01	1 8E-01	1 6E-01	9 0E-02	9 8E-02	3 6E-04	7 2E-03	1 3E-02	7 3E-02
PBF-14-1		1 000	2 5E+04	7 0E+03	30	7 9E+06	3 7E+04	1 1E+03	6 8E-01	1 6E-02	1 5E-02	1 1E-02	8 4E-03	1 4E-03	7 7E-04	2 6E-03	8 0E-03
						1 7E+06	3 8E+04	1 5E+04	3 2E-01	1 8E-01	1 6E-01	9 0E-02	9 8E-02	3 6E-04	7 2E-03	1 3E-02	7 3E-02
PBF-14-2		0 000															
PBF-14-3		0 000															
PBF-15	1 4E-06		2 8E+04	7 6E+03	30	7 4E+06	4 1E+04	1 2E+03	6 6E-01	1 4E-02	1 4E-02	5 2E-03	7 5E-04	3 6E-04	1 1E-04	1 3E-04	7 1E-04
						1 9E+06	4 2E+04	1 5E+04	3 4E-01	1 5E-01	1 4E-01	4 3E-02	2 1E-02	2 9E-06	7 8E-04	1 5E-03	1 3E-02
PBF-15-1		1 000	2 8E+04	7 6E+03	30	7 4E+06	4 1E+04	1 2E+03	6 6E-01	1 4E-02	1 4E-02	5 2E-03	7 5E-04	3 6E-04	1 1E-04	1 3E-04	7 1E-04
						1 9E+06	4 2E+04	1 5E+04	3 4E-01	1 5E-01	1 4E-01	4 3E-02	2 1E-02	2 9E-06	7 8E-04	1 5E-03	1 3E-02
PBF-15-2		0 000															
PBF-15-3		0 000															

Table 3.4-8 (Concluded)
Mean Source Terms Resulting from Partitioning for Fire Initiators - Peach Bottom

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBF-16	2.6E-07		2.9E+04	1.0E+04	30.	3.5E+06	4.5E+04	5.8E+03	5.5E-01	3.9E-02	3.9E-02	8.0E-03	1.8E-04	1.4E-04	2.7E-05	2.8E-05	2.1E-04
						1.5E+06	5.0E+04	1.9E+04	4.5E-01	8.5E-02	8.9E-02	1.1E-02	1.6E-04	2.1E-05	9.5E-06	1.3E-05	9.7E-05
PBF-16-1		1.000	2.9E+04	1.0E+04	30.	3.5E+06	4.5E+04	5.8E+03	5.5E-01	3.9E-02	3.9E-02	8.0E-03	1.8E-04	1.4E-04	2.7E-05	2.8E-05	2.1E-04
						1.5E+06	5.0E+04	1.9E+04	4.5E-01	8.5E-02	8.9E-02	1.1E-02	1.6E-04	2.1E-05	9.5E-06	1.3E-05	9.7E-05
PBF-16-2		0.000															
PBF-16-3		0.000															
PBF-17	1.8E-06		2.6E+04	7.1E+03	30.	7.9E+06	3.9E+04	8.7E+02	6.9E-01	1.4E-02	1.5E-02	1.6E-02	1.4E-02	7.4E-03	2.1E-03	3.2E-03	1.3E-02
						1.8E+06	4.0E+04	1.4E+04	3.1E-01	4.1E-01	4.5E-01	3.2E-01	3.0E-01	7.5E-04	1.8E-02	3.1E-02	2.2E-01
PBF-17-1		1.000	2.6E+04	7.1E+03	30.	7.9E+06	3.9E+04	8.7E+02	6.9E-01	1.4E-02	1.5E-02	1.6E-02	1.4E-02	7.4E-03	2.1E-03	3.2E-03	1.3E-02
						1.8E+06	4.0E+04	1.4E+04	3.1E-01	4.1E-01	4.5E-01	3.2E-01	3.0E-01	7.5E-04	1.8E-02	3.1E-02	2.2E-01
PBF-17-2		0.000															
PBF-17-3		0.000															
PBF-18	3.8E-07		2.7E+04	7.2E+03	30.	7.5E+06	4.0E+04	9.7E+02	5.6E-01	1.1E-02	1.1E-02	3.1E-03	1.6E-03	3.9E-04	2.1E-04	6.8E-04	1.7E-03
						1.9E+06	4.1E+04	1.4E+04	4.4E-01	4.2E-01	4.4E-01	1.3E-01	5.6E-02	2.6E-06	2.3E-03	4.8E-03	4.0E-02
PBF-18-1		1.000	2.7E+04	7.2E+03	30.	7.5E+06	4.0E+04	9.7E+02	5.6E-01	1.1E-02	1.1E-02	3.1E-03	1.6E-03	3.9E-04	2.1E-04	6.8E-04	1.7E-03
						1.9E+06	4.1E+04	1.4E+04	4.4E-01	4.2E-01	4.4E-01	1.3E-01	5.6E-02	2.6E-06	2.3E-03	4.8E-03	4.0E-02
PBF-18-2		0.000															
PBF-18-3		0.000															
PBF-19	1.6E-06		4.0E+03	1.3E+04	30.	2.5E+05	2.2E+04	9.0E+03	1.7E-03	2.4E-06	2.1E-09	1.0E-09	4.0E-10	6.2E-11	3.2E-11	9.4E-11	3.7E-10
						6.4E+04	3.1E+04	2.2E+04	1.7E-03	2.4E-06	2.1E-09	1.0E-09	4.0E-10	6.2E-11	3.2E-11	9.4E-11	3.7E-10
PBF-19-1		1.000	4.0E+03	1.3E+04	30.	2.5E+05	2.2E+04	9.0E+03	1.7E-03	2.4E-06	2.1E-09	1.0E-09	4.0E-10	6.2E-11	3.2E-11	9.4E-11	3.7E-10
						6.4E+04	3.1E+04	2.2E+04	1.7E-03	2.4E-06	2.1E-09	1.0E-09	4.0E-10	6.2E-11	3.2E-11	9.4E-11	3.7E-10
PBF-19-2		0.000															
PBF-19-3		0.000															
PBF-20	2.2E-06		4.5E+03	1.3E+04	30.	3.4E+05	2.2E+04	8.9E+03	2.0E-02	2.9E-04	8.8E-07	6.9E-07	7.3E-08	5.2E-08	1.2E-08	1.6E-08	8.7E-08
						8.4E+04	3.1E+04	2.2E+04	1.0E-02	2.9E-04	3.5E-07	5.9E-07	9.9E-07	3.0E-08	6.1E-08	1.1E-07	7.4E-07
PBF-20-1		1.000	4.5E+03	1.3E+04	30.	3.4E+05	2.2E+04	8.9E+03	2.0E-02	2.9E-04	8.8E-07	6.9E-07	7.3E-08	5.2E-08	1.2E-08	1.6E-08	8.7E-08
						8.4E+04	3.1E+04	2.2E+04	1.0E-02	2.9E-04	3.5E-07	5.9E-07	9.9E-07	3.0E-08	6.1E-08	1.1E-07	7.4E-07
PBF-20-2		0.000															
PBF-20-3		0.000															
PBF-21	2.4E-06		2.8E+04	9.5E+03	30.	5.2E+06	4.3E+04	3.7E+03	7.4E-01	2.0E-03	1.3E-03	8.9E-04	2.2E-04	5.0E-05	1.9E-05	3.5E-05	1.8E-04
						1.6E+06	4.7E+04	1.7E+04	2.5E-01	6.3E-03	4.5E-03	1.6E-03	5.4E-04	1.1E-05	3.9E-05	6.6E-05	4.1E-04
PBF-21-1		1.000	2.8E+04	9.5E+03	30.	5.2E+06	4.3E+04	3.7E+03	7.4E-01	2.0E-03	1.3E-03	8.9E-04	2.2E-04	5.0E-05	1.9E-05	3.5E-05	1.8E-04
						1.6E+06	4.7E+04	1.7E+04	2.5E-01	6.3E-03	4.5E-03	1.6E-03	5.4E-04	1.1E-05	3.9E-05	6.6E-05	4.1E-04
PBF-21-2		0.000															
PBF-21-3		0.000															

relative frequency of the PDSs. Since the accident progression and source term analysis are conditional on the PDS frequency, this difference would not result in different outcomes for the two seismic levels at Peach Bottom.

For the MACCS calculation two evacuation assumptions were used for the different cases and two separate runs were done. However, in the partitioning process, the frequencies of the PDSs are used to calculate frequencies for the APBs and these are used both in the partitioning itself and to calculate the subgroup mean source terms to be used in the MACCS calculation. Therefore, the partitioning process must also be done separately for each case.

The accident progression analysis and subsequent source term analysis for seismic initiators using the LLNL hazard distributions resulted in the generation of 9,480 source terms. Tables 3.4-9 and 3.4-10 show the number of these source terms with EH>0 and CH>0 and the number with EH=0 and CH>0 for the high and low PGA cases, respectively.

Figures 3.4-3 and 3.4-4 show a plot of the pairs (CH, EH) for the 9,036 source terms for which both EH and CH are nonzero for the high and low PGA cases, respectively. A summary of the partitioning process for EH>0 and CH>0 is given in Tables 3.4-11 and 3.4-13 for the high and low PGA cases, respectively. A summary of the partitioning process for the 444 source terms for which EH=0 and CH>0 is given in Tables 3.4-12 and 3.4-14 for the high and low PGA cases, respectively.

The 19 and 20 groups of source terms for the high and low PGA cases,respectively, that result from partitioning are further subdivided on the basis of evacuation timing into three subgroups as for internal initiators. Frequency-weighted mean source terms are calculated for each populated subgroup. The mean source terms obtained in this analysis are shown in Tables 3.4-15 and 3.4-16 for the high and low PGA cases, respectively. These tables contain frequency-weighted mean source terms for both the source term groups and subgroups. In the tables PBH-I and PBL-I and PBH-I-J and PBL-I-J are used to label the mean source term groups and subgroups, respectively, where I designates the source term group and J designates the source term subgroup. It is the source term subgroups, PBH-I-J and PBL-I-J in Tables 3.4-15 and 3.4-16, that are actually used for the risk calculations. Tables 3.4-15 and 3.4-16 are analogous to Table 3.4-4 for internal initiators.

The highest release fractions are associated with groups PBH-13 and PBl-13, as would be expected from Figures 3.4-3 and 3.4-4 and Table 3.4-11 and 3.4-13. The dominant accidents in this group are long-term station blackouts that have early containment failures and seismically induced LOCAs with initial or early containment failure and bypass of the suppression pool. The frequency for this group, however, is fairly low; relatively few source terms fall in the grid represented by groups PBH-13 and PBL-13, and they are not exceptionally frequent. The most likely

Table 3.4-9
Summary of Early and Chronic Health Effect Weights for Seismic Initiators -- LLNL - High PGA

	Number of Source Terms	Percent of Total Frequency
EF>0 AND CF>0	9036	95.50
EF=0 AND CF>0	444	4.50
EF=0 AND CF=0	0	0.00
TOTAL	9480	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.1954
RANGE LOG10(EH) = -0.6377 TO 2.5798

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -1.5655 TO 3.5647

Table 3.4-10
Summary of Early and Chronic Health Effect Weights for Seismic Initiators -- LLNL - Low PGA

	Number of Source Terms	Percent of Total Frequency
EF>0 AND CF>0	9036	90.50
EF=0 AND CF>0	444	9.50
EF=0 AND CF=0	0	0.00
TOTAL	9480	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.1954
RANGE LOG10(EH) = -0.6377 TO 2.5798

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -1.5655 TO 3.5647

Table 3.4-11
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - High PGA

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  9036:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
   1 |      |      |      |      |      |      |      |      |  406 |
     +------+------+------+------+------+------+------+------+------+
   2 |      |      |      |      |      |    2 |    4 |  435 | 1316 |
     +------+------+------+------+------+------+------+------+------+
   3 |      |      |      |      |      |   23 |  247 | 1874 |  332 |
     +------+------+------+------+------+------+------+------+------+
   4 |      |      |      |    4 |   38 |  351 | 1270 |  673 |      |
     +------+------+------+------+------+------+------+------+------+
   5 |      |      |    8 |   38 |  162 |  457 |  596 |   34 |      |
     +------+------+------+------+------+------+------+------+------+
   6 |   10 |   26 |   18 |  149 |  229 |  230 |  104 |      |      |
     +------+------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
   1 |      |      |      |      |      |      |      |      | 3.75 |
     +------+------+------+------+------+------+------+------+------+
   2 |      |      |      |      |      | 0.00 | 0.00 | 2.18 |23.27 |
     +------+------+------+------+------+------+------+------+------+
   3 |      |      |      |      |      | 0.12 |10.24 |14.11 | 1.18 |
     +------+------+------+------+------+------+------+------+------+
   4 |      |      |      | 0.00 | 1.11 | 6.97 |18.91 | 5.06 |      |
     +------+------+------+------+------+------+------+------+------+
   5 |      |      | 0.01 | 0.38 | 1.19 | 2.37 | 5.10 | 0.03 |      |
     +------+------+------+------+------+------+------+------+------+
   6 | 0.00 | 0.01 | 0.02 | 0.30 | 0.37 | 1.49 | 1.84 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

Table 3.4-11 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and
Chronic Fatality Weights for Seismic Initiators -- LLNL - High PGA

```
AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  9036:

        1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 406  |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |      |      | 435  | 1316 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |      |      | 263  | 1874 | 332  |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |      |      | 113  | 364  | 1270 | 684  |      |
     +------+------+------+------+------+------+------+------+------+
  5  |      |      |      |      | 540  | 457  | 619  |      |      |
     +------+------+------+------+------+------+------+------+------+
  6  |      |      |      |      |      | 259  | 104  |      |      |
     +------+------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

        1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 3.75 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |      |      | 2.18 |23.27 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |      |      |10.26 |14.11 | 1.18 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |      |      | 1.50 | 7.07 |18.91 | 5.08 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |      |      |      |      | 1.83 | 2.37 | 5.11 |      |      |
     +------+------+------+------+------+------+------+------+------+
  6  |      |      |      |      |      | 1.54 | 1.84 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

Table 3.4-11 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - High PGA

LABELING AFTER PARTITIONING:

	1	2	3	4	5	6	7	8	9
1									PBH-13
2								PBH-10	PBH-14
3							PBH-06	PBH-11	PBH-15
4					PBH-01	PBH-03	PBH-07	PBH-12	
5					PBH-02	PBH-04	PBH-08		
6						PBH-05	PBH-09		

Table 3.4-12
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Seismic Initiators -- LLNL - High PGA

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

         1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+
  1  |     1|     7|      |    22|    61|   198|   155|
     +------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+
  1  | 2.47 | 0.02 |      | 0.58 | 2.00 |15.91 |79.03 |
     +------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

         1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+
  1  |      |      |      |      |    91|   198|   155|
     +------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+
  1  |      |      |      |      | 5.06 |15.91 |79.03 |
     +------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

         1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+
  1  |      |      |      |      |PBH-16|PBH-17|PBH-18|
     +------+------+------+------+------+------+------+
```

Table 3.4-13
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - Low PGA

BEFORE PARTITIONING:

CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 9036:

	1	2	3	4	5	6	7	8	9
1									406
2						2	4	435	1316
3						23	247	1874	332
4				4	38	351	1270	673	
5			8	38	162	457	596	34	
6	10	26	18	149	229	230	104		

PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

	1	2	3	4	5	6	7	8	9
1									1.44
2						0.00	0.00	0.80	23.37
3						0.28	16.08	8.60	2.10
4				0.00	0.32	4.24	10.45	10.71	
5			0.00	0.15	1.63	1.31	11.43	0.06	
6	0.00	0.01	0.02	0.25	0.47	2.14	4.13		

Table 3.4-13 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - Low PGA

```
AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  9036:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      |  406 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |      |      |  435 | 1316 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |      |      |  261 | 1874 |  332 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |      |      |      |  384 | 1270 |  684 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |      |      |      |      |  202 |  457 |  619 |      |      |
     +------+------+------+------+------+------+------+------+------+
  6  |      |      |      |      |  462 |  230 |  104 |      |      |
     +------+------+------+------+------+------+------+------+------+


 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8      9
     +------+------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |      |      |      | 1.44 |
     +------+------+------+------+------+------+------+------+------+
  2  |      |      |      |      |      |      |      | 0.80 |23.37 |
     +------+------+------+------+------+------+------+------+------+
  3  |      |      |      |      |      |      |16.14 | 8.60 | 2.10 |
     +------+------+------+------+------+------+------+------+------+
  4  |      |      |      |      |      | 4.77 |10.45 |10.76 |      |
     +------+------+------+------+------+------+------+------+------+
  5  |      |      |      |      | 1.79 | 1.31 |11.45 |      |      |
     +------+------+------+------+------+------+------+------+------+
  6  |      |      |      |      | 0.75 | 2.14 | 4.13 |      |      |
     +------+------+------+------+------+------+------+------+------+
```

Table 3.4-13 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - Low PGA

LABELING AFTER PARTITIONING:

	1	2	3	4	5	6	7	8	9
1									PBL-13
2								PBL-10	PBL-14
3							PBL-06	PBL-11	PBL-15
4						PBL-03	PBL-07	PBL-12	
5					PBL-01	PBL-04	PBL-08		
6					PBL-02	PBL-05	PBL-09		

Table 3.4-14
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Seismic Initiators -- LLNL - Low PGA

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |    1 |      |    7 |    6 |   20 |   93 |  187 |  130 |
     +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  | 1.67 |      | 0.02 | 0.00 | 0.89 | 7.02 |10.91 |79.50 |
     +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |    8 |      |      |      |      |  119 |  187 |  130 |
     +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  | 1.68 |      |      |      |      | 7.91 |10.91 |79.50 |
     +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |PBL-16|      |      |      |      |PBL-17|PBL-18|PBL-19|
     +------+------+------+------+------+------+------+------+
```

Table 3 4-15
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA

Source Term	Freq (1/yr)	Cond Prob	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBH-01	6 9E-07		4 0E+03	-5 6E+03	30	1 9E+07	6 5E+03	3 3E+03	1 0E+00	3 0E-03	2 4E-03	1 6E-03	5 0E-04	8 4E-05	2 1E-05	8 4E-05	5 2E-04
						3 8E+05	1 3E+04	1 8E+04	2 0E-03	1 4E-03	7 6E-04	2 7E-04	2 7E-04	4 0E-06	4 5E-05	7 1E-05	2 5E-04
PBH-01-1		0 000															
PBH-01-2		0 269	4 0E+03	1 2E+03	30	6 3E+07	1 3E+04	3 0E+02	9 9E-01	8 0E-04	1 0E-04	6 6E-05	2 7E-05	4 4E-06	1 1E-06	3 5E-06	2 5E-05
						3 7E+05	1 4E+04	1 5E+04	7 4E-03	3 3E-03	1 3E-03	2 2E-04	4 0E-05	1 3E-06	1 4E-06	2 3E-06	2 3E-05
PBH-01-3		0 731	4 0E+03	-8 1E+03	30	2 9E+06	4 0E+03	4 5E+03	1 0E+00	3 8E-03	3 3E-03	2 2E-03	6 7E-04	1 1E-04	2 8E-05	1 1E-04	7 0E-04
						3 9E+05	1 3E+04	1 9E+04	0 0E+00	7 0E-04	5 4E-04	2 8E-04	3 5E-04	5 0E-06	6 1E-05	9 7E-05	3 3E-04
PBH-02	8 4E-07		1 3E+04	4 8E+03	30	3 0E+07	2 6E+04	1 3E+03	6 9E-01	2 9E-03	7 9E-04	5 8E-04	3 2E-04	1 4E-05	1 9E-05	3 8E-05	2 4E-04
						9 4E+05	2 7E+04	1 6E+04	3 1E-01	3 5E-02	2 7E-03	7 7E-04	6 7E-04	6 3E-06	3 5E-05	6 0E-05	4 4E-04
PBH-02-1		0 652	1 8E+04	6 9E+03	30	1 5E+07	3 3E+04	1 8E+03	8 2E-01	3 7E-03	8 0E-04	7 8E-04	4 8E-04	1 9E-05	2 9E-05	5 8E-05	3 6E-04
						1 3E+06	3 4E+04	1 6E+04	1 8E-01	5 2E-02	2 5E-03	4 6E-04	2 4E-04	7 4E-06	1 2E-05	2 2E-05	1 7E-04
PBH-02-2		0 348	4 0E+03	8 6E+02	30	5 8E+07	1 3E+04	5 8E+02	4 3E-01	1 4E-03	7 7E-04	1 9E-04	1 0E-05	2 9E-06	7 7E-07	1 4E-06	1 6E-05
						3 6E+05	1 4E+04	1 5E+04	5 7E-01	3 5E-03	3 2E-03	1 4E-03	1 5E-03	4 1E-06	7 8E-05	1 3E-04	9 7E-04
PBH-02-3		0 000															
PBH-03	3 2E-06		7 2E+03	-3 0E+03	30	2 3E+07	1 2E+04	2 1E+03	8 0E-01	5 8E-03	3 7E-03	1 1E-03	1 1E-04	6 1E-05	1 3E-05	2 4E-05	1 3E-04
						5 1E+05	1 7E+04	1 8E+04	2 0E-01	7 3E-02	5 7E-03	1 3E-03	6 6E-04	1 3E-06	4 1E-05	8 2E-05	5 1E-04
PBH-03-1		0 140	2 7E+04	4 5E+03	30	7 6E+06	4 0E+04	1 0E+03	4 1E-01	7 5E-04	7 2E-04	2 8E-04	7 9E-05	7 0E-05	2 1E-05	2 2E-05	9 5E-05
						1 9E+06	4 1E+04	1 5E+04	5 9E-01	4 4E-01	5 1E-03	1 9E-03	1 7E-03	1 1E-07	8 8E-05	1 8E-04	1 3E-03
PBH-03-2		0 369	4 0E+03	9 0E+02	30	5 4E+07	1 3E+04	5 2E+02	9 1E-01	4 9E-03	3 8E-03	1 7E-03	2 1E-04	1 0E-04	2 5E-05	5 4E-05	2 5E-04
						3 3E+05	1 3E+04	1 5E+04	8 9E-02	2 7E-02	5 2E-03	1 2E-03	1 1E-03	9 6E-07	7 7E-05	1 5E-04	8 7E-04
PBH-03-3		0 491	4 0E+03	-8 1E+03	30	3 2E+06	4 0E+03	3 6E+03	8 3E-01	8 0E-03	4 5E-03	1 0E-03	4 2E-05	2 7E-05	7 9E-07	1 7E-06	5 8E-05
						2 5E+05	1 3E+04	2 2E+04	1 7E-01	4 6E-03	6 2E-03	1 2E-03	1 7E-05	1 8E-06	1 3E-06	1 7E-06	1 3E-05
PBH-04	1 1E-06		5 6E+03	1 2E+03	30	1 3E+07	1 5E+04	2 7E+03	4 8E-01	5 4E-03	2 2E-03	2 4E-03	1 4E-03	1 3E-05	9 7E-05	2 0E-04	1 2E-03
						3 8E+05	1 9E+04	2 0E+04	5 2E-01	1 8E-02	1 2E-02	6 2E-03	6 0E-03	9 1E-05	2 7E-04	5 7E-04	4 1E-03
PBH-04-1		0 267	1 0E+04	9 4E+03	30	3 6E+07	2 8E+04	8 8E+02	8 7E-01	1 8E-02	7 0E-03	8 5E-03	5 3E-03	4 5E-05	3 6E-04	7 5E-04	4 4E-03
						7 7E+05	2 9E+04	1 5E+04	1 3E-01	2 1E-02	2 7E-03	2 2E-03	1 9E-03	8 7E-06	1 2E-04	2 3E-04	1 4E-03
PBH-04-2		0 516	4 0E+03	9 0E+02	30	4 7E+06	1 3E+04	3 4E+03	4 3E-01	1 2E-03	6 2E-04	1 7E-04	6 6E-06	2 2E-06	4 5E-07	6 3E-07	1 2E-05
						2 4E+05	1 6E+04	2 1E+04	5 7E-01	1 6E-02	1 6E-02	7 2E-03	7 0E-03	8 4E-06	1 5E-04	3 1E-04	4 0E-03
PBH-04-3		0 217	4 0E+03	-8 1E+03	30	3 2E+06	4 0E+03	3 6E+03	9 2E-02	1 7E-04	8 4E-05	2 1E-05	3 0E-07	5 0E-09	2 0E-09	2 0E-09	1 1E-06
						2 4E+05	1 3E+04	2 2E+04	9 1E-01	2 1E-02	1 5E-02	8 9E-03	8 6E-03	3 9E-04	7 4E-04	1 6E-03	7 7E-03
PBH-05	7 0E-07		1 1E+04	7 2E+03	30	5 5E+06	2 6E+04	2 4E+03	6 9E-01	2 9E-03	1 6E-03	2 2E-03	1 4E-03	2 1E-05	1 1E-04	2 3E-04	1 2E-03
						1 2E+06	2 9E+04	1 8E+04	3 1E-01	1 2E-02	1 2E-02	4 5E-03	2 1E-03	8 7E-06	1 7E-04	3 4E-04	1 7E-03
PBH-05-1		1 000	1 1E+04	7 2E+03	30	5 5E+06	2 6E+04	2 4E+03	6 9E-01	2 9E-03	1 6E-03	2 2E-03	1 4E-03	2 1E-05	1 1E-04	2 3E-04	1 2E-03
						1 2E+06	2 9E+04	1 8E+04	3 1E-01	1 2E-02	1 2E-02	4 5E-03	2 1E-03	8 7E-06	1 7E-04	3 4E-04	1 7E-03
PBH-05-2		0 000															
PBH-05-3		0 000															

Table 3.4-15 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBH-06	4.7E-06		2.0E+04	1.6E+03	30.	1.6E+07	3.0E+04	1.4E+03	6.2E-01	6.4E-03	4.4E-03	2.0E-03	4.6E-04	1.4E-04	4.6E-05	1.9E-04	4.7E-04
						1.3E+06	3.2E+04	1.5E+04	3.8E-01	4.1E-01	3.3E-02	2.8E-02	3.5E-02	3.0E-05	1.8E-03	3.6E-03	2.6E-02
PBH-06-1		0.650	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.0E+02	5.0E-01	1.9E-03	2.0E-03	5.0E-04	1.7E-04	7.2E-05	2.6E-05	4.2E-05	1.6E-04
						1.9E+06	4.2E+04	1.4E+04	5.0E-01	5.9E-01	3.0E-02	2.5E-02	2.8E-02	4.9E-06	1.6E-03	3.2E-03	2.2E-02
PBH-06-2		0.166	4.0E+03	9.0E+02	30.	6.1E+07	1.3E+04	1.8E+02	7.4E-01	7.2E-03	5.5E-03	3.0E-03	1.3E-03	2.4E-04	1.1E-04	5.9E-04	1.3E-03
						3.5E+05	1.3E+04	1.4E+04	2.6E-01	9.4E-02	3.2E-02	3.2E-02	4.1E-02	3.8E-05	3.3E-03	5.7E-03	3.4E-02
PBH-06-3		0.184	4.0E+03	-8.1E+03	30.	3.0E+06	4.0E+03	4.3E+03	9.4E-01	2.1E-02	1.2E-02	6.4E-03	7.3E-04	2.8E-04	6.0E-05	3.4E-04	8.4E-04
						3.6E+05	1.3E+04	2.0E+04	6.4E-02	5.7E-02	4.6E-02	3.7E-02	5.3E-02	1.1E-04	1.4E-03	2.9E-03	3.3E-02
PBH-07	8.6E-06		4.5E+03	-1.5E+01	30.	5.2E+07	1.3E+04	1.1E+03	6.1E-01	5.7E-03	4.4E-03	2.0E-03	9.8E-04	1.7E-04	6.6E-05	1.1E-04	8.3E-04
						4.4E+05	1.4E+04	1.5E+04	3.9E-01	5.3E-02	4.7E-02	1.8E-02	1.2E-02	4.3E-05	5.1E-04	1.0E-03	8.1E-03
PBH-07-1		0.055	1.4E+04	7.3E+03	30.	7.6E+06	2.9E+04	2.2E+03	6.9E-01	1.2E-02	9.8E-03	1.2E-02	1.4E-02	1.6E-04	5.1E-04	1.1E-03	1.0E-02
						1.1E+06	3.1E+04	1.8E+04	3.1E-01	1.2E-01	2.6E-02	2.1E-02	2.0E-02	7.6E-05	6.7E-04	1.4E-03	1.5E-02
PBH-07-2		0.804	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	6.3E-01	4.2E-03	3.5E-03	1.2E-03	2.0E-04	1.9E-04	4.4E-05	4.9E-05	2.5E-04
						3.6E+05	1.3E+04	1.4E+04	3.7E-01	5.0E-02	5.0E-02	1.9E-02	1.3E-02	2.9E-05	5.7E-04	1.1E-03	8.7E-03
PBH-07-3		0.141	4.0E+03	-8.1E+03	30.	2.5E+06	4.0E+03	5.7E+03	5.1E-01	1.2E-02	7.3E-03	2.8E-03	4.8E-04	9.2E-05	2.0E-05	7.8E-05	5.3E-04
						6.5E+05	1.3E+04	1.5E+04	4.9E-01	4.0E-02	4.2E-02	1.1E-02	3.1E-03	1.1E-04	1.3E-04	2.2E-04	2.0E-03
PBH-08	2.3E-06		2.6E+04	4.7E+03	30.	7.5E+06	3.8E+04	1.1E+03	6.9E-01	9.5E-04	8.2E-04	5.0E-04	4.0E-04	3.8E-05	2.0E-05	3.4E-05	3.1E-04
						1.9E+06	3.9E+04	1.5E+04	3.1E-01	5.7E-02	5.3E-02	1.6E-02	1.4E-02	1.5E-05	3.6E-04	6.6E-04	7.8E-03
PBH-08-1		1.000	2.6E+04	4.7E+03	30.	7.5E+06	3.8E+04	1.1E+03	6.9E-01	9.5E-04	8.2E-04	5.0E-04	4.0E-04	3.8E-05	2.0E-05	3.4E-05	3.1E-04
						1.9E+06	3.9E+04	1.5E+04	3.1E-01	5.7E-02	5.3E-02	1.6E-02	1.4E-02	1.5E-05	3.6E-04	6.6E-04	7.8E-03
PBH-08-2		0.000															
PBH-08-3		0.000															
PBH-09	8.4E-07		2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.2E-05	3.5E-05	6.5E-06	6.7E-06	4.7E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.8E-02	4.1E-02	7.3E-03	3.1E-03	3.0E-09	9.3E-05	1.5E-04	1.6E-03
PBH-09-1		1.000	2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.2E-05	3.5E-05	6.5E-06	6.7E-06	4.7E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.8E-02	4.1E-02	7.3E-03	3.1E-03	3.0E-09	9.3E-05	1.5E-04	1.6E-03
PBH-09-2		0.000															
PBH-09-3		0.000															
PBH-10	1.0E-06		4.1E+03	-4.1E+03	30.	2.7E+07	8.1E+03	3.1E+03	8.4E-01	6.6E-02	5.1E-02	2.9E-02	9.0E-03	1.9E-03	5.4E-04	2.3E-03	9.2E-03
						4.5E+05	1.3E+04	1.6E+04	1.6E-01	1.1E-01	1.3E-01	1.5E-01	1.9E-01	3.3E-03	1.4E-02	2.8E-02	1.5E-01
PBH-10-1		0.000															
PBH-10-2		0.434	4.4E+03	1.0E+03	30.	5.9E+07	1.3E+04	2.0E+02	9.1E-01	2.8E-02	2.4E-02	1.3E-02	5.3E-03	1.3E-03	4.3E-04	1.5E-03	4.9E-03
						3.7E+05	1.4E+04	1.4E+04	9.3E-02	1.2E-01	1.4E-01	1.9E-01	2.4E-01	3.8E-04	1.7E-02	3.3E-02	1.9E-01
PBH-10-3		0.566	4.0E+03	-8.1E+03	30.	2.6E+06	4.0E+03	5.4E+03	7.8E-01	9.6E-02	7.2E-02	4.2E-02	1.2E-02	2.3E-03	6.2E-04	2.8E-03	1.2E-02
						5.1E+05	1.3E+04	1.7E+04	2.2E-01	1.0E-01	1.2E-01	1.1E-01	1.4E-01	5.5E-03	1.2E-02	2.4E-02	1.3E-01

Table 3.4-15 (Continued)

Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBH-11	6.4E-06		5.9E+03	-1.4E+03	30.	3.5E+07	1.3E+04	2.6E+03	7.9E-01	5.2E-02	4.4E-02	2.9E-02	9.9E-03	1.1E-03	4.8E-04	1.2E-03	8.5E-03
						5.6E+05	1.6E+04	1.5E+04	2.1E-01	1.1E-01	1.1E-01	4.3E-02	4.6E-02	1.1E-04	1.5E-03	2.9E-03	3.0E-02
PBH-11-1		0.135	1.8E+04	7.5E+03	30.	1.1E+07	3.4E+04	2.2E+03	8.0E-01	5.5E-02	5.1E-02	5.8E-02	5.1E-02	8.2E-04	2.3E-03	4.9E-03	3.7E-02
						1.5E+06	3.6E+04	1.6E+04	2.0E-01	7.5E-02	6.4E-02	6.7E-02	9.6E-02	2.7E-04	4.4E-03	8.4E-03	6.7E-02
PBH-11-2		0.512	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	1.9E+02	7.4E-01	3.5E-02	3.2E-02	1.9E-02	4.2E-03	1.1E-03	2.4E-04	7.7E-04	4.5E-03
						3.7E+05	1.3E+04	1.4E+04	2.6E-01	1.6E-01	1.6E-01	4.6E-02	4.9E-02	2.4E-05	1.3E-03	2.5E-03	3.0E-02
PBH-11-3		0.353	4.0E+03	-8.1E+03	30.	2.3E+06	4.0E+03	6.2E+03	8.5E-01	7.6E-02	6.0E-02	3.2E-02	2.6E-03	1.1E-03	1.4E-04	5.1E-04	3.2E-03
						4.7E+05	1.3E+04	1.7E+04	1.5E-01	6.5E-02	6.6E-02	2.9E-02	2.2E-02	1.9E-04	7.0E-04	1.3E-03	1.5E-02
PBH-12	2.3E-06		2.2E+04	7.2E+03	30.	8.9E+06	3.7E+04	3.6E+03	7.0E-01	3.2E-02	2.6E-02	2.1E-02	1.5E-02	4.4E-04	8.4E-04	1.9E-03	1.3E-02
						1.6E+06	4.1E+04	1.7E+04	3.0E-01	9.5E-02	8.0E-02	4.1E-02	5.0E-02	2.5E-06	1.6E-03	3.4E-03	3.3E-02
PBH-12-1		0.934	2.3E+04	7.7E+03	30.	5.3E+06	3.9E+04	3.8E+03	7.2E-01	3.5E-02	2.8E-02	2.3E-02	1.6E-02	4.6E-04	9.0E-04	2.1E-03	1.4E-02
						1.7E+06	4.3E+04	1.7E+04	2.8E-01	9.5E-02	7.9E-02	4.2E-02	5.3E-02	2.7E-06	1.7E-03	3.7E-03	3.6E-02
PBH-12-2		0.066	4.0E+03	2.6E+02	30.	6.0E+07	1.2E+04	8.0E+02	3.4E-01	2.3E-03	1.5E-03	6.3E-04	2.4E-04	2.2E-04	2.9E-05	3.2E-05	2.9E-04
						3.7E+05	1.3E+04	1.5E+04	6.6E-01	9.8E-02	9.9E-02	2.7E-02	4.1E-03	7.5E-09	7.0E-05	1.4E-04	2.7E-03
PBH-12-3		0.000															
PBH-13	1.7E-06		4.0E+03	-3.4E+03	30.	3.4E+07	8.7E+03	4.3E+03	4.8E-01	5.6E-02	4.2E-02	2.5E-02	1.7E-02	2.6E-03	1.6E-03	7.7E-03	1.7E-02
						5.6E+05	1.3E+04	1.3E+04	5.2E-01	5.1E-01	5.6E-01	4.7E-01	5.2E-01	2.0E-03	3.1E-02	6.3E-02	4.1E-01
PBH-13-1		0.000															
PBH-13-2		0.523	4.1E+03	9.2E+02	30.	6.4E+07	1.3E+04	2.1E+02	4.9E-01	3.5E-02	3.3E-02	2.7E-02	2.5E-02	3.8E-03	2.5E-03	1.2E-02	2.5E-02
						3.7E+05	1.3E+04	1.4E+04	5.1E-01	5.2E-01	5.6E-01	4.6E-01	5.1E-01	3.7E-04	2.9E-02	5.9E-02	4.0E-01
PBH-13-3		0.477	4.0E+03	-8.1E+03	30.	1.4E+06	4.0E+03	8.8E+03	4.7E-01	8.0E-02	5.1E-02	2.3E-02	8.7E-03	1.2E-03	6.1E-04	2.9E-03	9.0E-03
						7.6E+05	1.3E+04	1.1E+04	5.3E-01	5.0E-01	5.5E-01	4.7E-01	5.3E-01	3.7E-03	3.3E-02	6.7E-02	4.3E-01
PBH-14	1.1E-05		1.2E+04	-3.1E+03	30.	8.6E+06	1.7E+04	4.1E+03	5.3E-01	3.1E-02	2.2E-02	7.2E-03	9.2E-04	2.5E-04	5.4E-05	1.4E-04	1.0E-03
						7.8E+05	2.4E+04	1.9E+04	4.7E-01	3.7E-01	4.1E-01	3.2E-01	3.5E-01	8.9E-05	1.6E-02	3.2E-02	2.5E-01
PBH-14-1		0.334	2.7E+04	4.5E+03	30.	4.3E+06	4.0E+04	4.8E+03	4.7E-01	4.1E-03	4.1E-03	1.8E-03	4.9E-04	1.3E-04	6.5E-05	1.1E-04	4.9E-04
						1.6E+06	4.5E+04	1.8E+04	5.3E-01	4.7E-01	4.6E-01	3.7E-01	4.1E-01	1.2E-04	2.2E-02	4.6E-02	3.2E-01
PBH-14-2		0.085	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	4.4E-01	3.1E-02	2.4E-02	9.4E-03	1.3E-03	5.2E-04	1.2E-04	2.6E-04	1.6E-03
						3.7E+05	1.3E+04	1.4E+04	5.6E-01	5.0E-01	5.3E-01	2.0E-01	1.0E-01	1.4E-05	3.1E-03	6.2E-03	6.5E-02
PBH-14-3		0.581	4.0E+03	-8.1E+03	30.	3.0E+06	4.0E+03	4.3E+03	5.8E-01	4.6E-02	3.2E-02	9.9E-03	1.1E-03	2.9E-04	3.9E-05	1.4E-04	1.3E-03
						3.6E+05	1.3E+04	2.0E+04	4.2E-01	3.0E-01	3.6E-01	3.1E-01	3.4E-01	8.5E-05	1.4E-02	2.9E-02	2.4E-01
PBH-15	5.4E-07		2.2E+04	3.4E+03	30.	1.5E+07	3.4E+04	1.2E+03	3.9E-01	1.1E-02	9.8E-03	2.4E-03	4.5E-04	4.6E-04	1.3E-04	1.4E-04	5.7E-04
						1.5E+06	3.5E+04	1.5E+04	6.1E-01	5.3E-01	5.5E-01	1.2E-01	1.1E-02	8.5E-07	2.4E-04	4.4E-04	4.8E-03
PBH-15-1		0.752	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	4.1E-01	1.1E-02	1.1E-02	2.4E-03	3.7E-04	4.0E-04	1.3E-04	1.5E-04	4.8E-04
						1.9E+06	4.2E+04	1.4E+04	5.9E-01	5.7E-01	6.0E-01	1.3E-01	1.3E-02	7.3E-09	2.9E-04	5.2E-04	5.7E-03
PBH-15-2		0.230	4.0E+03	9.0E+02	30.	3.8E+07	1.3E+04	1.7E+03	3.3E-01	1.2E-02	8.3E-03	2.9E-03	7.3E-04	7.0E-04	1.3E-04	1.3E-04	9.2E-04
						3.1E+05	1.5E+04	1.7E+04	6.7E-01	3.9E-01	4.1E-01	8.0E-02	5.0E-03	1.2E-09	1.1E-04	1.8E-04	1.9E-03
PBH-15-3		0.018	4.0E+03	-8.1E+03	30.	2.0E+06	4.0E+03	7.0E+03	1.1E-01	9.0E-04	5.6E-04	3.4E-04	5.3E-06	9.1E-08	3.6E-08	3.6E-08	1.1E-05
						3.2E+05	1.3E+04	1.7E+04	8.9E-01	4.1E-01	4.1E-01	8.0E-02	7.0E-03	4.8E-05	1.6E-04	2.6E-04	4.9E-03

Table 3.4-15 (Concluded)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBH-16	1.1E-07		1.5E+04	1.0E+04	30.	1.3E+06	3.3E+04	8.7E+03	2.7E-01	6.8E-04	1.2E-04	4.9E-05	6.0E-06	3.2E-06	9.3E-07	1.3E-06	5.8E-06
						7.9E+05	4.2E+04	2.1E+04	2.4E-01	7.5E-04	1.2E-04	5.0E-05	1.3E-05	1.7E-06	9.2E-07	1.4E-06	8.9E-06
PBH-16-1		1.000	1.5E+04	1.0E+04	30.	1.3E+06	3.3E+04	8.7E+03	2.7E-01	6.8E-04	1.2E-04	4.9E-05	6.0E-06	3.2E-06	9.3E-07	1.3E-06	5.8E-06
						7.9E+05	4.2E+04	2.1E+04	2.4E-01	7.5E-04	1.2E-04	5.0E-05	1.3E-05	1.7E-06	9.2E-07	1.4E-06	8.9E-06
PBH-16-2		0.000															
PBH-16-3		0.000															
PBH-17	3.4E-07		2.8E+04	5.3E+03	30.	7.2E+06	4.1E+04	1.5E+03	7.1E-01	4.9E-04	4.2E-04	2.7E-04	1.3E-04	8.5E-05	1.4E-05	1.5E-05	1.3E-04
						1.9E+06	4.3E+04	1.5E+04	2.9E-01	3.7E-03	2.4E-03	8.3E-04	7.7E-04	5.3E-06	4.4E-05	7.2E-05	5.1E-04
PBH-17-1		1.000	2.8E+04	5.3E+03	30.	7.2E+06	4.1E+04	1.5E+03	7.1E-01	4.9E-04	4.2E-04	2.7E-04	1.3E-04	8.5E-05	1.4E-05	1.5E-05	1.3E-04
						1.9E+06	4.3E+04	1.5E+04	2.9E-01	3.7E-03	2.4E-03	8.3E-04	7.7E-04	5.3E-06	4.4E-05	7.2E-05	5.1E-04
PBH-17-2		0.000															
PBH-17-3		0.000															
PBH-18	1.7E-06		2.9E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	8.7E-01	3.1E-04	3.4E-04	8.6E-05	1.7E-05	8.8E-06	3.6E-06	4.6E-06	1.7E-05
						1.9E+06	4.2E+04	1.4E+04	1.3E-01	1.6E-02	2.1E-02	4.5E-03	4.8E-04	2.0E-07	1.2E-05	2.2E-05	3.0E-04
PBH-18-1		1.000	2.9E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	8.7E-01	3.1E-04	3.4E-04	8.6E-05	1.7E-05	8.8E-06	3.6E-06	4.6E-06	1.7E-05
						1.9E+06	4.2E+04	1.4E+04	1.3E-01	1.6E-02	2.1E-02	4.5E-03	4.8E-04	2.0E-07	1.2E-05	2.2E-05	3.0E-04
PBH-18-2		0.000															
PBH-18-3		0.000															

Table 3.4-16
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBL-01	4.4E-07		2.2E+04	3.8E+03	30.	2.1E+07	3.4E+04	8.4E+02	9.0E-01	1.3E-03	6.5E-04	1.6E-04	3.6E-05	1.7E-05	8.1E-06	9.6E-06	3.4E-05
						1.5E+06	3.5E+04	1.4E+04	1.0E-01	7.6E-02	3.9E-03	4.7E-04	3.4E-04	2.9E-06	3.2E-05	5.0E-05	2.5E-04
PBL-01-1		0.771	2.7E+04	4.6E+03	30.	7.7E+06	4.0E+04	1.0E+03	9.4E-01	1.5E-03	7.2E-04	1.7E-04	4.1E-05	2.0E-05	1.0E-05	1.1E-05	3.8E-05
						1.9E+06	4.1E+04	1.5E+04	5.7E-02	9.7E-02	4.3E-03	3.1E-04	4.5E-05	9.4E-07	2.2E-06	3.4E-06	3.0E-05
PBL-01-2		0.229	4.0E+03	8.7E+02	30.	6.4E+07	1.3E+04	2.3E+02	7.4E-01	7.4E-04	4.3E-04	1.3E-04	2.0E-05	5.8E-06	1.4E-06	3.3E-06	2.3E-05
						3.7E+05	1.3E+04	1.4E+04	2.6E-01	3.3E-03	2.4E-03	1.0E-03	1.3E-03	9.6E-06	1.3E-04	2.1E-04	1.0E-03
PBL-01-3		0.000															
PBL-02	1.9E-07		1.2E+04	8.1E+03	30.	1.6E+07	2.8E+04	2.9E+03	6.7E-01	9.9E-03	7.2E-04	1.0E-03	6.5E-04	4.3E-05	3.8E-05	8.0E-05	5.1E-04
						9.9E+05	3.1E+04	1.8E+04	3.3E-01	8.5E-03	1.1E-03	7.2E-04	5.3E-04	2.0E-05	3.1E-05	5.5E-05	3.8E-04
PBL-02-1		0.967	1.2E+04	8.4E+03	30.	1.6E+07	2.9E+04	2.9E+03	6.8E-01	1.0E-02	7.3E-04	1.0E-03	6.7E-04	4.5E-05	3.9E-05	8.2E-05	5.3E-04
						1.0E+06	3.1E+04	1.8E+04	3.2E-01	8.7E-03	1.1E-03	7.4E-04	5.4E-04	2.1E-05	3.1E-05	5.5E-05	3.9E-04
PBL-02-2		0.033	4.0E+03	9.0E+02	30.	7.5E+06	1.3E+04	3.4E+03	3.0E-01	8.0E-04	5.0E-04	1.1E-04	8.1E-06	1.8E-06	7.1E-07	1.5E-06	1.3E-05
						2.5E+05	1.6E+04	2.1E+04	7.0E-01	1.2E-03	6.1E-04	2.6E-04	2.7E-04	1.5E-07	1.6E-05	3.2E-05	2.1E-04
PBL-02-3		0.000															
PBL-03	1.2E-06		1.5E+04	-4.7E+02	30.	1.5E+07	2.2E+04	1.9E+03	6.6E-01	3.7E-03	2.5E-03	8.7E-04	1.3E-04	7.1E-05	1.7E-05	3.0E-05	1.5E-04
						1.0E+06	2.6E+04	1.7E+04	3.4E-01	2.1E-01	5.2E-03	1.5E-03	1.1E-03	1.1E-06	6.1E-05	1.2E-04	8.0E-04
PBL-03-1		0.465	2.7E+04	4.5E+03	30.	7.6E+06	4.0E+04	1.0E+03	4.1E-01	7.5E-04	7.2E-04	2.8E-04	6.9E-05	7.1E-05	2.0E-05	2.1E-05	8.7E-05
						1.9E+06	4.1E+04	1.5E+04	5.9E-01	4.4E-01	5.2E-03	1.9E-03	1.7E-03	1.1E-07	8.8E-05	1.7E-04	1.3E-03
PBL-03-2		0.197	4.0E+03	9.0E+02	30.	5.4E+07	1.3E+04	5.3E+02	9.1E-01	4.8E-03	3.7E-03	1.6E-03	2.3E-04	1.2E-04	2.7E-05	6.1E-05	2.7E-04
						3.3E+05	1.3E+04	1.5E+04	8.9E-02	2.7E-02	5.3E-03	1.3E-03	1.2E-03	9.4E-07	7.9E-05	1.6E-04	9.1E-04
PBL-03-3		0.338	4.0E+03	-8.1E+03	30.	3.2E+06	4.0E+03	3.8E+03	8.6E-01	7.2E-03	4.3E-03	1.2E-03	1.6E-04	4.4E-05	6.1E-06	2.3E-05	1.8E-04
						2.7E+05	1.3E+04	2.1E+04	1.4E-01	3.8E-03	5.1E-03	1.1E-03	8.4E-05	2.4E-06	1.3E-05	2.1E-05	7.6E-05
PBL-04	3.3E-07		1.1E+04	4.5E+03	30.	1.3E+07	2.3E+04	2.0E+03	6.7E-01	1.4E-02	3.2E-03	2.1E-03	1.0E-03	2.3E-05	6.6E-05	1.3E-04	8.3E-04
						7.6E+05	2.6E+04	1.8E+04	3.3E-01	2.8E-02	8.3E-03	4.1E-03	4.1E-03	4.7E-05	1.9E-04	3.8E-04	2.7E-03
PBL-04-1		0.579	1.6E+04	8.9E+03	30.	2.0E+07	3.3E+04	9.9E+02	9.0E-01	2.3E-02	5.1E-03	3.6E-03	1.8E-03	3.9E-05	1.1E-04	2.3E-04	1.4E-03
						1.1E+06	3.4E+04	1.5E+04	9.7E-02	3.6E-02	3.3E-03	1.7E-03	1.7E-03	4.5E-06	1.0E-04	1.9E-04	1.2E-03
PBL-04-2		0.310	4.0E+03	9.0E+02	30.	4.9E+06	1.3E+04	3.4E+03	4.5E-01	1.2E-03	6.1E-04	1.7E-04	7.0E-06	2.5E-06	5.3E-07	7.5E-07	1.2E-05
						2.4E+05	1.6E+04	2.1E+04	5.5E-01	1.5E-02	1.6E-02	7.1E-03	6.9E-03	8.8E-06	1.5E-04	3.1E-04	4.0E-03
PBL-04-3		0.111	4.0E+03	-8.1E+03	30.	3.2E+06	4.0E+03	3.6E+03	9.5E-02	2.1E-04	1.1E-04	2.7E-05	3.9E-07	6.5E-09	2.6E-09	2.6E-09	1.5E-06
						2.4E+05	1.3E+04	2.2E+04	9.0E-01	2.1E-02	1.5E-02	8.7E-03	8.3E-03	3.8E-04	7.2E-04	1.6E-03	7.5E-03
PBL-05	5.3E-07		1.5E+04	5.7E+03	30.	6.7E+06	2.9E+04	1.7E+03	8.1E-01	2.7E-03	1.1E-03	6.6E-04	3.3E-04	1.7E-05	2.8E-05	5.5E-05	2.9E-04
						1.7E+06	3.0E+04	1.6E+04	1.9E-01	1.7E-02	1.8E-02	4.4E-03	1.5E-03	4.1E-06	1.1E-04	2.2E-04	1.1E-03
PBL-05-1		1.000	1.5E+04	5.7E+03	30.	6.7E+06	2.9E+04	1.7E+03	8.1E-01	2.7E-03	1.1E-03	6.6E-04	3.3E-04	1.7E-05	2.8E-05	5.5E-05	2.9E-04
						1.7E+06	3.0E+04	1.6E+04	1.9E-01	1.7E-02	1.8E-02	4.4E-03	1.5E-03	4.1E-06	1.1E-04	2.2E-04	1.1E-03
PBL-05-2		0.000															
PBL-05-3		0.000															

Table 3.4-16 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBL-06	4.0E-06		2.7E+04	3.9E+03	30.	9.4E+06	3.9E+04	1.0E+03	5.2E-01	2.8E-03	2.4E-03	7.7E-04	2.0E-04	8.6E-05	2.9E-05	7.2E-05	2.0E-04
						1.8E+06	4.0E+04	1.5E+04	4.8E-01	5.5E-01	3.1E-02	2.6E-02	3.0E-02	9.6E-06	1.7E-03	3.3E-03	2.3E-02
PBL-06-1		0.928	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.0E+02	5.0E-01	1.9E-03	2.0E-03	4.7E-04	1.4E-04	7.2E-05	2.4E-05	3.9E-05	1.3E-04
						1.9E+06	4.2E+04	1.4E+04	5.0E-01	5.9E-01	3.0E-02	2.5E-02	2.8E-02	4.9E-06	1.6E-03	3.2E-03	2.2E-02
PBL-06-2		0.037	4.0E+03	9.0E+02	30.	6.1E+07	1.3E+04	1.8E+02	7.5E-01	7.0E-03	5.4E-03	2.9E-03	1.2E-03	2.3E-04	1.0E-04	5.6E-04	1.2E-03
						3.5E+05	1.3E+04	1.4E+04	2.5E-01	9.4E-02	3.2E-02	3.2E-02	4.1E-02	3.9E-05	3.3E-03	5.8E-03	3.4E-02
PBL-06-3		0.035	4.0E+03	-8.1E+03	30.	2.9E+06	4.0E+03	4.4E+03	9.4E-01	2.2E-02	1.2E-02	6.6E-03	8.5E-04	3.0E-04	7.2E-05	4.1E-04	9.6E-04
						3.6E+05	1.3E+04	2.0E+04	6.3E-02	5.6E-02	4.6E-02	3.7E-02	5.2E-02	1.0E-04	1.4E-03	2.9E-03	3.2E-02
PBL-07	2.6E-06		6.2E+03	8.4E+02	30.	4.9E+07	1.5E+04	9.4E+02	6.0E-01	6.6E-03	5.7E-03	2.3E-03	1.4E-03	1.7E-04	1.0E-04	1.6E-04	1.1E-03
						5.5E+05	1.6E+04	1.5E+04	4.0E-01	6.8E-02	4.4E-02	1.9E-02	1.5E-02	4.3E-05	8.1E-04	1.7E-03	1.1E-02
PBL-07-1		0.153	1.8E+04	6.1E+03	30.	7.0E+06	3.3E+04	1.7E+03	7.6E-01	8.1E-03	6.4E-03	7.0E-03	8.1E-03	1.1E-04	2.8E-04	5.9E-04	5.8E-03
						1.4E+06	3.4E+04	1.6E+04	2.4E-01	1.7E-01	3.1E-02	2.2E-02	1.8E-02	3.7E-05	6.6E-04	1.3E-03	1.4E-02
PBL-07-2		0.751	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	5.9E-01	5.7E-03	5.3E-03	1.3E-03	1.7E-04	2.0E-04	7.5E-05	7.9E-05	2.3E-04
						3.7E+05	1.3E+04	1.4E+04	4.1E-01	5.1E-02	4.7E-02	2.0E-02	1.6E-02	3.7E-05	9.4E-04	1.9E-03	1.2E-02
PBL-07-3		0.096	4.0E+03	-8.1E+03	30.	2.5E+06	4.0E+03	5.6E+03	5.0E-01	1.1E-02	6.9E-03	2.5E-03	3.9E-04	7.9E-05	1.5E-05	6.1E-05	4.3E-04
						6.3E+05	1.3E+04	1.6E+04	5.0E-01	4.0E-02	4.2E-02	1.1E-02	3.1E-03	1.1E-04	1.1E-04	2.0E-04	2.0E-03
PBL-08	2.8E-06		2.6E+04	4.7E+03	30.	7.5E+06	3.8E+04	1.1E+03	6.9E-01	9.2E-04	7.9E-04	4.9E-04	4.0E-04	3.8E-05	1.9E-05	3.3E-05	3.1E-04
						1.9E+06	3.9E+04	1.5E+04	3.1E-01	5.7E-02	5.3E-02	1.6E-02	1.4E-02	1.5E-05	3.6E-04	6.6E-04	7.8E-03
PBL-08-1		1.000	2.6E+04	4.7E+03	30.	7.5E+06	3.8E+04	1.1E+03	6.9E-01	9.2E-04	7.9E-04	4.9E-04	4.0E-04	3.8E-05	1.9E-05	3.3E-05	3.1E-04
						1.9E+06	3.9E+04	1.5E+04	3.1E-01	5.7E-02	5.3E-02	1.6E-02	1.4E-02	1.5E-05	3.6E-04	6.6E-04	7.8E-03
PBL-08-2		0.000															
PBL-08-3		0.000															
PBL-09	1.0E-06		2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.2E-05	3.5E-05	6.5E-06	6.7E-06	4.7E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.8E-02	4.1E-02	7.3E-03	3.1E-03	3.0E-09	9.3E-05	1.5E-04	1.6E-03
PBL-09-1		1.000	2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.2E-05	3.5E-05	6.5E-06	6.7E-06	4.7E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.8E-02	4.1E-02	7.3E-03	3.1E-03	3.0E-09	9.3E-05	1.5E-04	1.6E-03
PBL-09-2		0.000															
PBL-09-3		0.000															
PBL-10	2.0E-07		5.0E+03	-3.5E+03	30.	2.8E+07	9.6E+03	3.0E+03	8.5E-01	6.6E-02	5.2E-02	3.2E-02	1.2E-02	2.1E-03	7.4E-04	3.2E-03	1.2E-02
						5.2E+05	1.4E+04	1.6E+04	1.5E-01	1.1E-01	1.2E-01	1.5E-01	1.9E-01	3.0E-03	1.5E-02	2.9E-02	1.6E-01
PBL-10-1		0.053	2.4E+04	5.3E+03	30.	9.6E+06	3.7E+04	9.3E+02	9.2E-01	1.1E-02	1.5E-02	3.9E-02	4.4E-02	6.3E-04	1.2E-03	2.7E-03	2.7E-02
						1.8E+06	3.8E+04	1.5E+04	7.7E-02	1.6E-01	1.3E-01	2.0E-01	2.8E-01	2.7E-03	2.5E-02	4.7E-02	2.4E-01
PBL-10-2		0.432	4.0E+03	9.0E+02	30.	6.1E+07	1.3E+04	1.8E+02	9.2E-01	3.1E-02	2.8E-02	1.5E-02	7.8E-03	1.8E-03	7.9E-04	3.5E-03	8.1E-03
						3.5E+05	1.3E+04	1.4E+04	8.4E-02	1.1E-01	1.3E-01	1.8E-01	2.4E-01	3.5E-04	1.7E-02	3.3E-02	1.9E-01
PBL-10-3		0.515	4.0E+03	-8.1E+03	30.	2.5E+06	4.0E+03	5.5E+03	7.9E-01	1.0E-01	7.6E-02	4.5E-02	1.2E-02	2.5E-03	6.5E-04	3.0E-03	1.3E-02
						5.3E+05	1.3E+04	1.7E+04	2.1E-01	1.0E-01	1.1E-01	1.1E-01	1.4E-01	5.3E-03	1.2E-02	2.3E-02	1.2E-01

Table 3.4-16 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBL-11	2.1E-06		1.1E+04	1.8E+03	30.	2.6E+07	2.1E+04	2.3E+03	8.1E-01	5.2E-02	4.6E-02	3.9E-02	2.3E-02	1.1E-03	1.1E-03	2.4E-03	1.8E-02
						9.5E+05	2.4E+04	1.6E+04	1.9E-01	1.0E-01	9.4E-02	5.4E-02	7.0E-02	1.8E-04	2.8E-03	5.3E-03	4.7E-02
PBL-11-1		0.444	2.0E+04	7.2E+03	30.	8.2E+06	3.5E+04	2.2E+03	8.2E-01	5.4E-02	5.1E-02	5.6E-02	4.8E-02	9.1E-04	2.2E-03	4.7E-03	3.5E-02
						1.6E+06	3.8E+04	1.6E+04	1.8E-01	8.1E-02	6.8E-02	7.1E-02	1.0E-01	3.0E-04	4.8E-03	9.1E-03	7.2E-02
PBL-11-2		0.347	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	1.9E+02	7.7E-01	3.5E-02	3.2E-02	1.9E-02	4.2E-03	1.2E-03	2.5E-04	7.6E-04	4.5E-03
						3.7E+05	1.3E+04	1.4E+04	2.3E-01	1.5E-01	1.5E-01	4.8E-02	5.7E-02	2.2E-05	1.5E-03	2.9E-03	3.5E-02
PBL-11-3		0.209	4.0E+03	-8.1E+03	30.	2.3E+06	4.0E+03	6.1E+03	8.5E-01	7.7E-02	6.2E-02	3.3E-02	2.5E-03	1.2E-03	1.3E-04	4.9E-04	3.1E-03
						4.7E+05	1.3E+04	1.7E+04	1.5E-01	6.3E-02	6.4E-02	2.7E-02	2.0E-02	1.9E-04	6.5E-04	1.2E-03	1.3E-02
PBL-12	2.7E-06		2.3E+04	7.6E+03	30.	5.9E+06	3.9E+04	3.7E+03	7.2E-01	3.4E-02	2.7E-02	2.2E-02	1.6E-02	4.6E-04	8.9E-04	2.0E-03	1.4E-02
						1.7E+06	4.2E+04	1.7E+04	2.8E-01	9.5E-02	7.9E-02	4.2E-02	5.3E-02	2.7E-06	1.7E-03	3.6E-03	3.5E-02
PBL-12-1		0.988	2.3E+04	7.6E+03	30.	5.2E+06	3.9E+04	3.8E+03	7.2E-01	3.4E-02	2.7E-02	2.3E-02	1.6E-02	4.6E-04	9.0E-04	2.1E-03	1.4E-02
						1.7E+06	4.3E+04	1.7E+04	2.8E-01	9.5E-02	7.9E-02	4.3E-02	5.4E-02	2.7E-06	1.7E-03	3.7E-03	3.6E-02
PBL-12-2		0.012	4.0E+03	2.6E+02	30.	6.0E+07	1.2E+04	8.0E+02	3.5E-01	2.2E-03	1.4E-03	6.3E-04	2.5E-04	2.2E-04	2.9E-05	3.3E-05	2.9E-04
						3.7E+05	1.3E+04	1.4E+04	6.5E-01	9.8E-02	9.9E-02	2.6E-02	4.1E-03	3.4E-08	7.0E-05	1.4E-04	2.7E-03
PBL-12-3		0.000															
PBL-13	3.6E-07		4.2E+03	-3.1E+03	30.	3.5E+07	9.2E+03	4.1E+03	4.8E-01	5.2E-02	3.8E-02	2.3E-02	1.5E-02	2.2E-03	1.4E-03	6.8E-03	1.5E-02
						5.6E+05	1.3E+04	1.3E+04	5.2E-01	5.1E-01	5.6E-01	4.7E-01	5.2E-01	1.8E-03	3.1E-02	6.3E-02	4.2E-01
PBL-13-1		0.014	2.5E+04	4.7E+03	30.	9.9E+06	3.7E+04	8.7E+02	5.7E-01	9.5E-03	1.0E-02	2.1E-02	2.3E-02	1.7E-04	1.9E-03	3.8E-03	2.0E-02
						1.8E+06	3.8E+04	1.4E+04	4.3E-01	5.6E-01	6.0E-01	5.7E-01	6.5E-01	5.0E-03	4.3E-02	8.5E-02	5.3E-01
PBL-13-2		0.536	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	4.9E-01	3.0E-02	2.8E-02	2.3E-02	2.1E-02	3.2E-03	2.1E-03	1.0E-02	2.1E-02
						3.7E+05	1.3E+04	1.4E+04	5.1E-01	5.2E-01	5.7E-01	4.6E-01	5.2E-01	4.9E-04	2.9E-02	6.0E-02	4.1E-01
PBL-13-3		0.450	4.0E+03	-8.1E+03	30.	1.4E+06	4.0E+03	8.8E+03	4.7E-01	8.0E-02	5.1E-02	2.3E-02	8.3E-03	1.1E-03	5.8E-04	2.8E-03	8.6E-03
						7.5E+05	1.3E+04	1.1E+04	5.3E-01	5.0E-01	5.5E-01	4.7E-01	5.3E-01	3.3E-03	3.2E-02	6.6E-02	4.2E-01
PBL-14	5.8E-06		2.2E+04	1.6E+03	30.	6.1E+06	3.1E+04	4.5E+03	4.9E-01	1.4E-02	1.1E-02	3.8E-03	6.4E-04	1.8E-04	6.1E-05	1.2E-04	6.9E-04
						1.3E+06	3.7E+04	1.8E+04	5.1E-01	4.3E-01	4.4E-01	3.5E-01	3.9E-01	1.1E-04	2.0E-02	4.1E-02	2.9E-01
PBL-14-1		0.747	2.7E+04	4.5E+03	30.	4.3E+06	4.0E+04	4.8E+03	4.7E-01	4.1E-03	4.1E-03	1.8E-03	4.8E-04	1.3E-04	6.4E-05	1.1E-04	4.9E-04
						1.6E+06	4.5E+04	1.8E+04	5.3E-01	4.7E-01	4.6E-01	3.7E-01	4.1E-01	1.2E-04	2.2E-02	4.6E-02	3.2E-01
PBL-14-2		0.034	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	4.3E-01	2.8E-02	2.3E-02	8.5E-03	1.2E-03	5.1E-04	1.3E-04	2.8E-04	1.5E-03
						3.7E+05	1.3E+04	1.4E+04	5.7E-01	4.9E-01	5.3E-01	1.9E-01	9.6E-02	1.3E-05	2.9E-03	5.8E-03	6.1E-02
PBL-14-3		0.219	4.0E+03	-8.1E+03	30.	3.0E+06	4.0E+03	4.3E+03	5.9E-01	4.7E-02	3.3E-02	1.0E-02	1.1E-03	2.9E-04	3.8E-05	1.4E-04	1.3E-03
						3.6E+05	1.3E+04	2.0E+04	4.1E-01	3.0E-01	3.6E-01	3.1E-01	3.4E-01	8.4E-05	1.4E-02	2.9E-02	2.4E-01
PBL-15	5.2E-07		2.7E+04	4.3E+03	30.	9.2E+06	3.9E+04	1.0E+03	4.0E-01	1.1E-02	1.0E-02	2.4E-03	3.8E-04	4.1E-04	1.3E-04	1.5E-04	4.9E-04
						1.8E+06	4.0E+04	1.5E+04	6.0E-01	5.6E-01	5.9E-01	1.3E-01	1.3E-02	1.8E-07	2.8E-04	5.1E-04	5.5E-03
PBL-15-1		0.948	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	4.1E-01	1.1E-02	1.1E-02	2.4E-03	3.7E-04	4.0E-04	1.3E-04	1.5E-04	4.8E-04
						1.9E+06	4.2E+04	1.4E+04	5.9E-01	5.7E-01	6.0E-01	1.3E-01	1.3E-02	7.3E-09	2.9E-04	5.2E-04	5.7E-03
PBL-15-2		0.052	4.0E+03	2.4E+02	30.	3.7E+07	1.2E+04	2.0E+03	3.1E-01	1.1E-02	7.8E-03	2.7E-03	6.3E-04	6.1E-04	1.1E-04	1.1E-04	8.0E-04
						3.2E+05	1.4E+04	1.7E+04	6.9E-01	3.9E-01	4.1E-01	8.1E-02	5.4E-03	3.3E-06	1.1E-04	1.9E-04	2.2E-03
PBL-15-3		0.000															

Table 3 4-16 (Concluded)

Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA

Source Term	Freq (1/yr)	Cond Prob	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PBL-16	4 4E-08		4 2E+03	9 9E+03	30	1 3E+06	2 2E+04	9 0E+03	7 1E-03	3 3E-06	6 3E-08	3 2E-07	6 4E-08	1 0E-08	6 7E-09	1 1E-08	5 7E-08
						2 5E+05	3 1E+04	2 2E+04	7 1E-03	3 3E-06	6 3E-08	3 2E-07	6 4E-08	1 0E-08	6 7E-09	1 1E-08	5 7E-08
PBL-16-1		1 000	4 2E+03	9 9E+03	30	1 3E+06	2 2E+04	9 0E+03	7 1E-03	3 3E-06	6 3E-08	3 2E-07	6 4E-08	1 0E-08	6 7E-09	1 1E-08	5 7E-08
						2 5E+05	3 1E+04	2 2E+04	7 1E-03	3 3E-06	6 3E-08	3 2E-07	6 4E-08	1 0E-08	6 7E-09	1 1E-08	5 7E-08
PBL-16-2		0 000															
PBL-16-3		0 000															
PBL-17	2 1E-07		2 7E+04	7 3E+03	30	5 1E+06	4 2E+04	3 9E+03	8 1E-01	5 4E-04	1 6E-04	9 7E-05	3 6E-05	2 9E-06	1 8E-06	2 6E-06	2 3E-05
						1 7E+06	4 6E+04	1 7E+04	1 9E-01	2 2E-03	1 0E-03	1 4E-04	4 1E-05	1 4E-06	1 7E-06	2 6E-06	2 6E-05
PBL-17-1		1 000	2 7E+04	7 3E+03	30	5 1E+06	4 2E+04	3 9E+03	8 1E-01	5 4E-04	1 6E-04	9 7E-05	3 6E-05	2 9E-06	1 8E-06	2 6E-06	2 3E-05
						1 7E+06	4 6E+04	1 7E+04	1 9E-01	2 2E-03	1 0E-03	1 4E-04	4 1E-05	1 4E-06	1 7E-06	2 6E-06	2 6E-05
PBL-17-2		0 000															
PBL-17-3		0 000															
PBL-18	2 8E-07		2 8E+04	5 1E+03	30	7 3E+06	4 1E+04	1 4E+03	5 9E-01	7 2E-04	6 3E-04	4 2E-04	2 0E-04	1 3E-04	2 1E-05	2 5E-05	2 0E-04
						1 9E+06	4 3E+04	1 5E+04	4 1E-01	4 2E-03	2 9E-03	1 1E-03	1 1E-03	7 7E-06	6 4E-05	1 1E-04	7 4E-04
PBL-18-1		1 000	2 8E+04	5 1E+03	30	7 3E+06	4 1E+04	1 4E+03	5 9E-01	7 2E-04	6 3E-04	4 2E-04	2 0E-04	1 3E-04	2 1E-05	2 5E-05	2 0E-04
						1 9E+06	4 3E+04	1 5E+04	4 1E-01	4 2E-03	2 9E-03	1 1E-03	1 1E-03	7 7E-06	6 4E-05	1 1E-04	7 4E-04
PBL-18-2		0 000															
PBL-18-3		0 000															
PBL-19	2 1E-06		2 9E+04	4 5E+03	30	7 6E+06	4 1E+04	9 4E+02	8 7E-01	3 0E-04	3 3E-04	7 7E-05	1 3E-05	8 2E-06	3 4E-06	4 1E-06	1 3E-05
						1 9E+06	4 2E+04	1 4E+04	1 3E-01	1 6E-02	2 1E-02	4 5E-03	4 8E-04	1 9E-07	1 2E-05	2 2E-05	3 0E-04
PBL-19-1		1 000	2 9E+04	4 5E+03	30	7 6E+06	4 1E+04	9 4E+02	8 7E-01	3 0E-04	3 3E-04	7 7E-05	1 3E-05	8 2E-06	3 4E-06	4 1E-06	1 3E-05
						1 9E+06	4 2E+04	1 4E+04	1 3E-01	1 6E-02	2 1E-02	4 5E-03	4 8E-04	1 9E-07	1 2E-05	2 2E-05	3 0E-04
PBL-19-2		0 000															
PBL-19-3		0 000															

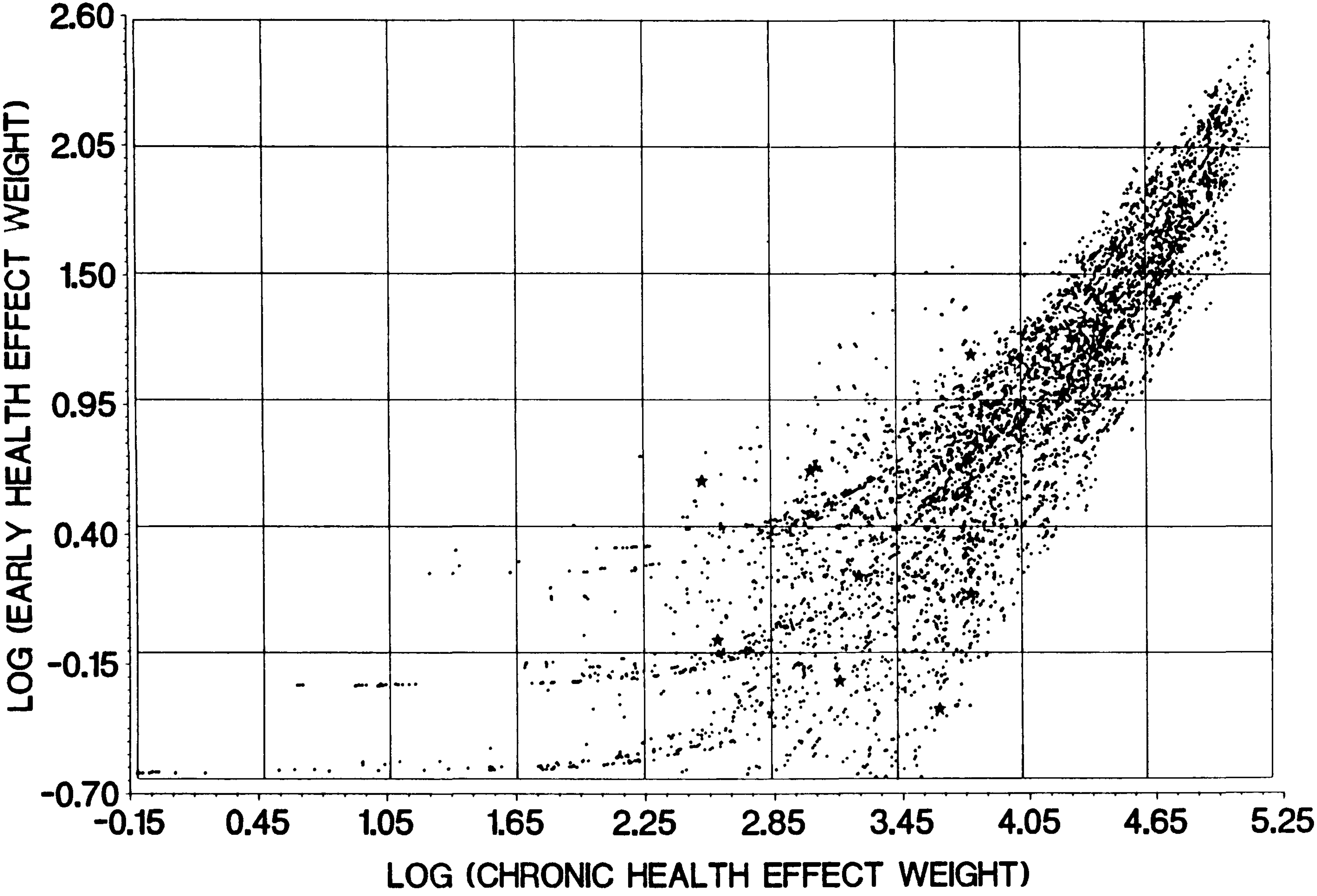

Figure 3.4-3. Distribution of Nonzero Early and Chronic Health Effect Weights for Seismic Initiators -- LLNL - High PGA

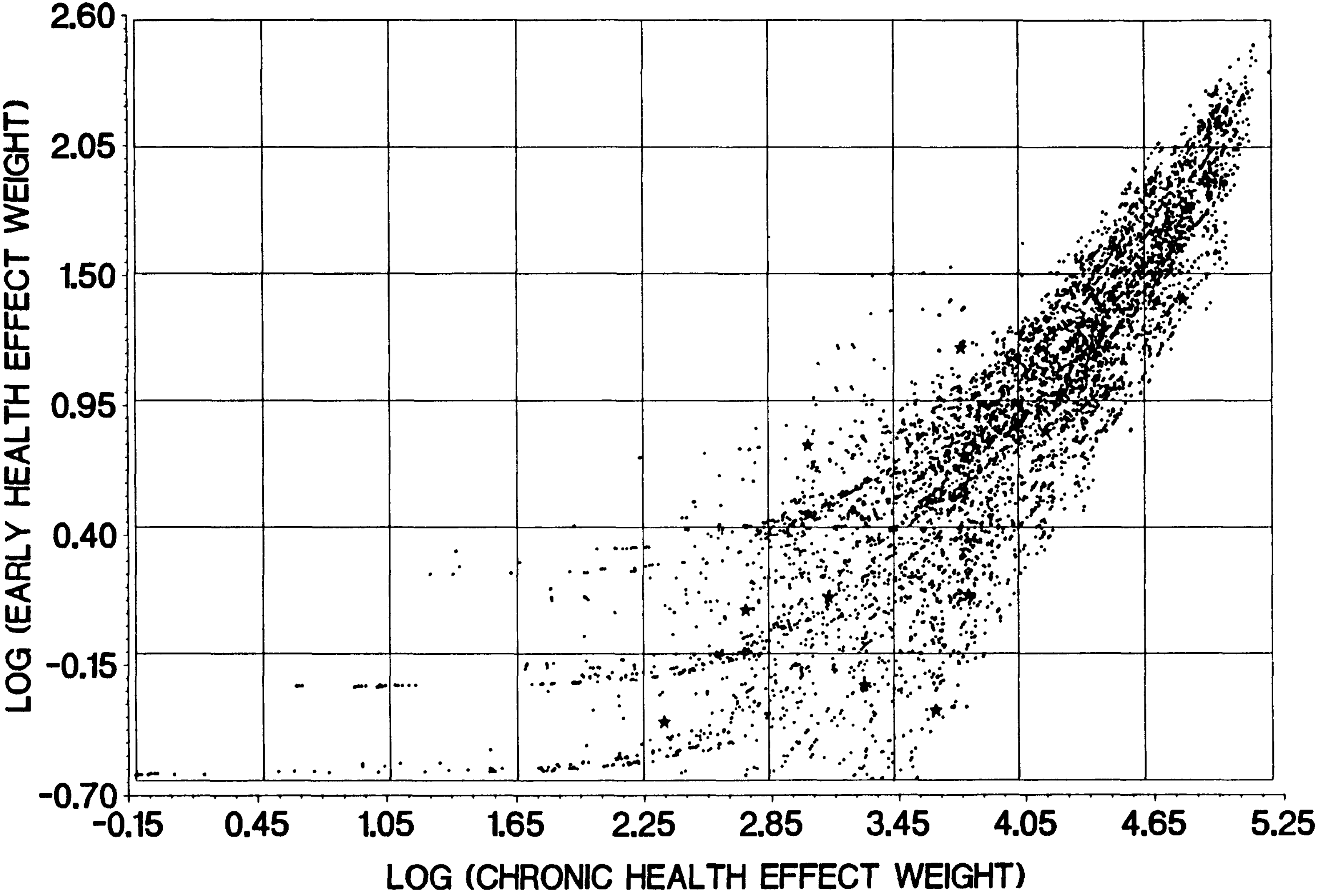

Figure 3.4-4. Distribution of Nonzero Early and Chronic Health Effect Weights for Seismic Initiators -- LLNL - Low PGA

source term groups are PBH-14, PBH-07, PBH-11, and PBH-06 for the Hi PGA case and PBL-14, PBL-06, PBL-08, and PBL-12 for the Low PGA case. For the seismic APBs, there is even less potential for recovery than in the fire analysis and all of the most likely groups have the potential to cause early fatalities with relatively high early health effect weights associated with the groups. In particular, PBH-14 and PBL-14 are the next highest source term groups in terms of early and chronic health effect weights and they are also the most frequent.

3.4.6 Sensitivity Analyses for Seismic Initiators: LLNL Hazard Curve

The only sensitivity carried through to risk for the LLNL hazard curve involved the elimination of initial containment failure from RPV support plate failure inducing a drywell shell failure at one of the penetration lines. The partitioning results for the high and low PGA cases are presented in Tables 3.4-17, 3.4-19, 3.4-20 and 3.4-18, 3.4-21, 3.4-22 respectively. Tables 3.4-23 and 3.4-24 contain the mean source terms from partitioning for this sensitivity calculation where PB2-XX represents the high PGA case and PB1-XX represents the low PGA case.

3.4.7 Results for Seismic Initiators: EPRI Hazard Curve

This section presents the results of partitioning the source terms for seismic initiators based on the EPRI hazard distributions. The partitioning process is described in Section 3.4.1. The partitioning process does not result in the loss of any source terms; rather, cells with a small number of source terms or a small frequency are pooled with other cells. Because of the differences in the evacuation of the surrounding population for large earthquakes, the consequence analysis was performed separately for seisms with PGA less than 0.6 g and greater than 0.6 g. Thus partitioning of the high acceleration and low acceleration earthquakes was performed separately.

As mentioned before, for Peach Bottom the accident progression analysis and source term analysis did not need to be performed separately for either the hazard curves or PGA levels because no variables were sampled in the APET differently for the two hazard curves or levels. This is different than for the Surry plant where, because of the grouping of the PDSs into PDSGs, the split fractions were different for the LLNL and EPRI hazard curves and the high and low PGA cases. No split fractions for Peach Bottom depended upon the seismic hazard curve or PGA level. The only difference in the cases for Peach Bottom is the relative frequency of the PDSs. Since the accident progression and source term analysis are conditional on the PDS frequency, this difference would not result in different outcomes for the two hazard curves or PGA levels at Peach Bottom.

For the MACCS calculation two evacuation assumptions were used for the different cases and two separate runs were done. In addition, in the partitioning process, the frequencies of the PDSs are used to calculate frequencies for the APBs and these are used both in the partitioning itself

Table 3.4-17
Summary of Early and Chronic Health Effect Weights for Seismic Initiators -- LLNL - High PGA - No CF at T=0

	Number of Source Terms	Percent of Total Frequency
EH>0 AND CH>0	8269	95.50
EH=0 AND CH>0	444	4.50
EH=0 AND CH=0	0	0.00
TOTAL	8713	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.1951
RANGE LOG10(EH) = -0.6377 TO 2.5104

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -1.5655 TO 3.5647

Table 3.4-18
Summary of Early and Chronic Health Effect Weights for Seismic Initiators -- LLNL - Low PGA - No CF at T=0

	Number of Source Terms	Percent of Total Frequency
EH>0 AND CH>0	8269	90.50
EH=0 AND CH>0	444	9.50
EH=0 AND CH=0	0	0.00
TOTAL	8713	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.1951
RANGE LOG10(EH) = -0.6377 TO 2.5104

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -1.5655 TO 3.5647

Table 3.4-19
Distribution of Source Terms with Nonzero Early Fatality and
Chronic Fatality Weights for Seismic Initiators -- LLNL - High PGA
No CF at T=0

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  8269:

          1      2      3      4      5      6      7      8      9
      +------+------+------+------+------+------+------+------+------+
   1  |      |      |      |      |      |      |      |      |  425 |
      +------+------+------+------+------+------+------+------+------+
   2  |      |      |      |      |      |    4 |    4 |  419 | 1135 |
      +------+------+------+------+------+------+------+------+------+
   3  |      |      |      |      |      |   26 |  256 | 1667 |  270 |
      +------+------+------+------+------+------+------+------+------+
   4  |      |      |      |    2 |   37 |  329 | 1130 |  578 |      |
      +------+------+------+------+------+------+------+------+------+
   5  |      |      |   10 |   38 |  175 |  424 |  569 |   28 |      |
      +------+------+------+------+------+------+------+------+------+
   6  |   10 |   26 |   18 |  152 |  210 |  228 |   99 |      |      |
      +------+------+------+------+------+------+------+------+------+


 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8      9
      +------+------+------+------+------+------+------+------+------+
   1  |      |      |      |      |      |      |      |      | 3.36 |
      +------+------+------+------+------+------+------+------+------+
   2  |      |      |      |      |      | 0.00 | 0.00 | 5.35 |14.77 |
      +------+------+------+------+------+------+------+------+------+
   3  |      |      |      |      |      | 0.95 |17.89 |11.56 | 0.91 |
      +------+------+------+------+------+------+------+------+------+
   4  |      |      |      | 0.05 | 0.32 | 6.19 |19.21 | 3.32 |      |
      +------+------+------+------+------+------+------+------+------+
   5  |      |      | 0.64 | 3.03 | 2.65 | 1.17 | 4.80 | 0.01 |      |
      +------+------+------+------+------+------+------+------+------+
   6  | 0.00 | 0.01 | 0.02 | 0.31 | 0.24 | 1.49 | 1.77 |      |      |
      +------+------+------+------+------+------+------+------+------+
```

Table 3.4-19 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - High PGA
No CF at T=0

AFTER PARTITIONING:

```
CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  8269:

        1      2      3      4      5      6      7      8      9
    +------+------+------+------+------+------+------+------+------+
  1 |      |      |      |      |      |      |      |      | 425  |
    +------+------+------+------+------+------+------+------+------+
  2 |      |      |      |      |      |      |      | 652  | 1144 |
    +------+------+------+------+------+------+------+------+------+
  3 |      |      |      |      |      |      | 276  | 1695 |      |
    +------+------+------+------+------+------+------+------+------+
  4 |      |      |      |      |      | 351  | 1130 | 593  |      |
    +------+------+------+------+------+------+------+------+------+
  5 |      |      |      | 257  | 349  | 424  | 582  |      |      |
    +------+------+------+------+------+------+------+------+------+
  6 |      |      |      |      |      | 292  |  99  |      |      |
    +------+------+------+------+------+------+------+------+------+
```

```
PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

        1      2      3      4      5      6      7      8      9
    +------+------+------+------+------+------+------+------+------+
  1 |      |      |      |      |      |      |      |      | 3.36 |
    +------+------+------+------+------+------+------+------+------+
  2 |      |      |      |      |      |      |      | 5.85 |15.17 |
    +------+------+------+------+------+------+------+------+------+
  3 |      |      |      |      |      |      |17.91 |11.56 |      |
    +------+------+------+------+------+------+------+------+------+
  4 |      |      |      |      |      | 7.11 |19.21 | 3.33 |      |
    +------+------+------+------+------+------+------+------+------+
  5 |      |      |      | 4.06 | 3.15 | 1.17 | 4.80 |      |      |
    +------+------+------+------+------+------+------+------+------+
  6 |      |      |      |      |      | 1.54 | 1.77 |      |      |
    +------+------+------+------+------+------+------+------+------+
```

Table 3.4-19 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - High PGA
No CF at T=0

LABELING AFTER PARTITIONING:

	1	2	3	4	5	6	7	8	9
1									PB2-13
2								PB2-10	PB2-14
3							PB2-06	PB2-11	
4						PB2-03	PB2-07	PB2-12	
5				PB2-01	PB2-02	PB2-04	PB2-08		
6						PB2-05	PB2-09		

Table 3.4-20
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Seismic Initiators -- LLNL - High PGA
No CF at T=0

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
   1 |    1 |      |    7 |    6 |   20 |   93 |  187 |  130 |
     +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
   1 | 2.47 |      | 0.02 | 0.00 | 0.89 | 6.96 |10.82 |78.85 |
     +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
   1 |      |      |      |      |      |  127 |  187 |  130 |
     +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
   1 |      |      |      |      |      |10.34 |10.82 |78.85 |
     +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

         1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
   1 |      |      |      |      |      |PB2-15|PB2-16|PB2-17|
     +------+------+------+------+------+------+------+------+
```

Table 3.4-21
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - Low PGA
No CF at T=0

BEFORE PARTITIONING:

CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 8269:

	1	2	3	4	5	6	7	8	9
1									425
2						4	4	419	1135
3						26	256	1667	270
4				2	37	329	1130	578	
5			10	38	175	424	569	28	
6	10	26	18	152	210	228	99		

PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

	1	2	3	4	5	6	7	8	9
1									1.98
2						0.01	0.00	2.07	19.94
3						2.13	19.03	10.95	1.57
4				0.02	0.13	2.27	11.16	6.75	
5			0.17	1.12	2.17	0.96	10.75	0.03	
6	0.00	0.01	0.02	0.25	0.37	2.14	3.99		

Table 3.4-21 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and
Chronic Fatality Weights for Seismic Initiators -- LLNL - Low PGA
No CF at T=0

AFTER PARTITIONING:

CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 8269:

	1	2	3	4	5	6	7	8	9
1									425
2								419	1135
3						27	264	1667	270
4						517	1130	593	
5				245	518		604		
6						356	99		

PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

	1	2	3	4	5	6	7	8	9
1									1.98
2								2.07	19.94
3						2.13	19.04	10.95	1.57
4						2.66	11.16	6.77	
5				1.49	3.10		10.80		
6						2.34	3.99		

Table 3.4-21 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- LLNL - Low PGA
No CF at T=0

LABELING AFTER PARTITIONING:

	1	2	3	4	5	6	7	8	9
1									PB1-13
2								PB1-10	PB1-14
3						PB1-03	PB1-06	PB1-11	PB1-15
4						PB1-04	PB1-07	PB1-12	
5				PB1-01	PB1-02		PB1-08		
6						PB1-05	PB1-09		

Table 3.4-22
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Seismic Initiators -- LLNL - Low PGA
No CF at T=0

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
    1 |    1 |      |    7 |    6 |   20 |   93 |  187 |  130 |
      +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
    1 | 1.67 |      | 0.02 | 0.00 | 0.89 | 7.02 |10.91 |79.50 |
      +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
    1 |      |      |      |      |      |  127 |  187 |  130 |
      +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
    1 |      |      |      |      |      | 9.60 |10.91 |79.50 |
      +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

          1      2      3      4      5      6      7      8
      +------+------+------+------+------+------+------+------+
    1 |      |      |      |      |      |PB1-16|PB1-17|PB1-18|
      +------+------+------+------+------+------+------+------+
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Table 3.4-23
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB2-01	1.8E-06		4.1E+03	1.5E+03	30.	1.5E+07	1.4E+04	2.9E+03	8.7E-01	4.0E-04	2.6E-04	1.0E-04	3.6E-05	2.9E-06	1.4E-06	3.5E-06	2.8E-05
						2.9E+05	1.7E+04	2.0E+04	1.3E-01	1.5E-03	4.1E-04	1.1E-04	4.2E-05	2.8E-07	3.4E-06	5.7E-06	3.1E-05
PB2-01-1		0.068	5.6E+03	9.0E+03	30.	7.5E+06	2.3E+04	3.0E+03	6.0E-01	4.9E-04	3.2E-04	5.1E-04	3.5E-04	1.5E-06	1.2E-05	2.3E-05	2.2E-04
						5.1E+05	2.6E+04	2.0E+04	4.0E-01	9.3E-04	5.6E-04	5.1E-04	3.4E-04	1.2E-06	1.1E-05	2.0E-05	2.1E-04
PB2-01-2		0.932	4.0E+03	9.0E+02	30.	1.6E+07	1.3E+04	2.9E+03	8.9E-01	3.9E-04	2.5E-04	7.5E-05	1.3E-05	3.0E-06	6.1E-07	2.1E-06	1.5E-05
						2.7E+05	1.6E+04	2.0E+04	1.1E-01	1.6E-03	4.0E-04	8.0E-05	2.0E-05	2.1E-07	2.9E-06	4.7E-06	1.8E-05
PB2-01-3		0.000															
PB2-02	1.4E-06		9.0E+03	2.5E+03	30.	3.8E+07	2.0E+04	1.0E+03	6.7E-01	2.8E-03	1.2E-03	6.1E-04	1.8E-04	1.7E-05	1.2E-05	2.5E-05	1.5E-04
						6.5E+05	2.1E+04	1.6E+04	3.3E-01	2.3E-02	3.5E-03	1.0E-03	8.2E-04	3.8E-06	3.0E-05	5.4E-05	5.0E-04
PB2-02-1		0.298	2.1E+04	6.4E+03	30.	1.8E+07	3.5E+04	1.4E+03	8.9E-01	4.9E-03	9.4E-04	8.6E-04	5.1E-04	2.5E-05	3.3E-05	6.7E-05	4.0E-04
						1.5E+06	3.7E+04	1.5E+04	1.1E-01	6.6E-02	3.0E-03	4.4E-04	2.0E-04	9.7E-06	1.2E-05	2.2E-05	1.5E-04
PB2-02-2		0.702	4.0E+03	9.0E+02	30.	4.7E+07	1.3E+04	8.3E+02	5.8E-01	1.9E-03	1.3E-03	5.0E-04	3.7E-05	1.4E-05	3.0E-06	7.6E-06	5.2E-05
						3.1E+05	1.4E+04	1.6E+04	4.2E-01	4.4E-03	3.7E-03	1.3E-03	1.1E-03	1.2E-06	3.7E-05	6.7E-05	6.5E-04
PB2-02-3		0.000															
PB2-03	3.2E-06		7.2E+03	1.4E+03	30.	3.9E+07	1.7E+04	9.2E+02	8.4E-01	4.6E-03	3.6E-03	1.7E-03	2.5E-04	9.8E-05	2.1E-05	4.9E-05	2.9E-04
						5.2E+05	1.8E+04	1.6E+04	1.6E-01	8.6E-02	5.5E-03	2.3E-03	2.7E-03	2.9E-06	1.1E-04	2.0E-04	1.8E-03
PB2-03-1		0.142	2.7E+04	4.6E+03	30.	8.8E+06	3.9E+04	1.0E+03	4.2E-01	1.5E-03	1.1E-03	6.3E-04	2.8E-04	9.1E-05	2.9E-05	5.4E-05	2.9E-04
						1.9E+06	4.1E+04	1.5E+04	5.8E-01	4.3E-01	5.1E-03	1.9E-03	1.7E-03	2.5E-06	8.7E-05	1.8E-04	1.3E-03
PB2-03-2		0.858	4.0E+03	9.0E+02	30.	4.4E+07	1.3E+04	9.1E+02	9.1E-01	5.1E-03	4.0E-03	1.9E-03	2.5E-04	9.9E-05	1.9E-05	4.8E-05	2.9E-04
						3.0E+05	1.4E+04	1.6E+04	9.3E-02	3.0E-02	5.5E-03	2.4E-03	2.8E-03	2.9E-06	1.1E-04	2.1E-04	1.9E-03
PB2-03-3		0.000															
PB2-04	5.3E-07		7.4E+03	6.2E+03	30.	2.5E+07	2.2E+04	1.3E+03	7.2E-01	1.1E-02	4.8E-03	5.3E-03	3.3E-03	4.2E-05	2.3E-04	4.8E-04	2.8E-03
						5.0E+05	2.3E+04	1.6E+04	2.8E-01	1.6E-02	5.4E-03	3.0E-03	2.3E-03	3.0E-05	1.3E-04	2.5E-04	1.7E-03
PB2-04-1		0.626	9.4E+03	9.4E+03	30.	3.2E+07	2.7E+04	1.2E+03	8.2E-01	1.7E-02	6.9E-03	8.2E-03	5.3E-03	6.3E-05	3.6E-04	7.6E-04	4.4E-03
						7.0E+05	2.8E+04	1.6E+04	1.8E-01	1.9E-02	3.2E-03	2.8E-03	2.3E-03	3.2E-05	1.5E-04	3.1E-04	1.9E-03
PB2-04-2		0.374	4.0E+03	9.0E+02	30.	1.4E+07	1.3E+04	1.5E+03	5.5E-01	2.0E-03	1.2E-03	3.5E-04	1.2E-05	7.7E-06	1.5E-06	1.7E-06	2.3E-05
						1.7E+05	1.5E+04	1.7E+04	4.5E-01	9.2E-03	9.0E-03	3.4E-03	2.3E-03	2.5E-05	8.0E-05	1.5E-04	1.5E-03
PB2-04-3		0.000															
PB2-05	7.0E-07		1.1E+04	7.1E+03	30.	5.5E+06	2.6E+04	2.4E+03	6.9E-01	2.9E-03	1.6E-03	2.2E-03	1.4E-03	2.1E-05	1.1E-04	2.3E-04	1.2E-03
						1.2E+06	2.9E+04	1.8E+04	3.1E-01	1.2E-02	1 2E-02	4.5E-03	2.1E-03	8.6E-06	1.7E-04	3.4E-04	1 7E-03
PB2-05-1		0.997	1.1E+04	7.2E+03	30.	5.5E+06	2.6E+04	2.4E+03	6.9E-01	2.9E-03	1.6E-03	2.2E-03	1.4E-03	2.1E-05	1.1E-04	2.3E-04	1.2E-03
						1.2E+06	2.9E+04	1.8E+04	3.1E-01	1.2E-02	1.2E-02	4.5E-03	2.1E-03	8.7E-06	1.7E-04	3.4E-04	1.7E-03
PB2-05-2		0.003	4.0E+03	9.0E+02	30.	3.2E+06	1.3E+04	3.6E+03	7.4E-02	1.0E-04	9.5E-05	2.5E-05	8.5E-08	0.0E+00	0.0E+00	0.0E+00	1.1E-06
						2.4E+05	1.7E+04	2.2E+04	9.3E-01	5.4E-03	4.5E-03	3.9E-04	2.9E-06	5.9E-12	2.2E-07	2.7E-07	1.9E-06
PB2-05-3		0.000															

Table 3.4-23 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB2-06	8.2E-06		1.3E+04	2.2E+03	30.	3.0E+07	2.3E+04	4.5E+02	5.1E-01	5.8E-03	4.4E-03	1.7E-03	2.2E-04	1.0E-04	2.8E-05	8.2E-05	2.7E-04
						8.5E+05	2.4E+04	1.4E+04	4.9E-01	2.9E-01	3.8E-02	3.2E-02	3.6E-02	1.4E-05	2.1E-03	4.2E-03	2.8E-02
PB2-06-1		0.372	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.0E+02	5.0E-01	1.8E-03	1.9E-03	4.4E-04	9.1E-05	7.2E-05	2.4E-05	3.9E-05	1.1E-04
						1.9E+06	4.2E+04	1.4E+04	5.0E-01	5.9E-01	3.0E-02	2.5E-02	2.8E-02	4.9E-06	1.6E-03	3.2E-03	2.2E-02
PB2-06-2		0.628	4.0E+03	9.0E+02	30.	4.3E+07	1.3E+04	1.8E+02	5.1E-01	8.2E-03	5.9E-03	2.5E-03	3.0E-04	1.2E-04	3.0E-05	1.1E-04	3.7E-04
						2.5E+05	1.3E+04	1.4E+04	4.9E-01	1.0E-01	4.3E-02	3.6E-02	4.1E-02	1.9E-05	2.4E-03	4.7E-03	3.2E-02
PB2-06-3		0.000															
PB2-07	8.8E-06		4.9E+03	1.3E+03	30.	5.5E+07	1.4E+04	3.7E+02	6.2E-01	5.8E-03	4.6E-03	2.3E-03	1.1E-03	2.7E-04	8.2E-05	1.2E-04	9.5E-04
						4.1E+05	1.5E+04	1.5E+04	3.8E-01	6.0E-02	5.0E-02	1.9E-02	1.3E-02	1.2E-04	6.9E-04	1.4E-03	9.7E-03
PB2-07-1		0.074	1.7E+04	6.8E+03	30.	8.1E+06	3.2E+04	2.0E+03	6.2E-01	1.0E-02	8.1E-03	9.4E-03	1.1E-02	1.3E-04	4.1E-04	8.6E-04	7.9E-03
						1.2E+06	3.4E+04	1.7E+04	3.8E-01	1.2E-01	3.8E-02	2.1E-02	1.6E-02	5.6E-05	5.2E-04	1.1E-03	1.2E-02
PB2-07-2		0.926	4.0E+03	9.0E+02	30.	5.9E+07	1.3E+04	2.4E+02	6.2E-01	5.4E-03	4.3E-03	1.7E-03	3.2E-04	2.8E-04	5.5E-05	6.5E-05	3.9E-04
						3.4E+05	1.3E+04	1.5E+04	3.8E-01	5.5E-02	5.1E-02	1.9E-02	1.3E-02	1.2E-04	7.0E-04	1.4E-03	9.6E-03
PB2-07-3		0.000															
PB2-08	2.2E-06		2.5E+04	4.6E+03	30.	7.6E+06	3.8E+04	1.0E+03	7.1E-01	8.1E-04	7.1E-04	4.0E-04	2.8E-04	3.9E-05	1.7E-05	2.8E-05	2.3E-04
						1.9E+06	3.9E+04	1.5E+04	2.9E-01	5.2E-02	5.1E-02	1.6E-02	1.4E-02	1.6E-05	3.8E-04	6.9E-04	8.0E-03
PB2-08-1		1.000	2.5E+04	4.6E+03	30.	7.6E+06	3.8E+04	1.0E+03	7.1E-01	8.1E-04	7.1E-04	4.0E-04	2.8E-04	3.9E-05	1.7E-05	2.8E-05	2.3E-04
						1.9E+06	3.9E+04	1.5E+04	2.9E-01	5.2E-02	5.1E-02	1.6E-02	1.4E-02	1.6E-05	3.8E-04	6.9E-04	8.0E-03
PB2-08-2		0.000	4.4E+03	8.7E+02	30.	2.2E+06	1.3E+04	2.7E+03	1.7E-01	1.7E-03	1.1E-03	2.8E-04	9.3E-06	1.9E-06	9.1E-07	1.7E-06	2.2E-05
						1.9E+05	1.6E+04	1.9E+04	8.3E-01	2.9E-02	2.7E-02	8.8E-03	7.4E-03	1.3E-06	4.0E-04	8.1E-04	5.6E-03
PB2-08-3		0.000															
PB2-09	8.1E-07		2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.4E-05	3.6E-05	6.6E-06	6.9E-06	4.8E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.7E-02	4.1E-02	7.1E-03	3.1E-03	3.0E-09	9.1E-05	1.4E-04	1.5E-03
PB2-09-1		1.000	2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.4E-05	3.6E-05	6.6E-06	6.9E-06	4.8E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.7E-02	4.1E-02	7.1E-03	3.1E-03	3.0E-09	9.1E-05	1.4E-04	1.5E-03
PB2-09-2		0.000															
PB2-09-3		0.000															
PB2-10	2.7E-06		5.1E+03	1.1E+03	30.	4.1E+07	1.4E+04	3.5E+02	8.8E-01	8.6E-02	7.2E-02	2.8E-02	4.9E-03	1.6E-03	2.9E-04	8.5E-04	5.2E-03
						3.3E+05	1.5E+04	1.5E+04	1.2E-01	1.2E-01	1.6E-01	1.5E-01	1.8E-01	1.0E-04	6.4E-03	1.3E-02	1.2E-01
PB2-10-1		0.049	2.6E+04	4.7E+03	30.	8.1E+06	3.9E+04	1.0E+03	5.6E-01	2.5E-02	2.6E-02	1.3E-02	1.1E-02	3.0E-04	3.5E-04	6.8E-04	6.7E-03
						1.9E+06	4.0E+04	1.5E+04	4.4E-01	3.9E-01	4.1E-01	1.2E-01	4.9E-02	5.2E-04	3.4E-03	6.1E-03	3.3E-02
PB2-10-2		0.951	4.0E+03	9.0E+02	30.	4.2E+07	1.3E+04	3.1E+02	9.0E-01	8.9E-02	7.5E-02	2.9E-02	4.6E-03	1.7E-03	2.9E-04	8.6E-04	5.1E-03
						2.5E+05	1.3E+04	1.5E+04	1.0E-01	1.1E-01	1.4E-01	1.5E-01	1.9E-01	7.9E-05	6.6E-03	1.3E-02	1.2E-01
PB2-10-3		0.000															

Table 3.4-23 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB2-11	5.3E-06		8.1E+03	3.8E+03	30.	4.4E+07	2.0E+04	1.8E+03	7.2E-01	2.6E-02	2.1E-02	1.9E-02	1.5E-02	6.2E-04	8.3E-04	1.9E-03	1.2E-02
						6.9E+05	2.2E+04	1.6E+04	2.8E-01	1.4E-01	1.3E-01	5.1E-02	4.6E-02	6.0E-05	1.8E-03	3.5E-03	3.1E-02
PB2-11-1		0.319	1.7E+04	1.0E+04	30.	6.3E+06	3.5E+04	5.1E+03	6.8E-01	5.7E-02	4.6E-02	4.9E-02	4.4E-02	4.6E-04	2.2E-03	4.8E-03	3.5E-02
						1.4E+06	4.0E+04	1.8E+04	3.2E-01	6.9E-02	5.5E-02	5.6E-02	7.2E-02	1.2E-04	3.3E-03	6.7E-03	5.3E-02
PB2-11-2		0.681	4.0E+03	9.0E+02	30.	6.2E+07	1.3E+04	2.4E+02	7.5E-01	1.2E-02	9.4E-03	5.3E-03	1.6E-03	7.0E-04	2.0E-04	6.0E-04	1.7E-03
						3.5E+05	1.3E+04	1.5E+04	2.5E-01	1.8E-01	1.7E-01	4.9E-02	3.3E-02	3.4E-05	1.0E-03	1.9E-03	2.0E-02
PB2-11-3		0.000															
PB2-12	1.5E-06		2.5E+04	4.3E+03	30.	1.2E+07	3.8E+04	1.1E+03	8.1E-01	1.9E-02	1.8E-02	1.1E-02	2.1E-03	6.4E-04	1.9E-04	4.0E-04	2.1E-03
						1.7E+06	3.9E+04	1.5E+04	1.9E-01	1.1E-01	1.0E-01	4.0E-02	5.0E-02	8.3E-07	1.2E-03	2.4E-03	3.0E-02
PB2-12-1		0.891	2.8E+04	4.7E+03	30.	7.6E+06	4.1E+04	1.1E+03	8.3E-01	2.1E-02	2.0E-02	1.2E-02	2.3E-03	6.8E-04	2.1E-04	4.4E-04	2.3E-03
						1.9E+06	4.2E+04	1.5E+04	1.7E-01	1.1E-01	9.9E-02	4.1E-02	5.6E-02	9.3E-07	1.4E-03	2.7E-03	3.3E-02
PB2-12-2		0.109	4.0E+03	9.0E+02	30.	4.9E+07	1.3E+04	1.0E+03	6.9E-01	3.1E-03	2.6E-03	1.6E-03	3.8E-04	3.4E-04	5.0E-05	5.7E-05	4.7E-04
						3.4E+05	1.4E+04	1.6E+04	3.1E-01	9.6E-02	1.0E-01	3.2E-02	2.2E-03	7.6E-10	5.2E-05	9.0E-05	1.4E-03
PB2-12-3		0.000															
PB2-13	1.5E-06		5.4E+03	1.3E+03	30.	5.8E+07	1.5E+04	3.0E+02	4.9E-01	3.4E-02	3.2E-02	2.7E-02	2.5E-02	3.9E-03	2.5E-03	1.2E-02	2.5E-02
						5.3E+05	1.5E+04	1.4E+04	5.1E-01	5.9E-01	6.4E-01	5.4E-01	6.1E-01	7.8E-04	3.5E-02	7.1E-02	4.8E-01
PB2-13-1		0.107	1.7E+04	4.5E+03	30.	7.8E+06	3.0E+04	9.0E+02	4.5E-01	1.9E-03	1.9E-03	1.8E-03	1.6E-03	1.0E-04	1.5E-04	2.8E-04	1.4E-03
						1.9E+06	3.1E+04	1.4E+04	5.5E-01	5.6E-01	5.8E-01	4.9E-01	5.5E-01	3.3E-04	3.0E-02	6.2E-02	4.3E-01
PB2-13-2		0.893	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.3E+02	5.0E-01	3.8E-02	3.6E-02	3.0E-02	2.8E-02	4.3E-03	2.8E-03	1.4E-02	2.8E-02
						3.7E+05	1.3E+04	1.5E+04	5.0E-01	5.9E-01	6.5E-01	5.5E-01	6.1E-01	8.4E-04	3.6E-02	7.2E-02	4.8E-01
PB2-13-3		0.000															
PB2-14	6.9E-06		1.7E+04	2.8E+03	30.	3.1E+07	2.8E+04	2.6E+03	5.5E-01	3.6E-02	3.1E-02	1.6E-02	3.0E-03	8.8E-04	1.8E-04	5.1E-04	3.3E-03
						1.0E+06	3.0E+04	1.6E+04	4.5E-01	4.4E-01	4.6E-01	3.0E-01	3.0E-01	5.9E-05	1.3E-02	2.6E-02	2.1E-01
PB2-14-1		0.531	2.8E+04	4.5E+03	30.	4.5E+06	4.1E+04	4.7E+03	4.6E-01	4.3E-03	4.2E-03	1.9E-03	5.0E-04	1.6E-04	7.3E-05	1.2E-04	5.1E-04
						1.6E+06	4.5E+04	1.8E+04	5.4E-01	4.8E-01	4.7E-01	3.5E-01	3.8E-01	1.0E-04	2.0E-02	4.1E-02	2.9E-01
PB2-14-2		0.469	4.0E+03	9.0E+02	30.	6.2E+07	1.3E+04	1.9E+02	6.4E-01	7.2E-02	6.1E-02	3.1E-02	5.8E-03	1.7E-03	3.0E-04	9.6E-04	6.4E-03
						3.5E+05	1.3E+04	1.4E+04	3.6E-01	4.1E-01	4.6E-01	2.4E-01	2.0E-01	9.8E-06	4.8E-03	9.5E-03	1.2E-01
PB2-14-3		0.000															
PB2-15	2.2E-07		2.1E+04	7.9E+03	30.	4.2E+06	3.7E+04	5.1E+03	6.1E-01	4.1E-04	1.3E-04	7.4E-05	2.8E-05	2.2E-06	1.4E-06	1.9E-06	1.8E-05
						1.3E+06	4.2E+04	1.8E+04	1.5E-01	1.7E-03	7.8E-04	1.1E-04	3.1E-05	1.1E-06	1.3E-06	1.9E-06	2.0E-05
PB2-15-1		1.000	2.1E+04	7.9E+03	30.	4.2E+06	3.7E+04	5.1E+03	6.1E-01	4.1E-04	1.3E-04	7.4E-05	2.8E-05	2.2E-06	1.4E-06	1.9E-06	1.8E-05
						1.3E+06	4.2E+04	1.8E+04	1.5E-01	1.7E-03	7.8E-04	1.1E-04	3.1E-05	1.1E-06	1.3E-06	1.9E-06	2.0E-05
PB2-15-2		0.000															
PB2-15-3		0.000															

Table 3.4-23 (Concluded)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - High PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB2-16	2.3E-07		2.8E+04	5.1E+03	30.	7.3E+06	4.1E+04	1.4E+03	5.9E-01	7.2E-04	6.3E-04	4.2E-04	2.0E-04	1.3E-04	2.1E-05	2.5E-05	2.0E-04
						1.9E+06	4.3E+04	1.5E+04	4.1E-01	4.2E-03	2.9E-03	1.1E-03	1.1E-03	7.7E-06	6.4E-05	1.1E-04	7.4E-04
PB2-16-1		1.000	2.8E+04	5.1E+03	30.	7.3E+06	4.1E+04	1.4E+03	5.9E-01	7.2E-04	6.3E-04	4.2E-04	2.0E-04	1.3E-04	2.1E-05	2.5E-05	2.0E-04
						1.9E+06	4.3E+04	1.5E+04	4.1E-01	4.2E-03	2.9E-03	1.1E-03	1.1E-03	7.7E-06	6.4E-05	1.1E-04	7.4E-04
PB2-16-2		0.000															
PB2-16-3		0.000															
PB2-17	1.7E-06		2.9E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	8.7E-01	3.0E-04	3.3E-04	7.7E-05	1.3E-05	8.2E-06	3.4E-06	4.1E-06	1.3E-05
						1.9E+06	4.2E+04	1.4E+04	1.3E-01	1.6E-02	2.1E-02	4.5E-03	4.8E-04	1.9E-07	1.2E-05	2.2E-05	3.0E-04
PB2-17-1		1.000	2.9E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	8.7E-01	3.0E-04	3.3E-04	7.7E-05	1.3E-05	8.2E-06	3.4E-06	4.1E-06	1.3E-05
						1.9E+06	4.2E+04	1.4E+04	1.3E-01	1.6E-02	2.1E-02	4.5E-03	4.8E-04	1.9E-07	1.2E-05	2.2E-05	3.0E-04
PB2-17-2		0.000															
PB2-17-3		0.000															

Table 3.4-24
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB1-01	3.7E-07		4.0E+03	1.8E+03	30.	1.4E+07	1.4E+04	3.0E+03	8.4E-01	4.2E-04	2.6E-04	1.2E-04	5.1E-05	2.7E-06	2.3E-06	5.0E-06	3.8E-05
						2.7E+05	1.7E+04	2.0E+04	1.6E-01	1.5E-03	4.1E-04	1.3E-04	5.5E-05	4.3E-07	3.7E-06	6.5E-06	3.9E-05
PB1-01-1		0.106	4.0E+03	9.9E+03	30.	9.2E+06	2.2E+04	3.3E+03	5.4E-01	6.2E-04	3.4E-04	5.7E-04	3.9E-04	3.1E-06	1.8E-05	3.3E-05	2.6E-04
						2.6E+05	2.5E+04	2.1E+04	4.6E-01	5.6E-04	3.2E-04	5.6E-04	3.7E-04	2.7E-06	1.5E-05	2.9E-05	2.4E-04
PB1-01-2		0.894	4.0E+03	9.0E+02	30.	1.4E+07	1.3E+04	3.0E+03	8.8E-01	4.0E-04	2.5E-04	6.9E-05	1.1E-05	2.7E-06	5.1E-07	1.7E-06	1.2E-05
						2.7E+05	1.6E+04	2.0E+04	1.2E-01	1.6E-03	4.2E-04	7.8E-05	1.7E-05	1.7E-07	2.4E-06	3.8E-06	1.5E-05
PB1-01-3		0.000															
PB1-02	7.7E-07		1.8E+04	5.1E+03	30.	2.1E+07	3.1E+04	1.3E+03	8.3E-01	7.6E-03	1.3E-03	6.2E-04	2.1E-04	2.0E-05	1.5E-05	2.6E-05	1.7E-04
						1.3E+06	3.3E+04	1.5E+04	1.7E-01	5.3E-02	3.4E-03	6.2E-04	4.3E-04	6.4E-06	2.8E-05	4.6E-05	3.0E-04
PB1-02-1		0.769	2.3E+04	6.4E+03	30.	1.2E+07	3.7E+04	1.4E+03	9.0E-01	9.5E-03	1.5E-03	7.5E-04	2.7E-04	2.5E-05	1.9E-05	3.4E-05	2.1E-04
						1.6E+06	3.8E+04	1.5E+04	9.7E-02	6.7E-02	3.2E-03	3.9E-04	1.5E-04	6.6E-06	9.3E-06	1.6E-05	1.1E-04
PB1-02-2		0.231	4.0E+03	9.0E+02	30.	5.0E+07	1.3E+04	1.0E+03	5.7E-01	1.3E-03	7.8E-04	2.1E-04	1.2E-05	4.5E-06	9.7E-07	1.7E-06	1.8E-05
						3.4E+05	1.4E+04	1.6E+04	4.3E-01	4.1E-03	3.9E-03	1.4E-03	1.4E-03	5.5E-06	8.9E-05	1.5E-04	9.1E-04
PB1-02-3		0.000															
PB1-03	5.3E-07		2.7E+04	4.5E+03	30.	7.7E+06	4.0E+04	9.2E+02	3.9E-01	7.2E-04	7.7E-04	3.0E-04	8.9E-05	4.9E-05	2.3E-05	7.7E-05	1.0E-04
						1.9E+06	4.1E+04	1.4E+04	6.1E-01	4.6E-01	5.2E-03	1.4E-03	2.2E-04	3.2E-10	6.2E-06	7.5E-06	1.5E-04
PB1-03-1		1.000	2.7E+04	4.5E+03	30.	7.7E+06	4.0E+04	9.2E+02	3.9E-01	7.2E-04	7.7E-04	3.0E-04	8.9E-05	4.9E-05	2.3E-05	7.7E-05	1.0E-04
						1.9E+06	4.1E+04	1.4E+04	6.1E-01	4.6E-01	5.2E-03	1.4E-03	2.2E-04	3.2E-10	6.2E-06	7.5E-06	1.5E-04
PB1-03-2		0.000															
PB1-03-3		0.000															
PB1-04	6.6E-07		5.4E+03	1.5E+03	30.	3.8E+07	1.5E+04	1.0E+03	8.9E-01	5.5E-03	4.0E-03	2.3E-03	6.2E-04	1.3E-04	4.5E-05	9.8E-05	5.9E-04
						3.9E+05	1.6E+04	1.6E+04	1.1E-01	3.7E-02	5.3E-03	2.6E-03	3.5E-03	4.7E-06	1.6E-04	3.1E-04	2.4E-03
PB1-04-1		0.106	1.8E+04	6.5E+03	30.	2.4E+07	3.2E+04	1.8E+03	9.3E-01	9.5E-03	4.6E-03	5.9E-03	3.8E-03	3.8E-04	2.6E-04	5.2E-04	3.2E-03
						1.3E+06	3.4E+04	1.5E+04	6.9E-02	1.1E-01	3.4E-03	5.1E-03	1.3E-02	1.1E-05	7.2E-04	1.4E-03	9.5E-03
PB1-04-2		0.894	4.0E+03	9.0E+02	30.	4.0E+07	1.3E+04	9.5E+02	8.9E-01	5.0E-03	3.9E-03	1.9E-03	2.4E-04	1.0E-04	1.9E-05	4.8E-05	2.8E-04
						2.8E+05	1.4E+04	1.6E+04	1.1E-01	2.9E-02	5.5E-03	2.3E-03	2.4E-03	3.9E-06	9.7E-05	1.8E-04	1.6E-03
PB1-04-3		0.000															
PB1-05	5.8E-07		1.5E+04	5.7E+03	30.	6.8E+06	2.9E+04	1.7E+03	8.0E-01	3.2E-03	1.3E-03	7.5E-04	3.8E-04	2.6E-05	2.9E-05	5.9E-05	3.3E-04
						1.7E+06	3.0E+04	1.6E+04	2.0E-01	1.6E-02	1.7E-02	4.4E-03	1.9E-03	6.9E-06	1.2E-04	2.5E-04	1.3E-03
PB1-05-1		0.996	1.5E+04	5.7E+03	30.	6.8E+06	2.9E+04	1.7E+03	8.0E-01	3.3E-03	1.3E-03	7.5E-04	3.9E-04	2.6E-05	2.9E-05	6.0E-05	3.4E-04
						1.7E+06	3.0E+04	1.6E+04	2.0E-01	1.6E-02	1.7E-02	4.4E-03	1.9E-03	6.9E-06	1.2E-04	2.5E-04	1.3E-03
PB1-05-2		0.004	4.0E+03	9.0E+02	30.	3.2E+06	1.3E+04	3.6E+03	2.4E-01	8.7E-04	7.5E-04	1.6E-04	6.0E-06	1.0E-05	6.2E-06	6.3E-06	1.4E-05
						2.4E+05	1.7E+04	2.2E+04	7.6E-01	1.0E-02	1.1E-02	2.8E-03	1.6E-03	1.5E-07	8.0E-05	1.9E-04	1.2E-03
PB1-05-3		0.000															

Table 3.4-24 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB1-06	4.7E-06		2.3E+04	3.7E+03	30.	1.5E+07	3.5E+04	7.4E+02	5.0E-01	3.2E-03	2.8E-03	8.7E-04	1.1E-04	7.8E-05	2.3E-05	4.3E-05	1.4E-04
						1.5E+06	3.6E+04	1.4E+04	5.0E-01	4.9E-01	3.3E-02	2.7E-02	3.1E-02	7.8E-06	1.8E-03	3.6E-03	2.4E-02
PB1-06-1		0.783	2.8E+04	4.5E+03	30.	7.5E+06	4.1E+04	9.0E+02	5.0E-01	1.8E-03	1.9E-03	4.2E-04	7.0E-05	7.0E-05	2.2E-05	2.8E-05	9.0E-05
						1.9E+06	4.2E+04	1.4E+04	5.0E-01	5.9E-01	3.0E-02	2.5E-02	2.8E-02	4.9E-06	1.6E-03	3.2E-03	2.2E-02
PB1-06-2		0.217	4.0E+03	9.0E+02	30.	4.2E+07	1.3E+04	1.8E+02	5.1E-01	8.1E-03	5.9E-03	2.5E-03	2.7E-04	1.1E-04	2.7E-05	9.6E-05	3.4E-04
						2.4E+05	1.3E+04	1.4E+04	4.9E-01	1.1E-01	4.3E-02	3.6E-02	4.1E-02	1.8E-05	2.3E-03	4.7E-03	3.2E-02
PB1-06-3		0.000															
PB1-07	2.8E-06		7.8E+03	2.0E+03	30.	4.9E+07	1.8E+04	5.2E+02	6.0E-01	6.5E-03	5.6E-03	2.5E-03	1.5E-03	2.3E-04	1.1E-04	1.6E-04	1.2E-03
						6.1E+05	1.8E+04	1.5E+04	4.0E-01	7.6E-02	4.8E-02	2.0E-02	1.5E-02	8.0E-05	8.7E-04	1.8E-03	1.2E-02
PB1-07-1		0.217	2.1E+04	5.8E+03	30.	7.1E+06	3.5E+04	1.6E+03	6.4E-01	6.3E-03	5.0E-03	5.3E-03	6.1E-03	8.1E-05	2.1E-04	4.3E-04	4.4E-03
						1.5E+06	3.7E+04	1.6E+04	3.6E-01	1.5E-01	4.5E-02	2.1E-02	1.4E-02	2.4E-05	4.7E-04	9.4E-04	1.0E-02
PB1-07-2		0.783	4.0E+03	9.0E+02	30.	6.0E+07	1.3E+04	2.3E+02	5.9E-01	6.5E-03	5.8E-03	1.7E-03	2.6E-04	2.7E-04	8.1E-05	8.8E-05	3.4E-04
						3.5E+05	1.3E+04	1.4E+04	4.1E-01	5.5E-02	4.8E-02	2.0E-02	1.6E-02	9.6E-05	9.8E-04	2.0E-03	1.2E-02
PB1-07-3		0.000															
PB1-08	2.7E-06		2.5E+04	4.6E+03	30.	7.6E+06	3.8E+04	1.0E+03	7.1E-01	8.4E-04	7.0E-04	4.2E-04	3.0E-04	3.9E-05	1.8E-05	3.1E-05	2.5E-04
						1.9E+06	3.9E+04	1.5E+04	2.9E-01	5.2E-02	5.1E-02	1.6E-02	1.4E-02	1.6E-05	3.8E-04	6.9E-04	8.0E-03
PB1-08-1		1.000	2.5E+04	4.6E+03	30.	7.6E+06	3.8E+04	1.0E+03	7.1E-01	8.4E-04	7.0E-04	4.2E-04	3.0E-04	3.9E-05	1.8E-05	3.1E-05	2.5E-04
						1.9E+06	3.9E+04	1.5E+04	2.9E-01	5.2E-02	5.1E-02	1.6E-02	1.4E-02	1.6E-05	3.8E-04	6.9E-04	8.0E-03
PB1-08-2		0.000	6.1E+03	7.4E+02	30.	2.2E+06	1.5E+04	3.2E+03	2.4E-01	1.7E-03	1.2E-03	3.4E-04	3.6E-05	8.7E-06	4.3E-06	8.2E-06	5.0E-05
						2.7E+05	1.8E+04	2.0E+04	7.6E-01	3.3E-02	2.6E-02	8.6E-03	8.3E-03	3.6E-06	4.4E-04	8.3E-04	6.0E-03
PB1-08-3		0.000															
PB1-09	9.9E-07		2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.4E-05	3.6E-05	6.6E-06	6.9E-06	4.8E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.7E-02	4.1E-02	7.1E-03	3.1E-03	3.0E-09	9.1E-05	1.4E-04	1.5E-03
PB1-09-1		1.000	2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.4E-01	2.7E-04	3.0E-04	9.8E-05	4.4E-05	3.6E-05	6.6E-06	6.9E-06	4.8E-05
						1.9E+06	4.2E+04	1.4E+04	2.6E-01	3.7E-02	4.1E-02	7.1E-03	3.1E-03	3.0E-09	9.1E-05	1.4E-04	1.5E-03
PB1-09-2		0.000															
PB1-09-3		0.000															
PB1-10	5.1E-07		4.7E+03	1.1E+03	30.	4.2E+07	1.4E+04	2.1E+02	9.2E-01	9.0E-02	7.6E-02	3.2E-02	7.5E-03	1.7E-03	4.0E-04	1.3E-03	7.0E-03
						3.0E+05	1.4E+04	1.4E+04	7.8E-02	9.3E-02	1.3E-01	1.6E-01	2.0E-01	2.4E-04	7.6E-03	1.5E-02	1.3E-01
PB1-10-1		0.035	2.4E+04	6.2E+03	30.	8.8E+06	3.8E+04	9.4E+02	9.4E-01	1.6E-02	2.3E-02	6.3E-02	6.9E-02	9.2E-04	1.8E-03	3.9E-03	4.2E-02
						1.9E+06	3.9E+04	1.5E+04	6.5E-02	1.2E-01	9.0E-02	1.5E-01	2.4E-01	4.4E-03	2.6E-02	4.6E-02	2.1E-01
PB1-10-2		0.965	4.0E+03	9.0E+02	30.	4.3E+07	1.3E+04	1.8E+02	9.2E-01	9.3E-02	7.8E-02	3.0E-02	5.2E-03	1.7E-03	3.5E-04	1.2E-03	5.8E-03
						2.4E+05	1.3E+04	1.4E+04	7.8E-02	9.2E-02	1.3E-01	1.6E-01	2.0E-01	8.5E-05	6.9E-03	1.3E-02	1.3E-01
PB1-10-3		0.000															

Table 3.4-24 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB1-11	2.7E-06		1.4E+04	7.4E+03	30.	2.1E+07	2.9E+04	3.8E+03	7.0E-01	4.4E-02	3.6E-02	3.6E-02	3.1E-02	5.8E-04	1.6E-03	3.5E-03	2.5E-02
						1.2E+06	3.3E+04	1.7E+04	3.0E-01	1.0E-01	8.7E-02	5.5E-02	6.5E-02	9.6E-05	2.8E-03	5.6E-03	4.6E-02
PB1-11-1		0.712	1.8E+04	1.0E+04	30.	4.8E+06	3.6E+04	5.3E+03	6.8E-01	5.6E-02	4.5E-02	4.8E-02	4.3E-02	4.9E-04	2.1E-03	4.7E-03	3.4E-02
						1.5E+06	4.1E+04	1.8E+04	3.2E-01	7.2E-02	5.6E-02	5.8E-02	7.5E-02	1.2E-04	3.4E-03	7.0E-03	5.4E-02
PB1-11-2		0.288	4.0E+03	9.0E+02	30.	6.2E+07	1.3E+04	2.3E+02	7.6E-01	1.4E-02	1.2E-02	6.7E-03	1.9E-03	8.0E-04	2.2E-04	6.3E-04	2.0E-03
						3.5E+05	1.3E+04	1.5E+04	2.4E-01	1.7E-01	1.6E-01	5.0E-02	4.0E-02	3.3E-05	1.2E-03	2.3E-03	2.5E-02
PB1-11-3		0.000															
PB1-12	1.7E-06		2.7E+04	4.6E+03	30.	8.4E+06	4.0E+04	1.1E+03	8.2E-01	2.0E-02	2.0E-02	1.1E-02	2.3E-03	6.7E-04	2.1E-04	4.3E-04	2.3E-03
						1.9E+06	4.1E+04	1.5E+04	1.8E-01	1.1E-01	9.9E-02	4.1E-02	5.5E-02	8.7E-07	1.4E-03	2.6E-03	3.3E-02
PB1-12-1		0.980	2.8E+04	4.7E+03	30.	7.5E+06	4.1E+04	1.1E+03	8.3E-01	2.0E-02	2.0E-02	1.2E-02	2.3E-03	6.8E-04	2.1E-04	4.4E-04	2.3E-03
						1.9E+06	4.2E+04	1.5E+04	1.7E-01	1.1E-01	9.9E-02	4.1E-02	5.6E-02	8.8E-07	1.4E-03	2.7E-03	3.4E-02
PB1-12-2		0.020	4.0E+03	9.0E+02	30.	5.0E+07	1.3E+04	9.6E+02	6.9E-01	3.1E-03	2.6E-03	1.6E-03	3.7E-04	3.3E-04	4.8E-05	5.5E-05	4.6E-04
						3.4E+05	1.4E+04	1.6E+04	3.1E-01	9.6E-02	1.0E-01	3.2E-02	2.1E-03	7.4E-10	5.1E-05	8.9E-05	1.4E-03
PB1-12-3		0.000															
PB1-13	4.9E-07		9.4E+03	2.4E+03	30.	4.1E+07	2.0E+04	5.0E+02	4.7E-01	2.1E-02	2.0E-02	1.7E-02	1.5E-02	2.4E-03	1.5E-03	7.4E-03	1.5E-02
						1.0E+06	2.0E+04	1.4E+04	5.3E-01	5.8E-01	6.2E-01	5.2E-01	5.9E-01	6.6E-04	3.3E-02	6.8E-02	4.6E-01
PB1-13-1		0.409	1.7E+04	4.5E+03	30.	7.7E+06	3.0E+04	9.0E+02	4.5E-01	1.6E-03	1.7E-03	1.0E-03	6.6E-04	8.3E-05	6.6E-05	1.2E-04	5.9E-04
						1.9E+06	3.1E+04	1.4E+04	5.5E-01	5.7E-01	5.8E-01	4.9E-01	5.5E-01	3.3E-04	3.0E-02	6.2E-02	4.3E-01
PB1-13-2		0.591	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.3E+02	4.9E-01	3.5E-02	3.3E-02	2.8E-02	2.5E-02	3.9E-03	2.5E-03	1.2E-02	2.5E-02
						3.7E+05	1.3E+04	1.4E+04	5.1E-01	6.0E-01	6.5E-01	5.5E-01	6.1E-01	8.8E-04	3.5E-02	7.2E-02	4.8E-01
PB1-13-3		0.000															
PB1-14	4.9E-06		2.5E+04	4.0E+03	30.	1.2E+07	3.7E+04	4.2E+03	4.9E-01	1.4E-02	1.2E-02	6.0E-03	1.3E-03	3.8E-04	1.0E-04	2.4E-04	1.4E-03
						1.4E+06	4.1E+04	1.7E+04	5.1E-01	4.6E-01	4.6E-01	3.4E-01	3.7E-01	9.5E-05	1.9E-02	3.9E-02	2.8E-01
PB1-14-1		0.862	2.8E+04	4.5E+03	30.	4.3E+06	4.1E+04	4.9E+03	4.7E-01	4.3E-03	4.3E-03	1.9E-03	5.2E-04	1.6E-04	7.1E-05	1.2E-04	5.3E-04
						1.6E+06	4.5E+04	1.8E+04	5.3E-01	4.7E-01	4.6E-01	3.6E-01	4.0E-01	1.1E-04	2.1E-02	4.4E-02	3.1E-01
PB1-14-2		0.138	4.0E+03	9.0E+02	30.	6.2E+07	1.3E+04	1.9E+02	6.4E-01	7.3E-02	6.2E-02	3.2E-02	6.0E-03	1.7E-03	3.1E-04	9.9E-04	6.5E-03
						3.5E+05	1.3E+04	1.4E+04	3.6E-01	4.1E-01	4.5E-01	2.4E-01	2.0E-01	8.9E-06	4.8E-03	9.5E-03	1.2E-01
PB1-14-3		0.000															
PB1-15	3.9E-07		2.7E+04	4.3E+03	30.	7.9E+06	3.9E+04	1.1E+03	4.1E-01	1.2E-02	1.1E-02	2.6E-03	1.8E-04	2.4E-04	9.6E-05	9.6E-05	3.2E-04
						1.8E+06	4.0E+04	1.5E+04	5.9E-01	5.3E-01	5.6E-01	1.3E-01	1.2E-02	4.8E-09	2.6E-04	4.6E-04	4.7E-03
PB1-15-1		0.944	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.6E+02	4.1E-01	1.2E-02	1.2E-02	2.6E-03	1.1E-04	1.8E-04	9.1E-05	9.1E-05	2.4E-04
						1.9E+06	4.2E+04	1.4E+04	5.9E-01	5.4E-01	5.7E-01	1.3E-01	1.2E-02	5.0E-09	2.7E-04	4.8E-04	5.0E-03
PB1-15-2		0.056	4.0E+03	9.0E+02	30.	1.2E+07	1.3E+04	3.1E+03	3.8E-01	9.5E-03	6.3E-03	3.3E-03	1.4E-03	1.3E-03	1.8E-04	1.8E-04	1.6E-03
						2.6E+05	1.6E+04	2.1E+04	6.2E-01	4.0E-01	4.2E-01	7.1E-02	5.6E-04	1.0E-09	4.4E-05	5.2E-05	4.5E-04
PB1-15-3		0.000															

Table 3.4-24 (Concluded)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- LLNL - Low PGA - No CF at T=0

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB1-16	2.5E-07		2.3E+04	7.7E+03	30.	4.4E+06	3.8E+04	4.8E+03	6.7E-01	4.4E-04	1.4E-04	8.0E-05	3.0E-05	2.4E-06	1.5E-06	2.1E-06	1.9E-05
						1.4E+06	4.3E+04	1.8E+04	1.6E-01	1.9E-03	8.5E-04	1.2E-04	3.4E-05	1.1E-06	1.4E-06	2.1E-06	2.1E-05
PB1-16-1		1.000	2.3E+04	7.7E+03	30.	4.4E+06	3.8E+04	4.8E+03	6.7E-01	4.4E-04	1.4E-04	8.0E-05	3.0E-05	2.4E-06	1.5E-06	2.1E-06	1.9E-05
						1.4E+06	4.3E+04	1.8E+04	1.6E-01	1.9E-03	8.5E-04	1.2E-04	3.4E-05	1.1E-06	1.4E-06	2.1E-06	2.1E-05
PB1-16-2		0.000															
PB1-16-3		0.000															
PB1-17	2.8E-07		2.8E+04	5.1E+03	30.	7.3E+06	4.1E+04	1.4E+03	5.9E-01	7.2E-04	6.3E-04	4.2E-04	2.0E-04	1.3E-04	2.1E-05	2.5E-05	2.0E-04
						1.9E+06	4.3E+04	1.5E+04	4.1E-01	4.2E-03	2.9E-03	1.1E-03	1.1E-03	7.7E-06	6.4E-05	1.1E-04	7.4E-04
PB1-17-1		1.000	2.8E+04	5.1E+03	30.	7.3E+06	4.1E+04	1.4E+03	5.9E-01	7.2E-04	6.3E-04	4.2E-04	2.0E-04	1.3E-04	2.1E-05	2.5E-05	2.0E-04
						1.9E+06	4.3E+04	1.5E+04	4.1E-01	4.2E-03	2.9E-03	1.1E-03	1.1E-03	7.7E-06	6.4E-05	1.1E-04	7.4E-04
PB1-17-2		0.000															
PB1-17-3		0.000															
PB1-18	2.1E-06		2.9E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	8.7E-01	3.0E-04	3.3E-04	7.7E-05	1.3E-05	8.2E-06	3.4E-06	4.1E-06	1.3E-05
						1.9E+06	4.2E+04	1.4E+04	1.3E-01	1.6E-02	2.1E-02	4.5E-03	4.8E-04	1.9E-07	1.2E-05	2.2E-05	3.0E-04
PB1-18-1		1.000	2.9E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.4E+02	8.7E-01	3.0E-04	3.3E-04	7.7E-05	1.3E-05	8.2E-06	3.4E-06	4.1E-06	1.3E-05
						1.9E+06	4.2E+04	1.4E+04	1.3E-01	1.6E-02	2.1E-02	4.5E-03	4.8E-04	1.9E-07	1.2E-05	2.2E-05	3.0E-04
PB1-18-2		0.000															
PB1-18-3		0.000															

and to calculate the subgroup mean source terms to be used in the MACCS calculation. Therefore, the partitioning process must be done separately for each hazard curve or each PGA level.

The accident progression analysis and subsequent source term analysis for seismic initiators using the EPRI hazard distributions resulted in the generation of 9,481 source terms. Tables 3.4-25 and 3.4-26 show the number of these source terms with EH>0 and CH>0 and the number with EH=0 and CH>0 for the high and low PGA cases, respectively.

Figures 3.4-5 and 3.4-6 show a plot of the pairs (CH, EH) for the 9,037 source terms for which both EH and CH are nonzero for the high and low PGA cases, respectively. A summary of the partitioning process for EH>0 and CH>0 is given in Tables 3.4-27 and 3.4-29 for the high and low PGA cases, respectively. A summary of the partitioning process for the 444 source terms for which EH=0 and CH>0 is given in Tables 3.4-28 and 3.4-30 for the high and low PGA cases, respectively.

The 18 and 16 groups of source terms for the high and low PGA cases,respectively, that result from partitioning are further subdivided on the basis of evacuation timing into three subgroups as for internal initiators. Frequency-weighted mean source terms are calculated for each populated subgroup. The mean source terms obtained in this analysis are shown in Tables 3.4-31 and 3.4-32 for the high and low PGA cases, respectively. These tables contain frequency-weighted mean source terms for both the source term groups and subgroups. In the tables, PB4-I and PB3-I and PB4-I-J and PB3-I-J are used to label the mean source term groups and subgroups, respectively, where 4 designates the high PGA source terms, 3 designates the low PGA source terms, I designates the source term group, and J designates the source term subgroup. It is the source term subgroups, PB4-I-J and PB3-I-J in Tables 3.4-31 and 3.4-32, that are actually used for the risk calculations. Tables 3.4-31 and 3.4-32 are analogous to Table 3.4-4 for internal initiators.

The highest release fractions are associated with groups PB4-13 and PB3-11, as would be expected from Figures 3.4-5 and 3.4-6 and Table 3.4-27 and 3.4-29. The dominant accidents in this group are long-term station blackouts that have early containment failures and seismically induced LOCAs with initial or early containment failure and bypass of the suppression pool. The frequency for this group, however, is fairly low; relatively few source terms fall in the grid represented by groups PB4-13 and PB3-11, and they are not exceptionally frequent. The most likely source term groups are PB4-07, PB4-14, PB4-11, and PBH-06 for the Hi PGA case and PB3-12, PB3-06, PB3-05, and PB3-10 for the Low PGA case. For the seismic APBs, there is even less potential for recovery than in the fire analysis and all of the most likely groups have the potential to cause early fatalities with relatively high early health effect weights associated with the groups. In particular, PB4-14 and PB3-12 are the next highest source term groups in terms of early and chronic health effect weights and they are also the most frequent or the second most frequent.

Table 3.4-25
Summary of Early and Chronic Health Effect Weights for Seismic Initiators -- EPRI - High PGA

	Number of Source Terms	Percent of Total Frequency
EH>0 AND CH>0	9037	94.91
EH=0 AND CH>0	444	5.09
EH=0 AND CH=0	0	0.00
TOTAL	9481	100.00

FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.1954
RANGE LOG10(EH) = -0.6377 TO 2.5798

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -1.5655 TO 3.5647

Table 3.4-26
Summary of Early and Chronic Health Effect Weights for Seismic Initiators -- EPRI - Low PGA

	Number of Source Terms	Percent of Total Frequency
EH>0 AND CH>0	9037	89.53
EH=0 AND CH>0	444	10.47
EH=0 AND CH=0	0	0.00
TOTAL	9481	100.00

```
FOR EH>0 AND CH>0, RANGE LOG10(CH) = -0.1153 TO 5.1954
                   RANGE LOG10(EH) = -0.6377 TO 2.5798

FOR EH=0 AND CH>0, RANGE LOG10(CH) = -1.5655 TO 3.5647
```

Table 3.4-27
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- EPRI - High PGA

BEFORE PARTITIONING:

```
 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  9037:

          1      2      3      4      5      6      7      8      9
      +------+------+------+------+------+------+------+------+------+
   1  |      |      |      |      |      |      |      |      |  406 |
      +------+------+------+------+------+------+------+------+------+
   2  |      |      |      |      |      |    2 |    4 |  435 | 1316 |
      +------+------+------+------+------+------+------+------+------+
   3  |      |      |      |      |      |   23 |  247 | 1874 |  332 |
      +------+------+------+------+------+------+------+------+------+
   4  |      |      |      |    4 |   38 |  351 | 1270 |  674 |      |
      +------+------+------+------+------+------+------+------+------+
   5  |      |      |    8 |   38 |  162 |  457 |  596 |   34 |      |
      +------+------+------+------+------+------+------+------+------+
   6  |   10 |   26 |   18 |  149 |  229 |  230 |  104 |      |      |
      +------+------+------+------+------+------+------+------+------+


 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

          1      2      3      4      5      6      7      8      9
      +------+------+------+------+------+------+------+------+------+
   1  |      |      |      |      |      |      |      |      | 2.99 |
      +------+------+------+------+------+------+------+------+------+
   2  |      |      |      |      |      | 0.00 | 0.00 | 2.90 |17.32 |
      +------+------+------+------+------+------+------+------+------+
   3  |      |      |      |      |      | 0.16 | 7.89 |16.23 | 2.49 |
      +------+------+------+------+------+------+------+------+------+
   4  |      |      |      | 0.01 | 2.13 | 6.33 |20.11 | 5.37 |      |
      +------+------+------+------+------+------+------+------+------+
   5  |      |      | 0.02 | 0.60 | 1.36 | 2.58 | 6.31 | 0.12 |      |
      +------+------+------+------+------+------+------+------+------+
   6  | 0.00 | 0.02 | 0.04 | 0.38 | 0.62 | 1.91 | 2.09 |      |      |
      +------+------+------+------+------+------+------+------+------+
```

Table 3.4-27 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- EPRI - High PGA

AFTER PARTITIONING:

CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 9037:

	1	2	3	4	5	6	7	8	9
1									406
2								435	1316
3							263	1874	332
4					46	364	1270	695	
5					557	457	609		
6						309	104		

PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

	1	2	3	4	5	6	7	8	9
1									2.99
2								2.90	17.32
3							7.95	16.23	2.49
4					2.15	6.43	20.11	5.46	
5					2.91	2.58	6.34		
6						2.05	2.09		

Table 3.4-27 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- EPRI - High PGA

LABELING AFTER PARTITIONING:

```
        1      2      3      4      5      6      7      8      9
    +------+------+------+------+------+------+------+------+------+
  1 |      |      |      |      |      |      |      |      |PB4-13|
    +------+------+------+------+------+------+------+------+------+
  2 |      |      |      |      |      |      |      |PB4-10|PB4-14|
    +------+------+------+------+------+------+------+------+------+
  3 |      |      |      |      |      |      |PB4-06|PB4-11|PB4-15|
    +------+------+------+------+------+------+------+------+------+
  4 |      |      |      |      |PB4-01|PB4-03|PB4-07|PB4-12|      |
    +------+------+------+------+------+------+------+------+------+
  5 |      |      |      |      |PB4-02|PB4-04|PB4-08|      |      |
    +------+------+------+------+------+------+------+------+------+
  6 |      |      |      |      |      |PB4-05|PB4-09|      |      |
    +------+------+------+------+------+------+------+------+------+
```

Table 3.4-28
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Seismic Initiators -- EPRI - High PGA

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

        1      2      3      4      5      6      7      8
    +------+------+------+------+------+------+------+------+
 1  |    1 |      |    7 |    6 |   20 |   93 |  187 |  130 |
    +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

        1      2      3      4      5      6      7      8
    +------+------+------+------+------+------+------+------+
 1  | 2.73 |      | 0.18 | 0.01 | 2.39 |12.24 |16.26 |66.19 |
    +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

        1      2      3      4      5      6      7      8
    +------+------+------+------+------+------+------+------+
 1  |      |      |      |      |      |  127 |  187 |  130 |
    +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

        1      2      3      4      5      6      7      8
    +------+------+------+------+------+------+------+------+
 1  |      |      |      |      |      |17.55 |16.26 |66.19 |
    +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

        1      2      3      4      5      6      7      8
    +------+------+------+------+------+------+------+------+
 1  |      |      |      |      |      |PB4-16|PB4-17|PB4-18|
    +------+------+------+------+------+------+------+------+
```

Table 3.4-29
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- EPRI - Low PGA

BEFORE PARTITIONING:

CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF 9037:

	1	2	3	4	5	6	7	8	9
1									406
2						2	4	435	1316
3						23	247	1874	332
4				4	38	351	1270	674	
5			8	38	162	457	596	34	
6	10	26	18	149	229	230	104		

PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

	1	2	3	4	5	6	7	8	9
1									1.17
2						0.00	0.00	1.17	16.50
3						0.35	10.84	10.54	4.53
4				0.00	0.63	3.85	12.57	11.19	
5			0.01	0.26	1.99	1.68	13.75	0.27	
6	0.01	0.02	0.04	0.38	0.88	2.79	4.59		

Table 3.4-29 (Continued)
Distribution of Source Terms with Nonzero Early Fatality and Chronic Fatality Weights for Seismic Initiators -- EPRI - Low PGA

AFTER PARTITIONING:

```
 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF  9037:

           1      2      3      4      5      6      7      8      9
       +------+------+------+------+------+------+------+------+------+
     1 |      |      |      |      |      |      |      |      | 406  |
       +------+------+------+------+------+------+------+------+------+
     2 |      |      |      |      |      |      |      | 435  | 1316 |
       +------+------+------+------+------+------+------+------+------+
     3 |      |      |      |      |      |      | 261  | 1874 | 332  |
       +------+------+------+------+------+------+------+------+------+
     4 |      |      |      |      |      | 488  | 1270 | 695  |      |
       +------+------+------+------+------+------+------+------+------+
     5 |      |      |      |      | 724  |      | 705  |      |      |
       +------+------+------+------+------+------+------+------+------+
     6 |      |      |      |      |      | 427  | 104  |      |      |
       +------+------+------+------+------+------+------+------+------+


 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

           1      2      3      4      5      6      7      8      9
       +------+------+------+------+------+------+------+------+------+
     1 |      |      |      |      |      |      |      |      | 1.17 |
       +------+------+------+------+------+------+------+------+------+
     2 |      |      |      |      |      |      |      | 1.17 |16.50 |
       +------+------+------+------+------+------+------+------+------+
     3 |      |      |      |      |      |      |10.97 |10.54 | 4.53 |
       +------+------+------+------+------+------+------+------+------+
     4 |      |      |      |      |      | 4.96 |12.57 |11.39 |      |
       +------+------+------+------+------+------+------+------+------+
     5 |      |      |      |      | 3.96 |      |14.49 |      |      |
       +------+------+------+------+------+------+------+------+------+
     6 |      |      |      |      |      | 3.17 | 4.59 |      |      |
       +------+------+------+------+------+------+------+------+------+
```

Table 3.4-29 (Concluded)
Distribution of Source Terms with Nonzero Early Fatality and
Chronic Fatality Weights for Seismic Initiators -- EPRI - Low PGA

LABELING AFTER PARTITIONING:

	1	2	3	4	5	6	7	8	9
1									PB3-11
2								PB3-08	PB3-12
3							PB3-04	PB3-09	PB3-13
4						PB3-02	PB3-05	PB3-10	
5					PB3-01		PB3-06		
6						PB3-03	PB3-07		

Table 3.4-30
Distribution of Source Terms with Zero Early Fatality Weight and Nonzero Chronic Fatality Weight for Seismic Initiators -- EPRI - Low PGA

```
BEFORE PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

        1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |    1 |      |    7 |    6 |   20 |   93 |  187 |  130 |
     +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

        1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  | 1.98 |      | 0.18 | 0.01 | 2.40 |12.33 |16.38 |66.70 |
     +------+------+------+------+------+------+------+------+


AFTER PARTITIONING:

 CELL COUNTS WITHIN THE GRID FOR A TOTAL COUNT OF   444:

        1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |  127 |  187 |  130 |
     +------+------+------+------+------+------+------+------+

 PERCENTAGE OF WEIGHTED FREQUENCIES CONTAINED IN EACH CELL:

        1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |16.92 |16.38 |66.70 |
     +------+------+------+------+------+------+------+------+


LABELING AFTER PARTITIONING:

        1      2      3      4      5      6      7      8
     +------+------+------+------+------+------+------+------+
  1  |      |      |      |      |      |PB3-14|PB3-15|PB3-16|
     +------+------+------+------+------+------+------+------+
```

Table 3.4-31

Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB4-01	3.7E-08		4.0E+03	-7.9E+03	30.	3.6E+06	4.2E+03	4.5E+03	1.0E+00	4.0E-03	3.2E-03	2.1E-03	6.0E-04	1.1E-04	2.5E-05	1.0E-04	6.2E-04
						4.1E+05	1.3E+04	1.9E+04	1.7E-03	1.3E-03	6.1E-04	2.8E-04	2.8E-04	4.4E-06	4.8E-05	7.6E-05	2.6E-04
PB4-01-1		0.003	1.5E+04	1.3E+04	30.	2.2E+06	3.6E+04	7.9E+03	5.5E-01	1.0E-01	1.0E-03	1.8E-03	1.2E-03	1.8E-04	3.9E-05	6.8E-05	8.6E-04
						1.3E+06	4.4E+04	2.1E+04	4.5E-01	9.3E-02	9.3E-04	1.7E-03	1.2E-03	1.6E-04	3.6E-05	5.8E-05	8.1E-04
PB4-01-2		0.012	4.0E+03	9.0E+02	30.	6.3E+07	1.3E+04	2.2E+02	9.6E-01	1.8E-03	1.5E-03	4.9E-04	2.4E-05	1.6E-05	1.2E-06	3.2E-06	3.3E-05
						3.6E+05	1.3E+04	1.4E+04	4.3E-02	2.6E-02	1.5E-03	4.0E-04	1.8E-05	4.4E-07	1.3E-06	2.3E-06	1.5E-05
PB4-01-3		0.985	4.0E+03	-8.1E+03	30.	2.9E+06	4.0E+03	4.5E+03	1.0E+00	3.8E-03	3.2E-03	2.1E-03	6.0E-04	1.1E-04	2.5E-05	1.0E-04	6.3E-04
						4.1E+05	1.3E+04	1.9E+04	0.0E+00	7.6E-04	6.0E-04	2.8E-04	2.8E-04	4.0E-06	4.9E-05	7.7E-05	2.6E-04
PB4-02	5.0E-08		1.2E+04	4.3E+03	30.	3.5E+07	2.4E+04	1.4E+03	7.7E-01	3.5E-03	6.0E-04	4.7E-04	2.6E-04	1.5E-05	1.6E-05	3.3E-05	2.1E-04
						8.5E+05	2.5E+04	1.6E+04	2.3E-01	2.8E-02	2.2E-03	6.1E-04	5.3E-04	7.6E-06	3.6E-05	6.0E-05	3.7E-04
PB4-02-1		0.555	1.8E+04	7.1E+03	30.	1.5E+07	3.3E+04	2.1E+03	8.1E-01	5.8E-03	7.7E-04	7.5E-04	4.6E-04	2.4E-05	2.8E-05	5.7E-05	3.6E-04
						1.3E+06	3.5E+04	1.7E+04	1.9E-01	4.9E-02	2.3E-03	4.6E-04	2.8E-04	1.1E-05	1.5E-05	2.7E-05	2.0E-04
PB4-02-2		0.443	4.0E+03	9.0E+02	30.	5.9E+07	1.3E+04	4.7E+02	7.2E-01	6.7E-04	3.9E-04	1.2E-04	1.8E-05	4.2E-06	1.1E-06	2.9E-06	2.1E-05
						3.6E+05	1.3E+04	1.5E+04	2.8E-01	2.8E-03	2.1E-03	7.8E-04	8.3E-04	3.8E-06	6.1E-05	1.0E-04	5.8E-04
PB4-02-3		0.002	4.0E+03	-8.1E+03	30.	1.3E+06	4.0E+03	9.0E+03	1.8E-01	1.8E-04	9.7E-05	2.4E-05	3.9E-07	2.6E-09	1.0E-09	1.0E-09	1.6E-06
						5.0E+05	1.3E+04	1.3E+04	8.2E-01	2.1E-03	2.2E-03	1.4E-03	1.5E-03	5.5E-08	6.1E-05	1.3E-04	1.1E-03
PB4-03	1.1E-07		7.2E+03	-2.2E+03	30.	2.7E+07	1.3E+04	1.9E+03	8.3E-01	5.8E-03	3.9E-03	1.4E-03	2.5E-04	1.0E-04	2.4E-05	6.3E-05	2.8E-04
						5.2E+05	1.7E+04	1.8E+04	1.7E-01	7.0E-02	5.9E-03	1.8E-03	1.5E-03	4.8E-06	9.9E-05	2.0E-04	1.2E-03
PB4-03-1		0.141	2.7E+04	4.5E+03	30.	7.4E+06	4.0E+04	1.3E+03	4.9E-01	9.1E-04	7.7E-04	3.9E-04	2.0E-04	1.4E-04	3.1E-05	3.6E-05	2.2E-04
						1.9E+06	4.1E+04	1.5E+04	5.1E-01	4.1E-01	5.2E-03	2.7E-03	4.2E-03	2.9E-07	2.3E-04	4.5E-04	3.1E-03
PB4-03-2		0.455	4.0E+03	9.0E+02	30.	5.5E+07	1.3E+04	5.0E+02	9.3E-01	5.4E-03	4.1E-03	2.0E-03	4.4E-04	1.5E-04	4.2E-05	1.2E-04	4.8E-04
						3.4E+05	1.3E+04	1.5E+04	6.8E-02	2.4E-02	5.7E-03	1.9E-03	2.0E-03	3.0E-06	1.5E-04	2.9E-04	1.6E-03
PB4-03-3		0.404	4.0E+03	-8.1E+03	30.	3.2E+06	4.0E+03	3.6E+03	8.4E-01	8.1E-03	4.7E-03	1.2E-03	5.4E-05	3.3E-05	1.6E-06	4.2E-06	7.5E-05
						2.5E+05	1.3E+04	2.1E+04	1.6E-01	4.7E-03	6.3E-03	1.4E-03	5.0E-05	8.3E-06	2.8E-06	3.8E-06	3.8E-05
PB4-04	4.4E-08		6.3E+03	1.3E+03	30.	1.5E+07	1.6E+04	2.6E+03	5.2E-01	5.7E-03	2.6E-03	2.8E-03	1.7E-03	2.6E-05	1.1E-04	2.4E-04	1.4E-03
						4.4E+05	2.0E+04	1.9E+04	4.8E-01	1.9E-02	1.1E-02	5.8E-03	5.4E-03	8.7E-05	2.7E-04	5.5E-04	3.8E-03
PB4-04-1		0.338	1.1E+04	8.7E+03	30.	3.2E+07	2.8E+04	1.1E+03	8.6E-01	1.5E-02	6.6E-03	8.0E-03	5.0E-03	6.9E-05	3.4E-04	6.9E-04	4.1E-03
						8.3E+05	2.9E+04	1.6E+04	1.4E-01	2.4E-02	3.7E-03	3.1E-03	3.0E-03	1.4E-05	1.7E-04	3.3E-04	2.1E-03
PB4-04-2		0.418	4.0E+03	9.0E+02	30.	8.5E+06	1.3E+04	3.2E+03	4.7E-01	1.3E-03	7.0E-04	2.2E-04	1.6E-05	7.2E-06	1.5E-06	2.4E-06	2.2E-05
						2.5E+05	1.6E+04	2.1E+04	5.3E-01	1.5E-02	1.5E-02	6.9E-03	6.6E-03	1.9E-05	1.6E-04	3.2E-04	3.8E-03
PB4-04-3		0.245	4.0E+03	-8.1E+03	30.	3.2E+06	4.0E+03	3.6E+03	1.2E-01	2.2E-04	1.2E-04	4.8E-05	7.6E-07	2.3E-08	9.1E-09	9.1E-09	2.2E-06
						2.4E+05	1.3E+04	2.2E+04	8.8E-01	1.9E-02	1.5E-02	7.6E-03	6.8E-03	3.0E-04	5.8E-04	1.2E-03	6.0E-03
PB4-05	3.5E-08		1.3E+04	7.3E+03	30.	5.3E+06	2.8E+04	2.6E+03	7.0E-01	3.5E-03	1.8E-03	2.3E-03	1.3E-03	3.5E-05	1.1E-04	2.2E-04	1.2E-03
						1.1E+06	3.1E+04	1.8E+04	3.0E-01	1.2E-02	9.6E-03	4.6E-03	3.3E-03	1.4E-05	2.2E-04	4.5E-04	2.4E-03
PB4-05-1		0.996	1.3E+04	7.3E+03	30.	5.3E+06	2.8E+04	2.6E+03	7.0E-01	3.5E-03	1.8E-03	2.3E-03	1.3E-03	3.5E-05	1.1E-04	2.2E-04	1.2E-03
						1.2E+06	3.1E+04	1.8E+04	3.0E-01	1.2E-02	9.7E-03	4.6E-03	3.3E-03	1.4E-05	2.2E-04	4.5E-04	2.4E-03
PB4-05-2		0.004	4.0E+03	9.0E+02	30.	3.2E+06	1.3E+04	3.6E+03	1.1E-01	2.9E-04	2.9E-04	9.0E-05	3.7E-06	7.5E-06	4.7E-06	4.7E-06	8.7E-06
						2.4E+05	1.7E+04	2.2E+04	8.9E-01	5.2E-03	4.3E-03	3.8E-04	2.8E-06	5.5E-12	2.1E-07	2.6E-07	1.8E-06
PB4-05-3		0.000															

Table 3.4-31 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB4-06	1.4E-07		1.8E+04	6.7E+02	30.	1.7E+07	2.6E+04	1.6E+03	7.0E-01	9.3E-03	6.5E-03	3.6E-03	1.5E-03	3.4E-04	1.4E-04	6.7E-04	1.5E-03
						1.2E+06	2.9E+04	1.6E+04	3.0E-01	3.6E-01	3.2E-02	2.8E-02	3.5E-02	4.9E-05	2.0E-03	3.6E-03	2.6E-02
PB4-06-1		0.562	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.0E+02	5.4E-01	2.0E-03	2.0E-03	6.8E-04	3.7E-04	1.5E-04	4.5E-05	9.7E-05	3.5E-04
						1.9E+06	4.2E+04	1.4E+04	4.6E-01	5.9E-01	2.9E-02	2.5E-02	2.8E-02	6.7E-06	1.7E-03	3.3E-03	2.2E-02
PB4-06-2		0.187	4.0E+03	9.0E+02	30.	6.1E+07	1.3E+04	1.8E+02	8.5E-01	1.3E-02	1.0E-02	7.1E-03	4.2E-03	7.1E-04	3.6E-04	1.8E-03	4.2E-03
						3.5E+05	1.3E+04	1.4E+04	1.5E-01	8.5E-02	2.8E-02	2.8E-02	3.8E-02	7.2E-05	3.5E-03	5.8E-03	3.2E-02
PB4-06-3		0.250	4.0E+03	-8.1E+03	30.	2.9E+06	4.0E+03	4.4E+03	9.4E-01	2.3E-02	1.4E-02	7.7E-03	2.0E-03	5.0E-04	1.8E-04	1.1E-03	2.1E-03
						3.7E+05	1.3E+04	2.0E+04	6.3E-02	5.2E-02	4.4E-02	3.3E-02	4.6E-02	1.3E-04	1.5E-03	2.8E-03	2.9E-02
PB4-07	3.4E-07		4.8E+03	-8.9E+01	30.	5.0E+07	1.3E+04	1.1E+03	6.5E-01	7.6E-03	5.9E-03	2.7E-03	1.1E-03	2.2E-04	7.6E-05	1.3E-04	9.2E-04
						4.6E+05	1.4E+04	1.5E+04	3.5E-01	5.3E-02	4.6E-02	1.9E-02	1.3E-02	4.6E-05	5.8E-04	1.2E-03	9.0E-03
PB4-07-1		0.069	1.6E+04	6.8E+03	30.	8.3E+06	3.1E+04	1.9E+03	7.3E-01	1.1E-02	8.9E-03	9.8E-03	1.1E-02	1.6E-04	4.2E-04	8.8E-04	7.8E-03
						1.2E+06	3.3E+04	1.7E+04	2.7E-01	1.2E-01	2.8E-02	2.3E-02	2.3E-02	5.5E-05	9.3E-04	1.8E-03	1.7E-02
PB4-07-2		0.777	4.0E+03	9.0E+02	30.	6.3E+07	1.3E+04	2.1E+02	6.6E-01	5.9E-03	4.9E-03	1.8E-03	2.8E-04	2.4E-04	5.5E-05	6.7E-05	3.5E-04
						3.6E+05	1.3E+04	1.4E+04	3.4E-01	4.9E-02	4.9E-02	2.0E-02	1.4E-02	2.7E-05	6.3E-04	1.3E-03	9.5E-03
PB4-07-3		0.155	4.0E+03	-8.1E+03	30.	2.5E+06	4.0E+03	5.5E+03	5.8E-01	1.5E-02	9.8E-03	4.0E-03	6.6E-04	1.3E-04	2.8E-05	1.1E-04	7.3E-04
						6.0E+05	1.3E+04	1.6E+04	4.2E-01	3.7E-02	3.9E-02	1.1E-02	4.0E-03	1.4E-04	1.7E-04	2.9E-04	2.5E-03
PB4-08	1.1E-07		2.5E+04	4.6E+03	30.	7.5E+06	3.8E+04	1.1E+03	7.2E-01	1.4E-03	1.2E-03	6.2E-04	3.8E-04	7.3E-05	2.4E-05	3.7E-05	3.1E-04
						1.9E+06	3.9E+04	1.5E+04	2.8E-01	5.3E-02	4.9E-02	1.8E-02	1.5E-02	1.7E-05	4.0E-04	7.3E-04	8.4E-03
PB4-08-1		0.995	2.6E+04	4.7E+03	30.	7.5E+06	3.8E+04	1.1E+03	7.2E-01	1.4E-03	1.2E-03	6.3E-04	3.8E-04	7.4E-05	2.4E-05	3.7E-05	3.1E-04
						1.9E+06	3.9E+04	1.5E+04	2.8E-01	5.3E-02	4.9E-02	1.8E-02	1.5E-02	1.7E-05	4.0E-04	7.3E-04	8.4E-03
PB4-08-2		0.000	5.3E+03	8.1E+02	30.	1.8E+06	1.4E+04	2.5E+03	2.1E-01	2.4E-03	1.8E-03	6.2E-04	4.7E-05	4.4E-05	2.2E-05	2.5E-05	7.9E-05
						2.0E+05	1.7E+04	1.9E+04	7.9E-01	3.1E-02	2.6E-02	8.6E-03	8.2E-03	2.5E-06	4.4E-04	8.7E-04	6.1E-03
PB4-08-3		0.005	4.0E+03	-8.1E+03	30.	3.2E+06	4.0E+03	3.6E+03	1.6E-01	3.8E-03	1.2E-03	3.0E-04	3.9E-06	0.0E+00	0.0E+00	0.0E+00	1.9E-05
						2.4E+05	1.3E+04	2.2E+04	8.4E-01	3.4E-02	3.3E-02	6.7E-03	7.4E-04	1.6E-06	1.4E-05	2.5E-05	2.5E-04
PB4-09	3.6E-08		2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.5E-01	4.7E-04	5.3E-04	2.6E-04	1.3E-04	1.0E-04	1.8E-05	1.9E-05	1.4E-04
						1.9E+06	4.2E+04	1.4E+04	2.5E-01	3.7E-02	4.0E-02	8.1E-03	2.7E-03	5.9E-09	7.8E-05	1.2E-04	1.4E-03
PB4-09-1		1.000	2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.5E-01	4.7E-04	5.3E-04	2.6E-04	1.3E-04	1.0E-04	1.8E-05	1.9E-05	1.4E-04
						1.9E+06	4.2E+04	1.4E+04	2.5E-01	3.7E-02	4.0E-02	8.1E-03	2.7E-03	5.9E-09	7.8E-05	1.2E-04	1.4E-03
PB4-09-2		0.000															
PB4-09-3		0.000															
PB4-10	5.0E-08		4.2E+03	-4.1E+03	30.	2.7E+07	8.2E+03	3.5E+03	8.8E-01	8.4E-02	6.8E-02	4.2E-02	1.5E-02	2.9E-03	1.0E-03	4.6E-03	1.6E-02
						5.5E+05	1.3E+04	1.4E+04	1.2E-01	1.0E-01	1.2E-01	1.3E-01	1.6E-01	2.8E-03	1.3E-02	2.5E-02	1.3E-01
PB4-10-1		0.014	2.1E+04	5.4E+03	30.	1.0E+07	3.4E+04	1.1E+03	9.1E-01	1.4E-02	1.7E-02	3.9E-02	4.2E-02	1.7E-03	2.0E-03	4.3E-03	3.0E-02
						1.7E+06	3.5E+04	1.5E+04	9.4E-02	1.4E-01	1.1E-01	1.8E-01	2.7E-01	6.8E-03	3.0E-02	5.2E-02	2.3E-01
PB4-10-2		0.425	4.0E+03	9.0E+02	30.	6.1E+07	1.3E+04	1.8E+02	9.2E-01	3.2E-02	2.8E-02	1.6E-02	7.2E-03	1.8E-03	7.2E-04	3.1E-03	7.5E-03
						3.5E+05	1.3E+04	1.4E+04	8.3E-02	1.1E-01	1.3E-01	1.8E-01	2.4E-01	6.7E-04	1.8E-02	3.5E-02	1.9E-01
PB4-10-3		0.561	4.0E+03	-8.1E+03	30.	2.3E+06	4.0E+03	6.1E+03	8.5E-01	1.3E-01	9.9E-02	6.1E-02	2.1E-02	3.8E-03	1.2E-03	5.8E-03	2.1E-02
						6.8E+05	1.3E+04	1.5E+04	1.5E-01	9.8E-02	1.0E-01	8.4E-02	1.0E-01	4.4E-03	9.7E-03	1.8E-02	9.0E-02

Table 3.4-31 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB4-11	2.8E-07		6.5E+03	-1.8E+03	30.	3.2E+07	1.3E+04	2.6E+03	7.7E-01	4.7E-02	3.9E-02	2.4E-02	7.3E-03	1.0E-03	3.8E-04	1.0E-03	6.5E-03
						5.8E+05	1.7E+04	1.6E+04	2.3E-01	1.2E-01	1.2E-01	4.7E-02	4.4E-02	2.1E-04	1.9E-03	3.4E-03	3.0E-02
PB4-11-1		0.142	2.2E+04	6.4E+03	30.	9.6E+06	3.6E+04	1.9E+03	8.1E-01	4.0E-02	3.6E-02	3.8E-02	3.2E-02	9.1E-04	1.6E-03	3.3E-03	2.4E-02
						1.7E+06	3.8E+04	1.6E+04	1.9E-01	1.1E-01	9.5E-02	8.5E-02	1.1E-01	5.6E-04	6.9E-03	1.3E-02	8.0E-02
PB4-11-2		0.470	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	7.0E-01	2.9E-02	2.5E-02	1.5E-02	3.3E-03	9.4E-04	2.1E-04	7.0E-04	3.5E-03
						3.7E+05	1.3E+04	1.4E+04	3.0E-01	1.6E-01	1.6E-01	4.8E-02	4.5E-02	4.7E-05	1.3E-03	2.4E-03	2.8E-02
PB4-11-3		0.388	4.0E+03	-8.1E+03	30.	2.5E+06	4.0E+03	5.8E+03	8.4E-01	7.1E-02	5.7E-02	3.1E-02	3.1E-03	1.1E-03	1.6E-04	6.2E-04	3.7E-03
						4.5E+05	1.3E+04	1.7E+04	1.6E-01	7.6E-02	7.9E-02	3.2E-02	2.0E-02	2.9E-04	7.3E-04	1.3E-03	1.4E-02
PB4-12	9.3E-08		2.4E+04	6.2E+03	30.	9.0E+06	3.8E+04	2.7E+03	6.9E-01	2.6E-02	2.2E-02	1.5E-02	8.9E-03	3.9E-04	5.2E-04	1.2E-03	7.9E-03
						1.7E+06	4.0E+04	1.6E+04	3.1E-01	1.1E-01	9.6E-02	4.1E-02	4.4E-02	2.4E-06	1.3E-03	2.7E-03	2.8E-02
PB4-12-1		0.945	2.5E+04	6.5E+03	30.	6.2E+06	3.9E+04	2.8E+03	7.1E-01	2.8E-02	2.3E-02	1.6E-02	9.5E-03	4.0E-04	5.5E-04	1.2E-03	8.3E-03
						1.7E+06	4.2E+04	1.6E+04	2.9E-01	1.1E-01	9.6E-02	4.2E-02	4.6E-02	2.5E-06	1.4E-03	2.8E-03	2.9E-02
PB4-12-2		0.051	4.0E+03	9.0E+02	30.	6.3E+07	1.3E+04	2.8E+02	4.0E-01	2.9E-03	2.1E-03	8.8E-04	2.3E-04	2.2E-04	3.1E-05	3.4E-05	2.8E-04
						3.7E+05	1.3E+04	1.5E+04	6.0E-01	9.9E-02	1.0E-01	2.7E-02	5.3E-03	4.4E-08	1.1E-04	2.0E-04	3.6E-03
PB4-12-3		0.005	4.0E+03	-8.1E+03	30.	2.0E+06	4.0E+03	7.1E+03	3.8E-01	1.4E-02	7.8E-03	1.8E-03	5.1E-05	2.6E-06	4.8E-07	5.3E-07	1.1E-04
						3.2E+05	1.3E+04	1.7E+04	6.2E-01	9.0E-02	9.7E-02	1.8E-02	2.7E-03	3.4E-10	4.4E-05	9.3E-05	1.8E-03
PB4-13	5.1E-08		4.0E+03	-3.1E+03	30.	3.6E+07	9.1E+03	3.8E+03	5.9E-01	1.1E-01	1.0E-01	7.7E-02	6.5E-02	9.7E-03	6.1E-03	3.0E-02	6.5E-02
						5.7E+05	1.3E+04	1.3E+04	4.1E-01	4.2E-01	4.6E-01	4.1E-01	4.5E-01	2.4E-03	3.0E-02	6.0E-02	3.7E-01
PB4-13-1		0.005	2.0E+04	5.3E+03	30.	1.6E+07	3.4E+04	7.9E+02	7.1E-01	2.9E-02	3.2E-02	8.2E-02	9.3E-02	1.3E-03	8.1E-03	1.5E-02	8.1E-02
						1.7E+06	3.4E+04	1.4E+04	2.9E-01	4.2E-01	4.6E-01	5.1E-01	6.0E-01	8.8E-03	4.7E-02	9.0E-02	5.1E-01
PB4-13-2		0.551	4.0E+03	9.0E+02	30.	6.3E+07	1.3E+04	2.5E+02	6.3E-01	1.2E-01	1.1E-01	9.6E-02	9.2E-02	1.4E-02	9.2E-03	4.5E-02	9.2E-02
						3.6E+05	1.3E+04	1.5E+04	3.7E-01	3.8E-01	4.2E-01	3.6E-01	4.0E-01	6.4E-04	2.5E-02	5.1E-02	3.2E-01
PB4-13-3		0.444	4.0E+03	-8.1E+03	30.	1.5E+06	4.0E+03	8.3E+03	5.2E-01	1.1E-01	8.6E-02	5.2E-02	3.0E-02	4.1E-03	2.3E-03	1.1E-02	3.0E-02
						8.2E+05	1.3E+04	1.1E+04	4.8E-01	4.6E-01	5.1E-01	4.6E-01	5.1E-01	4.6E-03	3.5E-02	7.1E-02	4.2E-01
PB4-14	3.0E-07		1.1E+04	-2.7E+03	30.	1.4E+07	1.6E+04	3.8E+03	5.4E-01	3.5E-02	2.6E-02	9.7E-03	2.1E-03	4.3E-04	1.3E-04	3.6E-04	2.2E-03
						7.7E+05	2.3E+04	1.8E+04	4.6E-01	3.7E-01	4.1E-01	3.0E-01	3.1E-01	1.5E-04	1.4E-02	2.8E-02	2.2E-01
PB4-14-1		0.305	2.7E+04	4.5E+03	30.	4.7E+06	4.0E+04	4.4E+03	4.9E-01	5.6E-03	5.3E-03	3.1E-03	1.5E-03	2.7E-04	1.8E-04	2.9E-04	1.4E-03
						1.6E+06	4.4E+04	1.8E+04	5.1E-01	4.7E-01	4.6E-01	3.6E-01	4.0E-01	1.8E-04	2.2E-02	4.5E-02	3.1E-01
PB4-14-2		0.173	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.1E+02	4.4E-01	2.8E-02	2.2E-02	7.4E-03	9.3E-04	4.2E-04	1.2E-04	2.6E-04	1.2E-03
						3.7E+05	1.3E+04	1.4E+04	5.6E-01	4.7E-01	5.1E-01	1.8E-01	9.3E-02	1.5E-05	3.0E-03	6.0E-03	5.8E-02
PB4-14-3		0.522	4.0E+03	-8.1E+03	30.	2.9E+06	4.0E+03	4.5E+03	6.1E-01	5.5E-02	4.0E-02	1.4E-02	2.8E-03	5.3E-04	1.1E-04	4.3E-04	3.0E-03
						4.1E+05	1.3E+04	1.9E+04	3.9E-01	2.9E-01	3.6E-01	3.0E-01	3.3E-01	1.8E-04	1.3E-02	2.6E-02	2.3E-01
PB4-15	4.2E-08		2.3E+04	3.7E+03	30.	1.5E+07	3.5E+04	1.1E+03	4.0E-01	1.1E-02	1.0E-02	2.7E-03	6.5E-04	6.6E-04	1.8E-04	2.2E-04	7.8E-04
						1.6E+06	3.6E+04	1.5E+04	6.0E-01	5.3E-01	5.5E-01	1.2E-01	1.3E-02	5.4E-07	2.9E-04	5.3E-04	5.8E-03
PB4-15-1		0.792	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.5E+02	4.2E-01	1.1E-02	1.1E-02	2.7E-03	6.7E-04	6.9E-04	2.0E-04	2.4E-04	7.9E-04
						1.9E+06	4.2E+04	1.4E+04	5.8E-01	5.6E-01	5.9E-01	1.3E-01	1.5E-02	7.9E-09	3.4E-04	6.2E-04	6.9E-03
PB4-15-2		0.198	4.0E+03	9.0E+02	30.	4.6E+07	1.3E+04	1.2E+03	3.5E-01	1.2E-02	9.5E-03	3.1E-03	5.7E-04	5.9E-04	1.5E-04	1.5E-04	7.6E-04
						3.3E+05	1.4E+04	1.7E+04	6.5E-01	3.8E-01	4.1E-01	7.7E-02	4.6E-03	1.1E-09	9.9E-05	1.7E-04	1.7E-03
PB4-15-3		0.009	4.0E+03	-8.1E+03	30.	2.1E+06	4.0E+03	6.6E+03	1.2E-01	1.4E-03	7.4E-04	3.6E-04	5.5E-06	1.1E-07	4.3E-08	4.3E-08	1.3E-05
						3.1E+05	1.3E+04	1.8E+04	8.8E-01	4.1E-01	4.1E-01	8.6E-02	8.3E-03	5.7E-05	1.8E-04	3.0E-04	5.7E-03

Table 3.4-31 (Concluded)

Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - High PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB4-16	1.6E-08		2.3E+04	7.9E+03	30.	4.2E+06	3.9E+04	5.0E+03	6.6E-01	5.2E-04	1.5E-04	7.3E-05	1.8E-05	2.5E-06	1.2E-06	1.8E-06	1.3E-05
						1.4E+06	4.4E+04	1.8E+04	1.8E-01	1.8E-03	8.0E-04	1.1E-04	2.1E-05	1.5E-06	1.1E-06	1.8E-06	1.4E-05
PB4-16-1		1.000	2.3E+04	7.9E+03	30.	4.2E+06	3.9E+04	5.0E+03	6.6E-01	5.2E-04	1.5E-04	7.3E-05	1.8E-05	2.5E-06	1.2E-06	1.8E-06	1.3E-05
						1.4E+06	4.4E+04	1.8E+04	1.8E-01	1.8E-03	8.0E-04	1.1E-04	2.1E-05	1.5E-06	1.1E-06	1.8E-06	1.4E-05
PB4-16-2		0.000															
PB4-16-3		0.000															
PB4-17	1.5E-08		2.8E+04	5.9E+03	30.	6.5E+06	4.2E+04	2.3E+03	6.7E-01	1.1E-03	9.2E-04	6.8E-04	2.7E-04	1.1E-04	2.3E-05	3.4E-05	2.5E-04
						1.8E+06	4.4E+04	1.6E+04	3.3E-01	3.9E-03	2.5E-03	1.2E-03	1.0E-03	1.9E-05	7.3E-05	1.2E-04	7.3E-04
PB4-17-1		1.000	2.8E+04	5.9E+03	30.	6.5E+06	4.2E+04	2.3E+03	6.7E-01	1.1E-03	9.2E-04	6.8E-04	2.7E-04	1.1E-04	2.3E-05	3.4E-05	2.5E-04
						1.8E+06	4.4E+04	1.6E+04	3.3E-01	3.9E-03	2.5E-03	1.2E-03	1.0E-03	1.9E-05	7.3E-05	1.2E-04	7.3E-04
PB4-17-2		0.000															
PB4-17-3		0.000															
PB4-18	6.1E-08		2.9E+04	4.7E+03	30.	7.5E+06	4.2E+04	1.0E+03	8.7E-01	6.0E-04	6.6E-04	2.2E-04	4.3E-05	2.3E-05	1.0E-05	1.3E-05	4.1E-05
						1.9E+06	4.3E+04	1.5E+04	1.3E-01	1.6E-02	2.0E-02	4.4E-03	5.1E-04	6.0E-07	1.3E-05	2.4E-05	3.2E-04
PB4-18-1		1.000	2.9E+04	4.7E+03	30.	7.5E+06	4.2E+04	1.0E+03	8.7E-01	6.0E-04	6.6E-04	2.2E-04	4.3E-05	2.3E-05	1.0E-05	1.3E-05	4.1E-05
						1.9E+06	4.3E+04	1.5E+04	1.3E-01	1.6E-02	2.0E-02	4.4E-03	5.1E-04	6.0E-07	1.3E-05	2.4E-05	3.2E-04
PB4-18-2		0.000															
PB4-18-3		0.000															

Table 3.4-32
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB3-01	4.8E-08		1.8E+04	5.8E+03	30.	1.9E+07	3.2E+04	1.8E+03	8.5E-01	8.2E-03	1.0E-03	6.1E-04	3.0E-04	2.6E-05	1.9E-05	3.6E-05	2.4E-04
						1.3E+06	3.4E+04	1.6E+04	1.5E-01	5.1E-02	2.6E-03	5.3E-04	4.6E-04	1.1E-05	4.1E-05	6.6E-05	3.5E-04
PB3-01-1		0.840	2.1E+04	6.7E+03	30.	1.1E+07	3.6E+04	2.0E+03	8.6E-01	9.7E-03	1.1E-03	7.0E-04	3.6E-04	3.0E-05	2.2E-05	4.2E-05	2.8E-04
						1.5E+06	3.8E+04	1.6E+04	1.4E-01	6.0E-02	2.8E-03	4.7E-04	3.0E-04	1.0E-05	1.7E-05	3.0E-05	2.2E-04
PB3-01-2		0.159	4.1E+03	8.9E+02	30.	6.0E+07	1.3E+04	4.3E+02	8.0E-01	5.3E-04	3.4E-04	1.2E-04	2.4E-05	7.5E-06	1.8E-06	4.3E-06	2.8E-05
						3.6E+05	1.3E+04	1.5E+04	2.0E-01	3.4E-03	1.9E-03	8.7E-04	1.3E-03	1.2E-05	1.6E-04	2.5E-04	1.1E-03
PB3-01-3		0.001	4.0E+03	-8.1E+03	30.	1.3E+06	4.0E+03	9.0E+03	1.8E-01	1.8E-04	9.7E-05	2.4E-05	3.9E-07	2.6E-09	1.0E-09	1.0E-09	1.6E-06
						5.0E+05	1.3E+04	1.3E+04	8.2E-01	2.1E-03	2.2E-03	1.4E-03	1.5E-03	5.5E-08	6.1E-05	1.3E-04	1.1E-03
PB3-02	6.0E-08		1.4E+04	-5.3E+02	30.	1.7E+07	2.1E+04	2.0E+03	7.4E-01	3.9E-03	2.7E-03	1.2E-03	3.1E-04	1.2E-04	2.8E-05	6.3E-05	3.3E-04
						9.8E+05	2.5E+04	1.7E+04	2.6E-01	1.7E-01	5.1E-03	2.0E-03	2.3E-03	4.6E-06	1.3E-04	2.6E-04	1.7E-03
PB3-02-1		0.425	2.7E+04	4.6E+03	30.	7.6E+06	3.9E+04	1.2E+03	5.2E-01	1.6E-03	1.0E-03	5.8E-04	2.9E-04	1.4E-04	3.3E-05	4.4E-05	2.9E-04
						1.9E+06	4.1E+04	1.5E+04	4.8E-01	3.9E-01	5.1E-03	2.6E-03	3.9E-03	3.0E-07	2.1E-04	4.2E-04	2.9E-03
PB3-02-2		0.242	4.0E+03	9.0E+02	30.	5.3E+07	1.3E+04	6.1E+02	9.3E-01	4.9E-03	3.8E-03	1.8E-03	4.3E-04	1.6E-04	4.2E-05	1.3E-04	4.7E-04
						3.3E+05	1.4E+04	1.5E+04	7.3E-02	2.3E-02	5.9E-03	2.1E-03	2.2E-03	8.7E-06	1.5E-04	2.9E-04	1.7E-03
PB3-02-3		0.333	4.0E+03	-8.1E+03	30.	3.1E+06	4.0E+03	4.0E+03	8.8E-01	6.2E-03	4.0E-03	1.5E-03	2.6E-04	6.1E-05	1.0E-05	4.1E-05	2.8E-04
						3.1E+05	1.3E+04	2.1E+04	1.2E-01	3.6E-03	4.5E-03	1.1E-03	1.6E-04	7.0E-06	2.2E-05	3.4E-05	1.4E-04
PB3-03	3.9E-08		1.7E+04	6.1E+03	30.	8.0E+06	3.1E+04	1.9E+03	8.1E-01	3.8E-03	1.8E-03	1.3E-03	5.5E-04	4.8E-05	4.0E-05	7.5E-05	4.6E-04
						1.6E+06	3.3E+04	1.6E+04	1.9E-01	1.6E-02	1.3E-02	4.5E-03	3.7E-03	1.1E-05	2.3E-04	4.5E-04	2.5E-03
PB3-03-1		0.999	1.7E+04	6.1E+03	30.	8.0E+06	3.1E+04	1.9E+03	8.1E-01	3.8E-03	1.8E-03	1.3E-03	5.5E-04	4.8E-05	4.0E-05	7.5E-05	4.6E-04
						1.6E+06	3.3E+04	1.6E+04	1.9E-01	1.6E-02	1.3E-02	4.5E-03	3.7E-03	1.1E-05	2.3E-04	4.5E-04	2.5E-03
PB3-03-2		0.001	4.0E+03	9.0E+02	30.	5.2E+06	1.3E+04	3.5E+03	1.8E-01	1.1E-03	6.5E-04	1.3E-04	2.1E-06	6.7E-07	4.0E-07	4.5E-07	9.1E-06
						2.5E+05	1.6E+04	2.1E+04	8.2E-01	8.5E-03	8.8E-03	4.6E-03	4.9E-03	5.2E-07	2.7E-04	6.2E-04	3.8E-03
PB3-03-3		0.000															
PB3-04	1.3E-07		2.6E+04	3.6E+03	30.	9.9E+06	3.7E+04	1.1E+03	5.8E-01	3.7E-03	3.1E-03	1.3E-03	5.9E-04	2.0E-04	6.3E-05	2.3E-04	5.9E-04
						1.7E+06	3.9E+04	1.5E+04	4.2E-01	5.3E-01	3.0E-02	2.5E-02	3.0E-02	1.6E-05	1.8E-03	3.4E-03	2.3E-02
PB3-04-1		0.893	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.0E+02	5.4E-01	1.9E-03	2.0E-03	6.3E-04	2.9E-04	1.5E-04	3.9E-05	8.7E-05	2.9E-04
						1.9E+06	4.2E+04	1.4E+04	4.6E-01	5.9E-01	2.9E-02	2.5E-02	2.8E-02	6.6E-06	1.7E-03	3.3E-03	2.2E-02
PB3-04-2		0.048	4.0E+03	9.0E+02	30.	6.2E+07	1.3E+04	1.8E+02	8.5E-01	1.3E-02	1.0E-02	6.7E-03	3.9E-03	6.7E-04	3.4E-04	1.7E-03	4.0E-03
						3.5E+05	1.3E+04	1.4E+04	1.5E-01	8.5E-02	2.8E-02	2.8E-02	3.8E-02	7.1E-05	3.5E-03	5.9E-03	3.2E-02
PB3-04-3		0.058	4.0E+03	-8.1E+03	30.	2.9E+06	4.0E+03	4.5E+03	9.4E-01	2.3E-02	1.4E-02	8.0E-03	2.3E-03	5.5E-04	2.1E-04	1.3E-03	2.4E-03
						3.8E+05	1.3E+04	1.9E+04	6.1E-02	5.1E-02	4.3E-02	3.3E-02	4.5E-02	1.2E-04	1.5E-03	2.8E-03	2.8E-02
PB3-05	1.5E-07		6.9E+03	9.2E+02	30.	4.8E+07	1.6E+04	9.2E+02	6.4E-01	7.6E-03	6.5E-03	2.6E-03	1.3E-03	2.0E-04	1.1E-04	1.6E-04	1.1E-03
						6.0E+05	1.7E+04	1.5E+04	3.6E-01	6.9E-02	4.3E-02	2.1E-02	1.7E-02	4.5E-05	9.4E-04	1.9E-03	1.3E-02
PB3-05-1		0.182	2.0E+04	5.7E+03	30.	7.4E+06	3.4E+04	1.5E+03	7.9E-01	6.9E-03	5.6E-03	5.6E-03	6.0E-03	1.3E-04	2.3E-04	4.8E-04	4.4E-03
						1.5E+06	3.5E+04	1.6E+04	2.1E-01	1.6E-01	3.2E-02	2.4E-02	2.4E-02	2.7E-05	1.0E-03	1.9E-03	1.8E-02
PB3-05-2		0.724	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	6.1E-01	6.9E-03	6.4E-03	1.7E-03	2.1E-04	2.3E-04	8.6E-05	9.4E-05	2.8E-04
						3.7E+05	1.3E+04	1.4E+04	3.9E-01	5.0E-02	4.5E-02	2.1E-02	1.7E-02	3.6E-05	1.0E-03	2.1E-03	1.3E-02
PB3-05-3		0.095	4.0E+03	-8.1E+03	30.	2.6E+06	4.0E+03	5.4E+03	5.6E-01	1.4E-02	9.1E-03	3.6E-03	5.4E-04	1.2E-04	2.3E-05	9.1E-05	6.1E-04
						5.8E+05	1.3E+04	1.6E+04	4.4E-01	3.8E-02	4.0E-02	1.1E-02	4.1E-03	1.5E-04	1.6E-04	2.8E-04	2.5E-03

Table 3.4-32 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB3-06	1.8E-07		2.5E+04	4.5E+03	30.	7.6E+06	3.7E+04	1.2E+03	7.1E-01	1.5E-03	1.2E-03	7.0E-04	4.4E-04	7.1E-05	2.9E-05	4.7E-05	3.7E-04
						1.8E+06	3.9E+04	1.5E+04	2.9E-01	5.2E-02	4.8E-02	1.7E-02	1.4E-02	2.0E-05	4.0E-04	7.3E-04	8.3E-03
PB3-06-1		0.970	2.5E+04	4.7E+03	30.	7.7E+06	3.8E+04	1.1E+03	7.2E-01	1.6E-03	1.2E-03	7.1E-04	4.6E-04	7.3E-05	3.0E-05	4.8E-05	3.8E-04
						1.9E+06	3.9E+04	1.5E+04	2.8E-01	5.3E-02	4.9E-02	1.8E-02	1.5E-02	1.7E-05	4.0E-04	7.3E-04	8.4E-03
PB3-06-2		0.019	4.0E+03	9.0E+02	30.	3.6E+06	1.3E+04	3.6E+03	4.1E-01	1.1E-03	5.3E-04	1.4E-04	4.5E-06	8.8E-07	3.9E-07	4.4E-07	9.2E-06
						2.5E+05	1.7E+04	2.2E+04	5.9E-01	1.7E-02	1.7E-02	7.6E-03	7.3E-03	5.5E-08	1.5E-04	3.1E-04	4.2E-03
PB3-06-3		0.010	4.0E+03	-8.1E+03	30.	3.2E+06	4.0E+03	3.6E+03	8.9E-02	3.4E-04	1.4E-04	6.8E-05	1.1E-06	3.4E-08	1.4E-08	1.4E-08	2.9E-06
						2.4E+05	1.3E+04	2.2E+04	9.1E-01	2.2E-02	1.6E-02	9.0E-03	8.3E-03	3.7E-04	7.2E-04	1.5E-03	7.4E-03
PB3-07	5.6E-08		2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.5E-01	4.7E-04	5.3E-04	2.6E-04	1.3E-04	1.0E-04	1.8E-05	1.9E-05	1.4E-04
						1.9E+06	4.2E+04	1.4E+04	2.5E-01	3.7E-02	4.0E-02	8.1E-03	2.7E-03	5.9E-09	7.8E-05	1.2E-04	1.4E-03
PB3-07-1		1.000	2.9E+04	4.5E+03	30.	7.7E+06	4.1E+04	9.1E+02	7.5E-01	4.7E-04	5.3E-04	2.6E-04	1.3E-04	1.0E-04	1.8E-05	1.9E-05	1.4E-04
						1.9E+06	4.2E+04	1.4E+04	2.5E-01	3.7E-02	4.0E-02	8.1E-03	2.7E-03	5.9E-09	7.8E-05	1.2E-04	1.4E-03
PB3-07-2		0.000															
PB3-07-3		0.000															
PB3-08	1.4E-08		5.2E+03	-3.2E+03	30.	2.9E+07	1.0E+04	3.2E+03	9.0E-01	8.3E-02	6.8E-02	4.5E-02	2.0E-02	3.4E-03	1.5E-03	7.0E-03	2.0E-02
						6.3E+05	1.5E+04	1.4E+04	1.0E-01	1.0E-01	1.1E-01	1.2E-01	1.7E-01	2.9E-03	1.4E-02	2.7E-02	1.4E-01
PB3-08-1		0.069	2.2E+04	4.9E+03	30.	8.4E+06	3.5E+04	9.6E+02	9.3E-01	9.0E-03	1.1E-02	2.3E-02	2.5E-02	1.5E-03	1.1E-03	2.6E-03	1.7E-02
						1.8E+06	3.6E+04	1.5E+04	7.1E-02	1.5E-01	1.2E-01	1.9E-01	2.9E-01	7.0E-03	3.2E-02	5.5E-02	2.5E-01
PB3-08-2		0.445	4.0E+03	9.0E+02	30.	6.2E+07	1.3E+04	1.8E+02	9.3E-01	4.2E-02	3.9E-02	2.7E-02	1.8E-02	3.2E-03	1.8E-03	8.7E-03	1.9E-02
						3.5E+05	1.3E+04	1.4E+04	6.8E-02	9.8E-02	1.2E-01	1.6E-01	2.2E-01	6.8E-04	1.7E-02	3.3E-02	1.8E-01
PB3-08-3		0.486	4.0E+03	-8.1E+03	30.	2.3E+06	4.0E+03	6.3E+03	8.6E-01	1.3E-01	1.0E-01	6.4E-02	2.1E-02	3.9E-03	1.2E-03	6.0E-03	2.2E-02
						7.1E+05	1.3E+04	1.4E+04	1.4E-01	9.9E-02	1.0E-01	8.2E-02	1.0E-01	4.3E-03	9.4E-03	1.7E-02	8.7E-02
PB3-09	1.3E-07		1.2E+04	1.3E+03	30.	2.5E+07	2.2E+04	2.2E+03	7.9E-01	4.3E-02	3.7E-02	2.8E-02	1.5E-02	1.0E-03	7.9E-04	1.8E-03	1.2E-02
						1.0E+06	2.5E+04	1.6E+04	2.1E-01	1.2E-01	1.1E-01	6.4E-02	7.3E-02	3.5E-04	3.9E-03	7.2E-03	5.1E-02
PB3-09-1		0.452	2.3E+04	6.2E+03	30.	8.0E+06	3.7E+04	1.9E+03	8.1E-01	3.8E-02	3.5E-02	3.7E-02	3.0E-02	9.6E-04	1.5E-03	3.1E-03	2.2E-02
						1.7E+06	3.9E+04	1.5E+04	1.9E-01	1.2E-01	1.0E-01	8.9E-02	1.1E-01	5.9E-04	7.2E-03	1.3E-02	8.3E-02
PB3-09-2		0.324	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.0E+02	7.2E-01	2.8E-02	2.5E-02	1.4E-02	3.2E-03	1.0E-03	2.3E-04	6.8E-04	3.5E-03
						3.7E+05	1.3E+04	1.4E+04	2.8E-01	1.5E-01	1.5E-01	5.1E-02	5.3E-02	4.0E-05	1.6E-03	3.0E-03	3.3E-02
PB3-09-3		0.224	4.0E+03	-8.1E+03	30.	2.5E+06	4.0E+03	5.7E+03	8.4E-01	7.3E-02	5.8E-02	3.1E-02	3.0E-03	1.1E-03	1.6E-04	6.0E-04	3.6E-03
						4.5E+05	1.3E+04	1.7E+04	1.6E-01	7.4E-02	7.7E-02	3.1E-02	1.9E-02	3.0E-04	6.9E-04	1.3E-03	1.3E-02
PB3-10	1.4E-07		2.5E+04	6.4E+03	30.	6.7E+06	3.9E+04	2.8E+03	7.0E-01	2.7E-02	2.3E-02	1.5E-02	9.3E-03	4.0E-04	5.5E-04	1.2E-03	8.2E-03
						1.7E+06	4.2E+04	1.6E+04	3.0E-01	1.1E-01	9.6E-02	4.2E-02	4.6E-02	2.5E-06	1.4E-03	2.8E-03	2.9E-02
PB3-10-1		0.988	2.5E+04	6.5E+03	30.	6.0E+06	3.9E+04	2.8E+03	7.1E-01	2.7E-02	2.3E-02	1.6E-02	9.5E-03	4.0E-04	5.5E-04	1.2E-03	8.3E-03
						1.7E+06	4.2E+04	1.6E+04	2.9E-01	1.1E-01	9.6E-02	4.2E-02	4.7E-02	2.5E-06	1.4E-03	2.9E-03	2.9E-02
PB3-10-2		0.012	4.0E+03	9.0E+02	30.	6.3E+07	1.3E+04	2.6E+02	3.9E-01	2.5E-03	1.9E-03	8.3E-04	2.4E-04	2.2E-04	3.3E-05	3.8E-05	2.9E-04
						3.8E+05	1.3E+04	1.5E+04	6.1E-01	1.0E-01	1.1E-01	2.6E-02	4.8E-03	1.6E-07	1.0E-04	1.8E-04	3.1E-03
PB3-10-3		0.001	4.0E+03	-8.1E+03	30.	1.9E+06	4.0E+03	7.4E+03	3.6E-01	1.3E-02	7.0E-03	1.7E-03	4.6E-05	2.2E-06	4.3E-07	4.8E-07	9.8E-05
						3.3E+05	1.3E+04	1.7E+04	6.4E-01	9.1E-02	9.8E-02	2.0E-02	3.0E-03	3.7E-10	4.9E-05	1.0E-04	2.0E-03

Table 3.4-32 (Continued)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB3-11	1.4E-08		4.4E+03	-2.7E+03	30.	3.6E+07	9.7E+03	3.6E+03	5.8E-01	1.1E-01	9.4E-02	7.2E-02	6.0E-02	9.0E-03	5.7E-03	2.8E-02	6.0E-02
						5.9E+05	1.4E+04	1.3E+04	4.2E-01	4.3E-01	4.7E-01	4.1E-01	4.6E-01	2.4E-03	3.0E-02	6.0E-02	3.7E-01
PB3-11-1		0.024	2.2E+04	4.9E+03	30.	1.2E+07	3.5E+04	8.5E+02	7.0E-01	1.6E-02	1.8E-02	3.7E-02	4.1E-02	2.9E-04	3.3E-03	6.6E-03	3.5E-02
						1.8E+06	3.5E+04	1.4E+04	3.0E-01	4.6E-01	5.0E-01	5.5E-01	6.4E-01	9.5E-03	5.1E-02	9.7E-02	5.5E-01
PB3-11-2		0.560	4.0E+03	9.0E+02	30.	6.3E+07	1.3E+04	2.4E+02	6.2E-01	1.1E-01	1.0E-01	8.8E-02	8.4E-02	1.3E-02	8.4E-03	4.1E-02	8.4E-02
						3.7E+05	1.3E+04	1.5E+04	3.8E-01	4.0E-01	4.3E-01	3.7E-01	4.2E-01	7.8E-04	2.6E-02	5.2E-02	3.3E-01
PB3-11-3		0.416	4.0E+03	-8.1E+03	30.	1.5E+06	4.0E+03	8.4E+03	5.1E-01	1.1E-01	8.5E-02	5.2E-02	3.0E-02	4.1E-03	2.3E-03	1.1E-02	3.0E-02
						8.1E+05	1.3E+04	1.1E+04	4.9E-01	4.6E-01	5.1E-01	4.6E-01	5.1E-01	4.2E-03	3.5E-02	6.9E-02	4.2E-01
PB3-12	2.0E-07		2.0E+04	1.5E+03	30.	9.1E+06	3.0E+04	4.1E+03	5.1E-01	1.8E-02	1.4E-02	5.8E-03	1.7E-03	3.4E-04	1.6E-04	3.2E-04	1.7E-03
						1.3E+06	3.5E+04	1.8E+04	4.9E-01	4.3E-01	4.4E-01	3.3E-01	3.6E-01	1.6E-04	1.8E-02	3.7E-02	2.7E-01
PB3-12-1		0.702	2.7E+04	4.5E+03	30.	4.7E+06	4.0E+04	4.4E+03	4.9E-01	5.6E-03	5.3E-03	3.1E-03	1.5E-03	2.7E-04	1.8E-04	2.9E-04	1.4E-03
						1.6E+06	4.4E+04	1.8E+04	5.1E-01	4.7E-01	4.6E-01	3.6E-01	4.0E-01	1.8E-04	2.2E-02	4.5E-02	3.1E-01
PB3-12-2		0.080	4.0E+03	9.0E+02	30.	6.4E+07	1.3E+04	2.1E+02	4.2E-01	2.5E-02	2.0E-02	6.8E-03	1.0E-03	5.1E-04	1.7E-04	3.5E-04	1.2E-03
						3.7E+05	1.3E+04	1.4E+04	5.8E-01	4.6E-01	5.0E-01	1.7E-01	8.5E-02	1.5E-05	2.7E-03	5.4E-03	5.3E-02
PB3-12-3		0.217	4.0E+03	-8.1E+03	30.	2.9E+06	4.0E+03	4.5E+03	6.2E-01	5.5E-02	4.1E-02	1.4E-02	2.6E-03	5.1E-04	1.0E-04	3.9E-04	2.8E-03
						4.1E+05	1.3E+04	1.9E+04	3.8E-01	2.9E-01	3.6E-01	3.0E-01	3.3E-01	1.8E-04	1.3E-02	2.6E-02	2.3E-01
PB3-13	5.5E-08		2.7E+04	4.3E+03	30.	9.3E+06	4.0E+04	9.7E+02	4.1E-01	1.1E-02	1.1E-02	2.7E-03	6.7E-04	6.8E-04	1.9E-04	2.4E-04	7.8E-04
						1.8E+06	4.1E+04	1.5E+04	5.9E-01	5.5E-01	5.8E-01	1.3E-01	1.5E-02	1.2E-07	3.3E-04	6.0E-04	6.6E-03
PB3-13-1		0.955	2.8E+04	4.5E+03	30.	7.6E+06	4.1E+04	9.5E+02	4.2E-01	1.1E-02	1.1E-02	2.7E-03	6.7E-04	6.9E-04	2.0E-04	2.4E-04	7.9E-04
						1.9E+06	4.2E+04	1.4E+04	5.8E-01	5.6E-01	5.9E-01	1.3E-01	1.5E-02	7.9E-09	3.4E-04	6.2E-04	6.9E-03
PB3-13-2		0.043	4.0E+03	9.0E+02	30.	4.8E+07	1.3E+04	1.1E+03	3.4E-01	1.2E-02	9.5E-03	3.0E-03	5.2E-04	5.4E-04	1.3E-04	1.3E-04	6.9E-04
						3.3E+05	1.4E+04	1.6E+04	6.6E-01	3.8E-01	4.1E-01	7.8E-02	5.2E-03	1.2E-09	1.1E-04	1.8E-04	1.9E-03
PB3-13-3		0.002	4.0E+03	-8.1E+03	30.	2.1E+06	4.0E+03	6.9E+03	1.1E-01	1.3E-03	7.1E-04	3.6E-04	5.5E-06	9.7E-08	3.9E-08	3.9E-08	1.3E-05
						3.2E+05	1.3E+04	1.7E+04	8.9E-01	4.1E-01	4.1E-01	8.2E-02	7.5E-03	5.1E-05	1.7E-04	2.8E-04	5.2E-03
PB3-14	2.4E-08		2.4E+04	7.8E+03	30.	4.4E+06	4.0E+04	4.9E+03	6.9E-01	5.5E-04	1.5E-04	7.7E-05	1.9E-05	2.7E-06	1.3E-06	1.9E-06	1.3E-05
						1.5E+06	4.5E+04	1.8E+04	1.9E-01	1.9E-03	8.4E-04	1.1E-04	2.2E-05	1.6E-06	1.2E-06	1.9E-06	1.5E-05
PB3-14-1		1.000	2.4E+04	7.8E+03	30.	4.4E+06	4.0E+04	4.9E+03	6.9E-01	5.5E-04	1.5E-04	7.7E-05	1.9E-05	2.7E-06	1.3E-06	1.9E-06	1.3E-05
						1.5E+06	4.5E+04	1.8E+04	1.9E-01	1.9E-03	8.4E-04	1.1E-04	2.2E-05	1.6E-06	1.2E-06	1.9E-06	1.5E-05
PB3-14-2		0.000															
PB3-14-3		0.000															
PB3-15	2.3E-08		2.8E+04	5.9E+03	30.	6.5E+06	4.2E+04	2.3E+03	6.7E-01	1.1E-03	9.2E-04	6.8E-04	2.8E-04	1.1E-04	2.3E-05	3.4E-05	2.5E-04
						1.8E+06	4.4E+04	1.6E+04	3.3E-01	3.9E-03	2.5E-03	1.2E-03	1.0E-03	1.9E-05	7.3E-05	1.2E-04	7.3E-04
PB3-15-1		1.000	2.8E+04	5.9E+03	30.	6.5E+06	4.2E+04	2.3E+03	6.7E-01	1.1E-03	9.2E-04	6.8E-04	2.8E-04	1.1E-04	2.3E-05	3.4E-05	2.5E-04
						1.8E+06	4.4E+04	1.6E+04	3.3E-01	3.9E-03	2.5E-03	1.2E-03	1.0E-03	1.9E-05	7.3E-05	1.2E-04	7.3E-04
PB3-15-2		0.000															
PB3-15-3		0.000															

Table 3.4-32 (Concluded)
Mean Source Terms Resulting from Partitioning for Seismic Initiators -- EPRI - Low PGA

Source Term	Freq. (1/yr)	Cond. Prob.	Warn (s)	dEvac (s)	Elev (m)	Energy (w)	Start (s)	Dur (s)	Release Fractions								
									NG	I	Cs	Te	Sr	Ru	La	Ce	Ba
PB3-16	9.5E-08		2.9E+04	4.7E+03	30.	7.5E+06	4.2E+04	1.0E+03	8.7E-01	6.0E-04	6.6E-04	2.2E-04	4.3E-05	2.3E-05	1.0E-05	1.3E-05	4.1E-05
						1.9E+06	4.3E+04	1.5E+04	1.3E-01	1.6E-02	2.0E-02	4.4E-03	5.1E-04	6.0E-07	1.3E-05	2.4E-05	3.2E-04
PB3-16-1		1.000	2.9E+04	4.7E+03	30.	7.5E+06	4.2E+04	1.0E+03	8.7E-01	6.0E-04	6.6E-04	2.2E-04	4.3E-05	2.3E-05	1.0E-05	1.3E-05	4.1E-05
						1.9E+06	4.3E+04	1.5E+04	1.3E-01	1.6E-02	2.0E-02	4.4E-03	5.1E-04	6.0E-07	1.3E-05	2.4E-05	3.2E-04
PB3-16-2		0.000															
PB3-16-3		0.000															

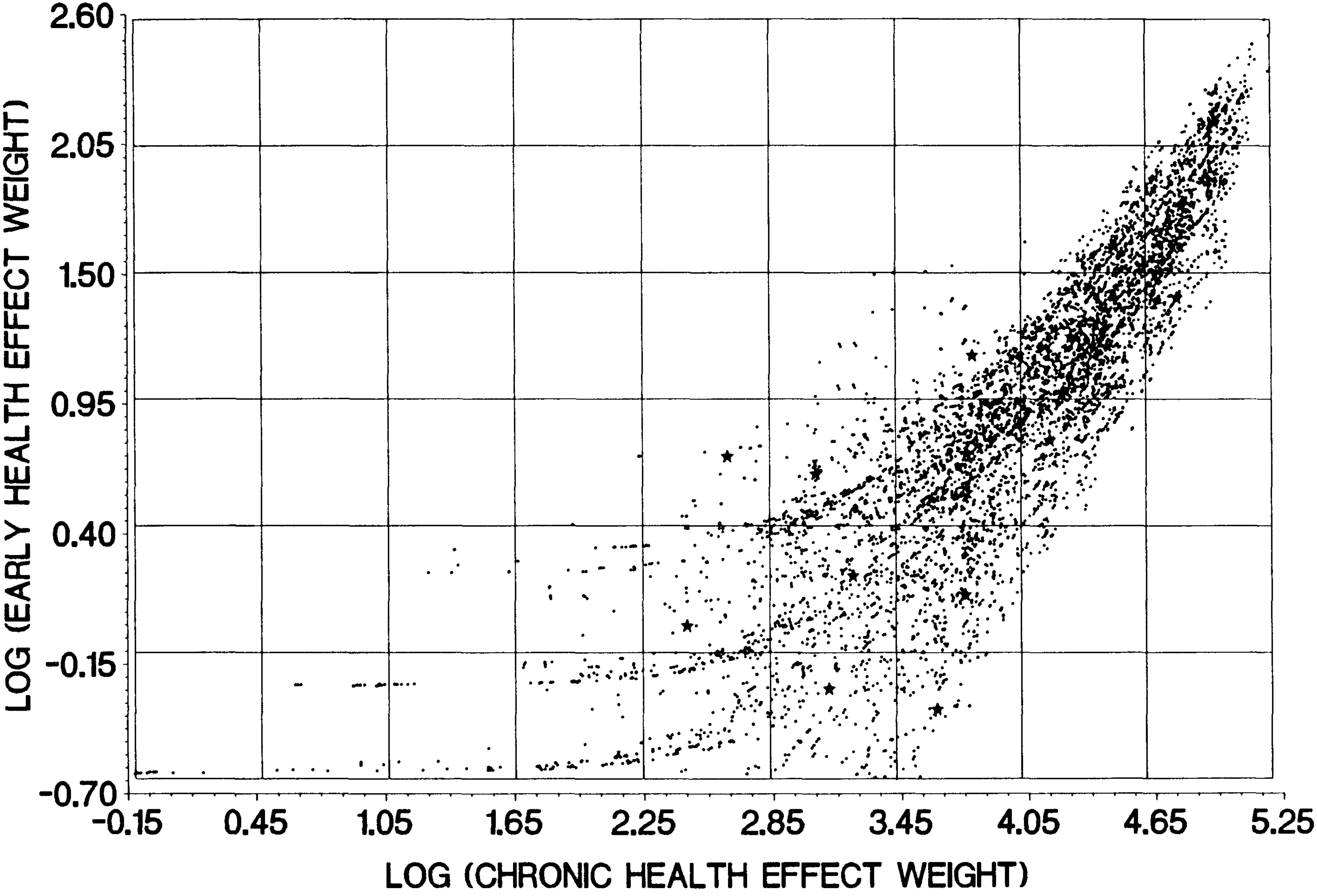

Figure 3.4-5. Distribution of Nonzero Early and Chronic Health Effect Weights for Seismic Initiators -- EPRI - High PGA

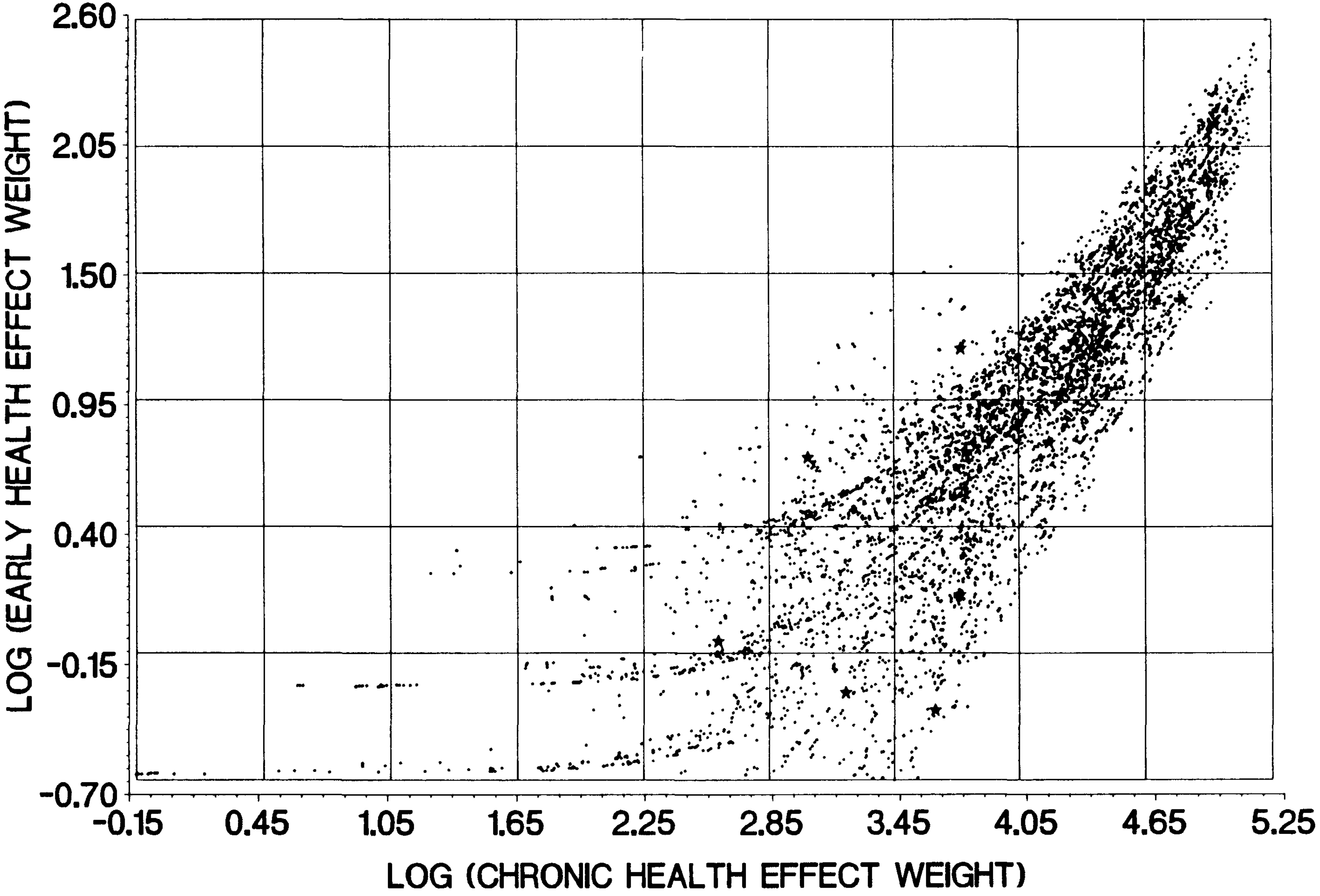

Figure 3.4-6. Distribution of Nonzero Early and Chronic Health Effect Weights for Seismic Initiators -- EPRI - Low PGA

3.4.8 Sensitivity Analyses for Seismic Initiators: EPRI Hazard Curve

The only sensitivity analysis performed for the EPRI hazard distribution was to use the normal evacuation speed for low PGA case. This sensitivity does not affect the results until after the MACCS calculations for the consequences of the source term partitions presented in Section 4.3.5

3.5 Insights from the Source Term Analysis

The range in the release fractions for similar accidents is large; typically several orders of magnitude. Although the containment is predicted to fail in most of the accidents analyzed, there are several features of Peach Bottom that tend to mitigate the release. First, the in-vessel releases are generally directed to the suppression pool where they are subjected to the pool DF. Although not as effective as the suppression pool, the containment sprays and water in the reactor cavity and on the drywell floor also offer mechanisms for reducing the release of radionuclides from the containment. The reactor building at Peach Bottom also offers a decontamination mechanism since, if not completely bypassed, the radionuclides have a significant chance of being retained in the reactor building after being released from containment. The largest releases tend to occur when the suppression pool is bypassed and the containment sprays are not operating. Furthermore, because many of the dominant accidents are SBOs, it is not uncommon for the containment sprays to be unavailable at the time of vessel breach. In these accidents, releases that occur at vessel breach (e.g., release associated with DCH or an ex-vessel steam explosion) and after vessel breach (e.g., CCI releases) bypass the suppression pool and are not subjected to either a pool DF or a spray DF.

3.6 References

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4. H.-N. Jow, J. L. Sprung, J. A. Rollstin, L. T. Ritche, and D. I. Chanin, "MELCOR Accident Consequence Code System (MACCS): Model Description," NUREG/CR-4691, SAND86-1562, Volume 2, Sandia National Laboratories, Albuquerque, NM, February 1990.

5. R. L. Iman, J. C. Helton, and J. D. Johnson, "PARTITION: A Program for Defining the Source Term/Consequence Analysis Interface in the NUREG-1150 Probabilistic Risk Assessments, User's Guide," NUREG/CR-5253, SAND88-2940, Sandia National Laboratories, Albuquerque, NM, May 1990.

4. CONSEQUENCE ANALYSIS

Offsite consequences were calculated with MACCS[1,2,3] for each of the source term groups defined in the partitioning process. This code has been in use for some time and will not be described in any detail. Although the variables thought to be the largest contributors to the uncertainty in risk were sampled from distributions in the accident frequency analysis, the accident progression analysis, and the source term analysis, there was no analogous treatment of uncertainties in the consequence analysis. Variability in the weather was fully accounted for, but the uncertainty in other parameters such as the dry deposition speed or the evacuation rate was not considered.

4.1 Description of the Consequence Analysis

Offsite consequences were calculated with MACCS for each of the source term groups defined in the partitioning process. MACCS tracks the dispersion of the radioactive material in the atmosphere as it spreads out from the plant and computes its deposition on the ground. MACCS then calculates the effects of this radioactivity on the population and the environment. Doses and the ensuing health effects from 60 radionuclides are computed for the following pathways: immersion or cloudshine, inhalation from the plume, groundshine, deposition on the skin, inhalation of resuspended ground contamination, ingestion of contaminated water and ingestion of contaminated food.

MACCS treats atmospheric dispersion by the use of multiple, straight-line Gaussian plumes. Each plume can have a different direction, duration, and initial radionuclide concentration. Cross-wind dispersion is treated by a multi-step function. Dry and wet deposition are treated as independent processes. The weather variability is treated by means of a stratified sampling process.

For early exposure, the following pathways are considered: immersion or cloudshine, inhalation from the plume, groundshine, deposition on the skin, and inhalation of resuspended ground contamination. Skin deposition and inhalation of resuspended ground contamination have generally not been considered in previous consequence models. For the long-term exposure, MACCS considers the following four pathways: groundshine, inhalation of resuspended ground contamination, ingestion of contaminated water and ingestion of contaminated food. The direct exposure pathways, groundshine, and inhalation of resuspended ground contamination, produce doses in the population living in the area surrounding the plant. The indirect exposure pathways, i.e., ingestion of contaminated water and food, produce doses in those who ingest food or water emanating from the area around the accident site. The contamination of water bodies is estimated for the washoff of land-deposited material as well as direct deposition. The food pathway model includes direct deposition onto crops and uptake from the soil.

Both short-term and long-term mitigative measures are modeled in MACCS. Short-term actions include evacuation, sheltering, and emergency relocation out of the emergency planing zone. Long-term actions include later relocation and restrictions on land use and crop disposition. Relocation and land decontamination, interdiction, and condemnation are based on projected long-term doses from groundshine and inhalation of resuspended radioactivity. The disposal of agricultural products and the removal of farmland from crop production are based on ground contamination criteria.

The health effects models use the dose received by an organ to predict morbidity or mortality. The models used in MACCS calculate both short-term and long-term effects for a number of organs.

The MACCS consequence model calculates a large number of different consequence measures. Results for the following six consequence measures are given in this report: early fatalities, total latent cancer fatalities, population dose within 50 miles, population dose for the entire region, early fatality risk within 1 mile, and latent cancer fatality risk within 10 miles. These consequence measures are described in Table 4.1-1. For the analyses performed for NUREG-1150, 99.5% of the population evacuates and 0.5% of the population does not evacuate and continues normal activity. Details of the methods used to incorporate the consequence results for the source term groups into the integrated risk analysis are given in Volume 1 of this report.

4.2 MACCS Input for Peach Bottom

The values of most MACCS input parameters (e.g., aerosol dry deposition velocity, health effects model parameter values, food pathway transfer factors) do not depend on site characteristics. For those parameters that do depend on site characteristics (e.g., evacuation speed, shielding factors, farmland usage), the methods used to calculate the parameters are essentially the same for all sites. Because the methods used to develop input parameter values for the MACCS NUREG-1150 analyses and the parameter values developed using those methods are documented in Volume 2, Part 7 of this report, only a small portion of the MACCS input is presented here.

Table 4.2-1 lists the MACCS input parameters that have strong site dependencies and presents the values of these parameters used in the MACCS calculations for the Peach Bottom site. The evacuation delay period begins when general emergency conditions occur and ends when the general public starts to evacuate; non-farm wealth includes personal, business, and public property; and the farmland fractions do not add to one because not all farmland is under cultivation. In addition to the site specific data presented in Table 4.2-1, the Peach Bottom MACCS calculations used one year of meteorological data from the Peach Bottom site and regional population data developed from the 1980 census tapes modified by updated NRC data for the 0-10 mile region. Table 4.2-2 gives the population within certain

Table 4.1-1
Definition of Consequence Analysis Results

Variable	Definition
Early fatalities	Number of fatalities occurring within 1 year of the accident.
Total latent cancer fatalities	Number of latent cancer fatalities due to both early and chronic exposure.
Population dose within 50 miles	Population dose, expressed in effective dose equivalents for whole body exposure (person-rem, 1Sv = 100 Rem), due to early and chronic exposure pathways within 50 miles of the reactor. Due to the nature of the chronic pathways models, the actual exposure due to food and water consumption may take place beyond 50 miles.
Population dose within entire region	Population dose, expressed in effective dose equivalents for whole body exposure (person-rem), due to early and chronic exposure pathways within the entire region.
Individual early fatality risk within one mile	The probability of dying within one year for an individual within one mile of the exclusion boundary (i.e., Σ (ef/pop)p, where ef is the number of early fatalities, pop is the population size, p is the weather condition probability, and the summation is over all weather conditions).
Individual latent cancer risk within 10 miles	The probability of dying from cancer due to the accident for an individual within 10 miles of the plant (i.e., Σ (cf/pop)p, where cf is the number of cancer fatalities due to direct exposure in the resident population, pop is the population size, p is the weather condition probability, and the summation is over all weather conditions; chronic exposure does not include ingestion but does include integrated groundshine and inhalation exposure from $t = 0$ to $t = \infty$).

Table 4.2-1
Site Specific Input Data for Peach Bottom MACCS Calculations

Parameter	
Reactor Power Level (MWt)	3293
Containment Height (m)	50
Containment Width (m)	50
Exclusion Zone Distance (km)	0.820
Evacuation Delay (h)	1.5
Evacuation Speed (m/s)	4.8
Farmland Fractions by Crop Categories	
Pasture	0.38
Stored Forage	0.13
Grains	0.23
Green Leafy Vegetables	0.002
Legumes and Seeds	0.16
Roots and Tubers	0.004
Other Food Crops	0.004
Non-Farm Wealth ($/person)	79,000
Farm Wealth	
Value ($/hectare)	4469
Fraction in Improvements	0.25

Table 4.2-2

Population at Different Radii From the Plant

Distance From Plant		Population
(km)	(miles)	
1.6	1.0	118
4.8	3.0	1822
16.1	10.0	28,647
48.3	30.0	989,356
160.9	100.0	14,849,112
563.3	350.0	68,008,584
1609.3	1000.0	154,828,144

There is considerable variation in the sector populations (out to 1000 miles) as well. The WNW sector has a population of about 35 million and the W and ENE sectors each have populations of about 22 million each, while the SE sector has a population of about two hundred thousand.

distances of the plant as summarized from the MACCS demographic input. Table 4.2-3 lists the shielding parameters used in this analysis.

The evacuation parameters for the seismic risk analyses differed from those for the fire and internal events analyses. It was estimated that for earthquakes with PGAs greater than 0.6 g, there would be no effective evacuation. For large earthquakes, the population within the evacuation zone continues normal activity for 24 hr. and is then relocated. For earthquakes with PGAs less than 0.6 G, it was judged that evacuation would be possible, but that it would start later and proceed at a slower rate than an evacuation for an internal or fire initiator. Thus, for seisms with PGAs less than 0.6 g, the delay time is 2.25 hr. (1.5 times the normal delay time) and the evacuation speed is 2.4 m/s (half the normal evacuation speed). This is referred to as degraded evacuation for low acceleration earthquakes.

The shielding parameters were also modified for seismic initiators. Table 4.2-3 lists the shielding parameters for internal and fire initiators, small earthquakes, and large earthquakes. For the large earthquakes, within ten miles of the plant it was assumed that the population remained outdoors for a period of 24 hr. and then were relocated. The shielding factors used were those for the outdoor exposure. At greater than ten miles, it was assumed that there was no earthquake damage and that the same shielding factors and relocation models used for the internal events would be applicable.

For small earthquakes, the normal activity shielding factors were modified to account for the effect of broken windows with people remaining indoors. For the inhalation and skin pathways, buildings offer no effective protection following an earthquake because of broken windows. The effectiveness of being indoors is reduced for groundshine as well because the broken windows allow deposition within buildings.

4.3 Results of MACCS Consequence Calculations

The results given in this section are conditional on the occurrence of a release. That is, given that a release takes place, with release fractions and other characteristics as defined by one of the source term groups, then the consequences reported in this section are calculated. The tables and figures in this section contain no information about the frequency with which these consequences may be expected. Information about the frequencies of consequences of various magnitudes is contained in the risk results (Chapter 5).

4.3.1 Results for Internal Initiators

The integration of the NUREG-1150 probabilistic risk assessments uses the results of the MACCS consequence calculations in two forms. In the first form, a single mean (over weather variation) result is reported for each

Table 4.2-3
Shielding Factors used for Peach Bottom MACCS Calculations

		Population Response	
Radiation Pathway	Evacuate	Normal Activity	Take Shelter
Internal and Fire Initiators			
Cloudshine	1.0	0.75	0.50
Groundshine	0.5	0.33	0.10
Inhalation	1.0	0.41	0.33
Skin	1.0	0.41	0.33
Low g Seismic Initiators (<0.6 g)			
Cloudshine	1.0	0.75	0.50
Groundshine	0.5	0.50	0.30
Inhalation	1.0	1.00	1.00
Skin	1.0	1.00	1.00

High g Seismic Initiators (.0.6 g)	Within Evacuation Zone	Beyond Evacuation Zone
Cloudshine	1.0	0.75
Groundshine	0.7	0.33
Inhalation	1.0	0.41
Skin	1.0	0.41

consequence measure. This produces a nSTG x nC matrix of mean consequence measures, where nSTG is the number of source term groups and nC is the number of consequence measures under consideration. For internal initiators at Peach Bottom, nSTG = 58 and nC = 6. The resultant 58 x 6 matrix of mean consequence measures is shown in Table 4.3-1. The source terms that give rise to these mean consequence measures are given in Table 3.4-4. Some of the cases indicated in Table 3.4-4 have a zero frequency and no consequence results are reported for these cases in Table 4.3-1. The mean consequence measures in Table 4.3-1 are used by PRAMIS[4] and RISQUE* in the calculation of the mean risk results for internal initiators at Peach Bottom. The population dose is the effective dose equivalent to the whole body for the population in the region indicated.

Table C.1-1 in Appendix C provides a breakdown of mean consequence results between individuals who evacuate, continue normal activities, and actively shelter; information on the division of results between early and chronic exposure is also given. In addition to the six consequence measures which are reported in the text of this report, Table C.1-1 contains results for early injuries (prodromal vomiting), economic cost, and individual early fatality risk at 1 mile.

In the second form, a complementary cumulative distribution function (CCDF) is used for each consequence measure. Conditional on the occurrence of a source term, each of these CCDFs gives the probability that individual consequence values will be exceeded due to the uncertainty in the weather conditions that exist at the time of an accident. These CCDFs are given in Figure 4.3-1. Each frame in this figure displays the CCDFs for a single consequence measure for all the subgroup source terms (PB-I-J) in Table 3.4-4 which have a non-zero frequency. The CCDFs were generated using the estimate that 99.5% of the population evacuates and 0.5% of the population continues normal activities. Each of the mean consequence results in Table 4.3-1 is the result of reducing one of the CCDFs in Figure 4.3-1 to a single number.

The CCDFs in Figure 4.3-1 will subsequently be used to create CCDFs for risk, with the PRPOST code, which is described in Volume 1 of this report. The CCDFs for risk are presented in the next chapter; they relate consequence values with the frequency at which these values are exceeded.

4.3.2 Results for Fire Initiators

Figure 4.3-2 contains the CCDFs for each source term subgroup for the fire initiators. There is a curve in these plots for each subgroup source term (PB-I-J) in Table 3.4-8 which has a non-zero frequency. Table 4.3-2 contains the mean consequence results for these same source term subgroups. As for internal initiators, 99.5% of the population

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* See Volume 1 of this report for a description of the RISQUE code.

Table 4.3-1
Mean Consequence Results for Internal Initiators
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB-01-1	0.00E+00	6.29E+01	1.82E+03	3.94E+03	0.00E+00	6.75E-05
PB-01-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-01-3	9.00E-07	3.94E+01	1.32E+03	2.50E+03	3.25E-09	7.39E-05
PB-02-1	9.10E-04	2.31E+02	8.04E+03	1.66E+04	3.18E-06	6.77E-05
PB-02-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-02-3	1.63E-03	2.49E+02	8.44E+03	1.67E+04	5.80E-06	1.14E-04
PB-03-1	1.40E-05	2.19E+02	6.20E+03	1.41E+04	5.10E-08	8.09E-05
PB-03-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-03-3	9.30E-06	1.64E+02	5.05E+03	1.03E+04	3.37E-08	1.18E-04
PB-04-1	7.60E-08	2.90E+02	7.31E+03	1.78E+04	2.75E-10	9.75E-05
PB-04-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-04-3	2.33E-07	2.29E+02	6.27E+03	1.39E+04	8.45E-10	1.01E-04
PB-05-1	2.00E-02	7.51E+02	2.44E+04	5.40E+04	5.65E-05	1.10E-04
PB-05-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-05-3	1.87E-02	5.36E+02	1.86E+04	3.79E+04	5.85E-05	1.34E-04
PB-06-1	1.31E-03	6.54E+02	1.70E+04	4.25E+04	4.72E-06	1.43E-04
PB-06-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-06-3	1.25E-03	6.40E+02	1.73E+04	4.10E+04	4.52E-06	1.83E-04
PB-07-1	1.25E-04	8.47E+02	1.89E+04	5.22E+04	4.51E-07	1.77E-04
PB-07-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-07-3	3.35E-04	5.27E+02	1.38E+04	3.33E+04	1.20E-06	1.72E-04

Table 4.3-1 (Continued)
Mean Consequence Results for Internal Initiators
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB-08-1	1.60E-06	8.76E+02	1.80E+04	5.36E+04	5.80E-09	1.75E-04
PB-08-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-08-3	1.56E-06	5.36E+02	1.22E+04	3.18E+04	5.65E-09	1.84E-04
PB-09-1	1.42E-02	1.70E+03	3.57E+04	1.13E+05	4.31E-05	1.52E-04
PB-09-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-09-3	4.05E-02	1.38E+03	3.24E+04	9.41E+04	1.01E-04	1.73E-04
PB-10-1	1.17E-03	1.74E+03	3.10E+04	1.10E+05	4.19E-06	1.65E-04
PB-10-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-10-3	4.45E-04	1.40E+03	2.39E+04	8.75E+04	1.61E-06	1.61E-04
PB-11-1	5.60E-05	1.45E+03	2.39E+04	8.82E+04	2.03E-07	1.56E-04
PB-11-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-11-3	6.50E-06	1.33E+03	2.00E+04	7.96E+04	2.36E-08	1.64E-04
PB-12-1	6.15E-02	4.98E+03	7.86E+04	3.03E+05	1.09E-04	1.78E-04
PB-12-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-12-3	1.07E-01	5.34E+03	8.66E+04	3.22E+05	1.31E-04	2.37E-04
PB-13-1	2.33E-02	3.68E+03	5.79E+04	2.28E+05	5.95E-05	1.47E-04
PB-13-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-13-3	1.09E-02	3.55E+03	4.89E+04	2.20E+05	3.29E-05	1.41E-04
PB-14-1	1.68E-03	2.46E+03	3.46E+04	1.49E+05	6.00E-06	1.10E-04
PB-14-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-14-3	1.24E-03	2.52E+03	2.86E+04	1.55E+05	4.31E-06	9.99E-05

Table 4.3-1 (Concluded)
Mean Consequence Results for Internal Initiators
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB-15-1	8.35E-01	1.01E+04	1.75E+05	5.19E+05	2.58E-04	2.52E-04
PB-15-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-15-3	1.03E+00	9.50E+03	1.49E+05	4.99E+05	1.85E-04	3.87E-04
PB-16-1	1.92E-01	6.54E+03	1.04E+05	3.84E+05	1.76E-04	2.22E-04
PB-16-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-16-3	1.22E-01	6.33E+03	9.09E+04	3.82E+05	1.31E-04	2.12E-04
PB-17-1	0.00E+00	1.33E-02	5.22E-01	9.28E-01	0.00E+00	3.98E-09
PB-17-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-17-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-18-1	0.00E+00	7.21E-01	3.22E+01	5.71E+01	0.00E+00	4.78E-07
PB-18-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-18-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-19-1	0.00E+00	1.85E+02	4.90E+03	1.11E+04	0.00E+00	1.01E-04
PB-19-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB-19-3	0.00E+00	5.48E+01	1.74E+03	3.28E+03	0.00E+00	8.88E-05
PB-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-2
Mean Consequence Results for Fire Initiators
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBF-01-1	5.80E-08	2.22E+01	7.45E+02	1.55E+03	2.11E-10	1.89E-05
PBF-01-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-01-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-02-1	2.27E-06	8.43E+01	2.63E+03	5.60E+03	8.25E-09	6.01E-05
PBF-02-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-02-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-03-1	2.51E-04	2.11E+02	6.67E+03	1.44E+04	8.55E-07	7.04E-05
PBF-03-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-03-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-04-1	9.85E-06	2.49E+02	7.90E+03	1.69E+04	3.57E-08	8.46E-05
PBF-04-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-04-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-05-1	2.71E-07	2.57E+02	7.16E+03	1.62E+04	9.85E-10	1.00E-04
PBF-05-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-05-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-06-1	2.40E-02	7.09E+02	2.32E+04	5.07E+04	6.60E-05	1.18E-04
PBF-06-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-06-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-07-1	9.30E-04	6.49E+02	1.65E+04	4.11E+04	3.36E-06	1.57E-04
PBF-07-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-07-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-2 (Continued)
Mean Consequence Results for Fire Initiators
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBF-08-1	3.62E-05	5.82E+02	1.52E+04	3.70E+04	1.32E-07	1.30E-04
PBF-08-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-08-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-09-1	1.21E-06	5.82E+02	1.45E+04	3.75E+04	4.41E-09	1.46E-04
PBF-09-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-09-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-10-1	1.23E-02	1.79E+03	3.69E+04	1.19E+05	3.83E-05	1.73E-04
PBF-10-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-10-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-11-1	2.04E-03	1.89E+03	3.43E+04	1.21E+05	7.30E-06	1.64E-04
PBF-11-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-11-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-12-1	1.22E-04	1.43E+03	2.39E+04	8.83E+04	4.41E-07	1.56E-04
PBF-12-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-12-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-13-1	2.04E-06	1.22E+03	2.04E+04	7.20E+04	7.35E-09	1.66E-04
PBF-13-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-13-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-14-1	1.82E-02	3.44E+03	5.73E+04	2.15E+05	4.97E-05	1.50E-04
PBF-14-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-14-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-2 (Concluded)
Mean Consequence Results for Fire Initiators
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBF-15-1	2.22E-03	2.89E+03	4.13E+04	1.75E+05	7.90E-06	1.44E-04
PBF-15-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-15-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-16-1	4.67E-05	3.13E+03	3.81E+04	1.86E+05	1.69E-07	1.88E-04
PBF-16-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-16-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-17-1	1.57E-01	6.19E+03	9.85E+04	3.69E+05	1.65E-04	1.98E-04
PBF-17-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-17-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-18-1	3.08E-02	4.81E+03	6.91E+04	2.91E+05	7.20E-05	1.76E-04
PBF-18-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-18-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-19-1	0.00E+00	1.43E-02	6.29E-01	1.05E+00	0.00E+00	4.64E-09
PBF-19-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-19-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-20-1	0.00E+00	7.21E-01	3.54E+01	6.02E+01	0.00E+00	7.59E-07
PBF-20-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-20-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-21-1	0.00E+00	3.55E+02	8.69E+03	2.13E+04	0.00E+00	1.30E-04
PBF-21-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-21-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBF-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

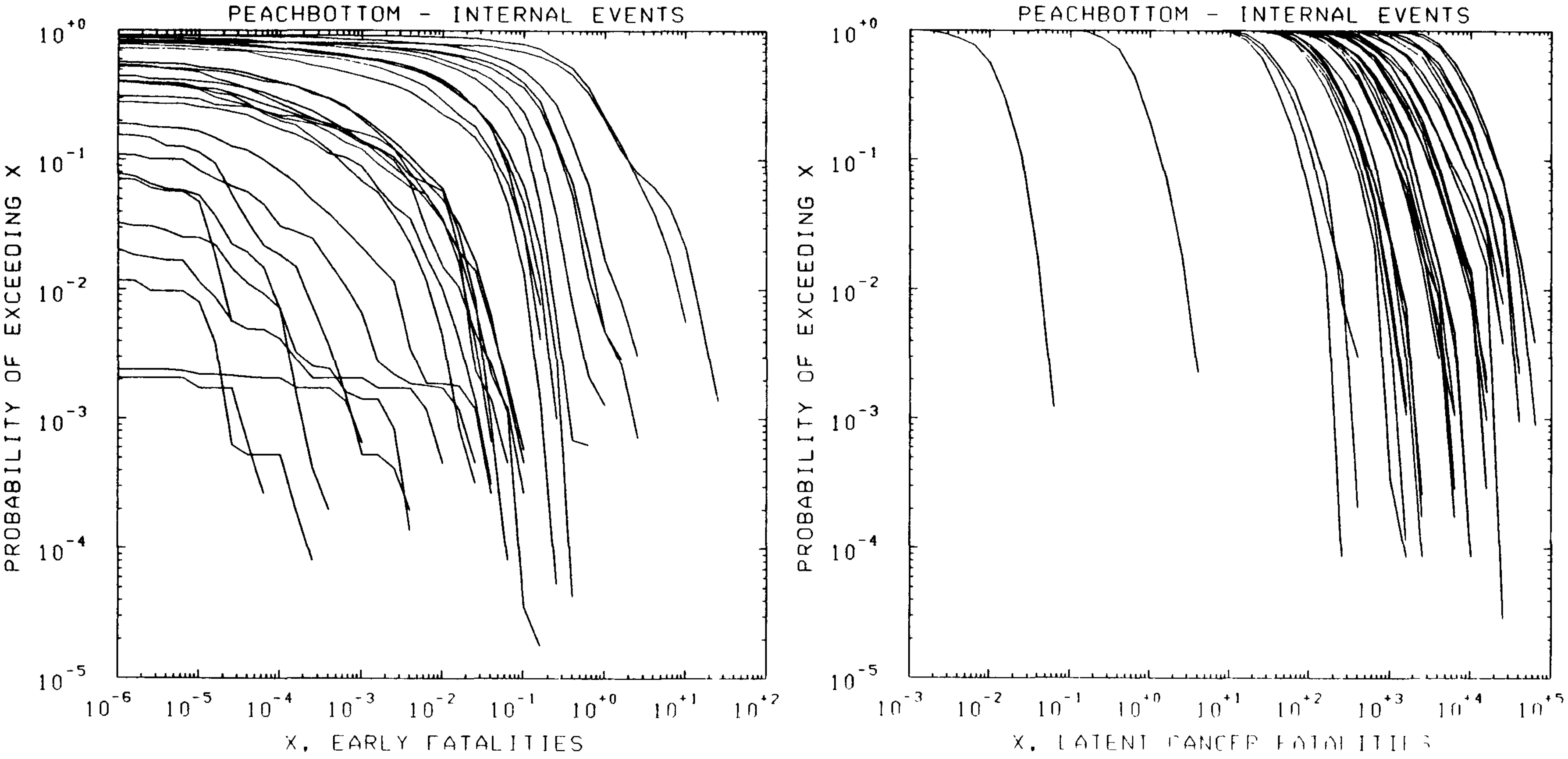


Figure 4.3-1 Consequence CCDFs for Internal Source Term Groups

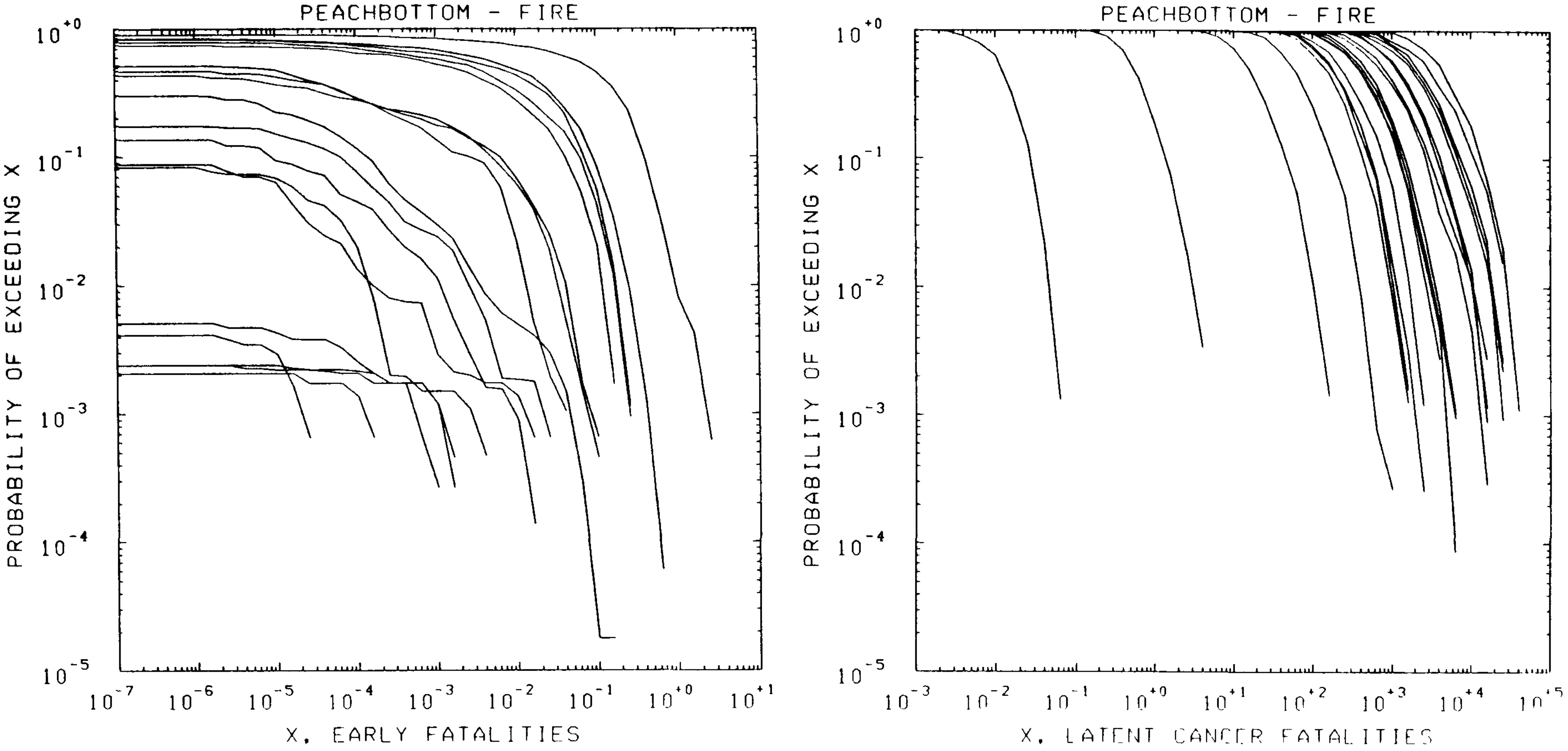


Figure 4.3-2 Consequence CCDFs for Fire Source Term Groups

evacuates and 0.5% continues normal activities. Each of the mean consequence results in Table 4.3-2 is the result of reducing one of the CCDFs in Figure 4.3-2 to a single number.

4.3.3 Results for Seismic Initiators: LLNL Hazard Curve

Figures 4.3-3 and 4.3-4 contain the CCDFs for each source term subgroup for the seismic initiators using the LLNL hazard distribution. There is a curve in these plots for each subgroup source term (PB-I-J) in Tables 3.4-15 and 3.4-16 which has a non-zero frequency. Tables 4.3-3 and 4.3-4 contain the mean consequence results for these same source term subgroups for high and low PGA earthquakes, respectively. The source terms designated PBL-I-J arise from earthquakes with PGAs less than 0.6 g, and the source terms designated PBH-I-J arise from earthquakes with PGAs greater than 0.6 g. For low PGA seisms, 99.5% of the population evacuates (although later and more slowly than if there were no earthquake) and 0.5% continues normal activities. For high PGA seisms, there is no evacuation. The population that would have evacuated is relocated 24 hours after the accident.

4.3.4 Results for Seismic Initiators: EPRI Hazard Curve

Figures 4.3-5 and 4.3-6 contain the CCDFs for each source term subgroup for the seismic initiators using the EPRI hazard distribution. There is a curve in these plots for each subgroup source term (PB-I-J) in Tables 3.4-33 and 3.4-34 which has a non-zero frequency. Tables 4.3-5 and 4.3-6 contain the mean consequence results for these same source term subgroups for high and low PGA earthquakes, respectively. The source terms designated PB3-I-J arise from earthquakes with PGAs less than 0.6 g, and the source terms designated PB4-I-J arise from earthquakes with PGAs greater than 0.6 g. For low PGA seisms, 99.5% of the population evacuates (although later and more slowly than if there were no earthquake) and 0.5% continues normal activities. For high PGA seisms, there is no evacuation. The population that would have evacuated is relocated 24 hours after the accident.

4.3.5 Results for Seismic Sensitivities

4.3.5.1 No CFs at the Start due to RPV Support Failures: LLNL Hazard Curve

Tables 4.3-7 and 4.3-8 contain the mean consequence results for the source term subgroups for high and low PGA earthquakes, respectively. The source terms designated PB1-I-J arise from earthquakes with PGAs less than 0.6 g, and the source terms designated PB2-I-J arise from earthquakes with PGAs greater than 0.6 g. For low PGA seisms, 99.5% of the population evacuates (although later and more slowly than if there were no earthquake) and 0.5% continues normal activities. For high PGA seisms, there is no evacuation. The population that would have evacuated

Table 4.3-3
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - High PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBH-01-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-01-2	8.18E-06	9.49E+01	2.74E+03	5.64E+03	2.96E-08	1.19E-04
PBH-01-3	1.57E-01	2.54E+02	6.94E+03	1.53E+04	4.80E-04	3.30E-04
PBH-02-1	3.27E-02	2.60E+02	7.69E+03	1.67E+04	1.18E-04	3.20E-04
PBH-02-2	4.43E-03	2.50E+02	6.65E+03	1.52E+04	1.61E-05	2.40E-04
PBH-02-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-03-1	5.18E+00	6.09E+02	2.28E+04	4.40E+04	1.34E-02	1.58E-03
PBH-03-2	2.81E-01	5.53E+02	1.27E+04	3.35E+04	1.02E-03	4.10E-04
PBH-03-3	1.07E-01	5.40E+02	1.34E+04	3.18E+04	3.44E-04	3.59E-04
PBH-04-1	9.63E-02	6.54E+02	1.45E+04	4.24E+04	3.19E-04	5.14E-04
PBH-04-2	3.77E-01	6.24E+02	1.55E+04	3.83E+04	1.35E-03	6.44E-04
PBH-04-3	1.54E+00	6.32E+02	1.59E+04	3.94E+04	5.01E-03	1.53E-03
PBH-05-1	5.13E-03	6.82E+02	1.61E+04	4.19E+04	1.86E-05	5.43E-04
PBH-05-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-05-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-06-1	1.52E+01	1.57E+03	4.11E+04	1.06E+05	2.57E-02	3.96E-03
PBH-06-2	1.82E+01	1.56E+03	3.40E+04	9.74E+04	3.39E-02	4.92E-03
PBH-06-3	1.42E+01	1.87E+03	3.85E+04	1.15E+05	3.07E-02	3.76E-03
PBH-07-1	4.00E+00	1.50E+03	3.23E+04	9.70E+04	1.18E-02	2.57E-03
PBH-07-2	5.40E+00	1.48E+03	2.56E+04	8.95E+04	1.56E-02	1.62E-03
PBH-07-3	2.23E+00	1.55E+03	2.74E+04	9.23E+04	7.53E-03	1.03E-03

Table 4.3-3 (Continued)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - High PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBH-08-1	3.62E-01	1.52E+03	2.44E+04	9.21E+04	1.30E-03	1.03E-03
PBH-08-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-08-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-09-1	2.92E-02	1.25E+03	2.05E+04	7.45E+04	1.06E-04	4.86E-04
PBH-09-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-09-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-10-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-10-2	1.20E+02	4.72E+03	9.62E+04	2.75E+05	6.52E-02	1.85E-02
PBH-10-3	9.94E+01	4.81E+03	9.10E+04	2.86E+05	7.99E-02	1.63E-02
PBH-11-1	1.58E+01	3.48E+03	5.85E+04	2.14E+05	2.52E-02	9.06E-03
PBH-11-2	3.08E+01	3.43E+03	4.98E+04	2.07E+05	4.32E-02	4.00E-03
PBH-11-3	2.28E+01	3.03E+03	4.51E+04	1.82E+05	4.29E-02	3.41E-03
PBH-12-1	4.86E+00	2.91E+03	4.71E+04	1.80E+05	1.19E-02	4.88E-03
PBH-12-2	1.10E+01	1.89E+03	2.93E+04	1.13E+05	2.61E-02	1.38E-03
PBH-12-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-13-1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-13-2	3.74E+02	8.72E+03	1.82E+05	4.97E+05	7.87E-02	2.41E-02
PBH-13-3	4.10E+02	8.94E+03	1.89E+05	5.09E+05	9.28E-02	2.28E-02
PBH-14-1	1.46E+02	7.13E+03	1.37E+05	4.06E+05	5.84E-02	2.25E-02
PBH-14-2	1.46E+02	5.43E+03	9.10E+04	3.26E+05	6.82E-02	8.20E-03
PBH-14-3	2.02E+02	6.15E+03	1.21E+05	3.64E+05	7.93E-02	1.69E-02

Table 4.3-3 (Concluded)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - High PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBH-15-1	3.17E+01	5.43E+03	7.86E+04	3.25E+05	3.48E-02	4.77E-03
PBH-15-2	6.72E+01	4.33E+03	6.71E+04	2.60E+05	5.78E-02	3.98E-03
PBH-15-3	7.54E+01	4.31E+03	6.49E+04	2.59E+05	5.79E-02	3.78E-03
PBH-16-1	0.00E+00	2.17E+01	7.06E+02	1.30E+03	0.00E+00	5.42E-05
PBH-16-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-16-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-17-1	0.00E+00	1.99E+02	5.34E+03	1.21E+04	0.00E+00	1.50E-04
PBH-17-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-17-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-18-1	1.03E-03	8.26E+02	1.57E+04	4.88E+04	3.72E-06	3.08E-04
PBH-18-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-18-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBH-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-4
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - Low PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBL-01-1	1.50E-04	5.00E+02	1.49E+04	3.28E+04	5.45E-07	1.34E-04
PBL-01-2	1.99E-08	2.58E+02	7.45E+03	1.64E+04	7.20E-11	1.05E-04
PBL-01-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-02-1	2.79E-08	2.32E+02	6.98E+03	1.55E+04	1.01E-10	8.11E-05
PBL-02-2	0.00E+00	1.16E+02	3.48E+03	7.05E+03	0.00E+00	1.04E-04
PBL-02-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-03-1	1.34E-02	8.55E+02	3.06E+04	6.55E+04	4.01E-05	1.44E-04
PBL-03-2	7.45E-05	7.45E+02	1.64E+04	4.60E+04	2.69E-07	1.51E-04
PBL-03-3	1.96E-02	6.55E+02	1.62E+04	3.90E+04	6.12E-05	3.18E-04
PBL-04-1	6.65E-05	7.70E+02	1.84E+04	5.03E+04	2.39E-07	1.35E-04
PBL-04-2	3.05E-04	7.96E+02	1.82E+04	4.96E+04	1.10E-06	2.00E-04
PBL-04-3	1.28E-03	8.08E+02	1.92E+04	5.27E+04	4.57E-06	1.82E-04
PBL-05-1	4.34E-06	1.03E+03	1.93E+04	6.27E+04	1.58E-08	1.85E-04
PBL-05-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-05-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-06-1	4.73E-02	2.02E+03	5.04E+04	1.44E+05	9.45E-05	1.43E-04
PBL-06-2	4.23E-02	2.02E+03	4.12E+04	1.32E+05	1.06E-04	1.55E-04
PBL-06-3	8.04E-02	2.35E+03	4.53E+04	1.49E+05	2.56E-04	5.87E-04
PBL-07-1	6.30E-03	1.92E+03	3.88E+04	1.27E+05	2.10E-05	1.73E-04
PBL-07-2	1.01E-02	1.93E+03	3.24E+04	1.20E+05	3.45E-05	1.49E-04
PBL-07-3	1.90E-03	1.91E+03	3.17E+04	1.15E+05	6.89E-06	3.15E-04

Table 4.3-4 (Continued)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - Low PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBL-08-1	6.60E-04	1.87E+03	2.83E+04	1.15E+05	2.38E-06	1.33E-04
PBL-08-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-08-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-09-1	4.12E-05	1.55E+03	2.22E+04	9.33E+04	1.49E-07	1.50E-04
PBL-09-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-09-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-10-1	6.22E-01	8.44E+03	1.55E+05	4.39E+05	2.29E-04	2.20E-04
PBL-10-2	3.65E-01	6.61E+03	1.16E+05	3.64E+05	2.85E-04	3.40E-04
PBL-10-3	1.57E+00	6.42E+03	1.11E+05	3.75E+05	4.59E-03	2.44E-03
PBL-11-1	5.55E-02	4.69E+03	7.66E+04	2.92E+05	1.00E-04	1.31E-04
PBL-11-2	6.30E-02	4.20E+03	5.91E+04	2.59E+05	1.37E-04	1.85E-04
PBL-11-3	4.40E-01	3.79E+03	5.31E+04	2.31E+05	1.51E-03	9.70E-04
PBL-12-1	1.60E-02	3.64E+03	5.72E+04	2.31E+05	4.03E-05	1.49E-04
PBL-12-2	1.62E-02	2.38E+03	3.45E+04	1.43E+05	5.25E-05	1.24E-04
PBL-12-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-13-1	1.39E+01	1.60E+04	2.62E+05	7.33E+05	2.97E-04	2.93E-04
PBL-13-2	1.57E+00	1.26E+04	2.08E+05	6.23E+05	3.62E-04	5.76E-04
PBL-13-3	5.37E+00	1.29E+04	2.16E+05	6.37E+05	2.81E-03	1.71E-03
PBL-14-1	1.15E+00	9.68E+03	1.60E+05	5.11E+05	2.77E-04	2.66E-04
PBL-14-2	3.09E-01	6.63E+03	9.63E+04	4.00E+05	2.72E-04	2.20E-04
PBL-14-3	4.95E-01	7.94E+03	1.32E+05	4.51E+05	4.03E-04	6.84E-04

Table 4.3-4 (Concluded)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - Low PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PBL-15-1	1.04E-01	6.49E+03	8.79E+04	3.96E+05	1.41E-04	1.93E-04
PBL-15-2	1.24E-01	5.14E+03	7.47E+04	3.12E+05	1.93E-04	1.99E-04
PBL-15-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-16-1	0.00E+00	7.42E-02	2.81E+00	4.87E+00	0.00E+00	7.07E-08
PBL-16-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-16-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-17-1	0.00E+00	1.21E+02	3.37E+03	7.25E+03	0.00E+00	9.77E-05
PBL-17-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-17-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-18-1	0.00E+00	3.31E+02	8.82E+03	2.07E+04	0.00E+00	1.11E-04
PBL-18-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-18-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-19-1	6.00E-07	1.08E+03	1.87E+04	6.43E+04	2.16E-09	1.72E-04
PBL-19-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-19-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PBL-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-5
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - High PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB4-01-1	5.12E-01	2.96E+02	1.15E+04	2.17E+04	1.81E-03	8.02E-04
PB4-01-2	1.48E-01	2.41E+02	6.15E+03	1.46E+04	5.36E-04	2.64E-04
PB4-01-3	1.54E-01	2.51E+02	6.84E+03	1.51E+04	4.70E-04	3.18E-04
PB4-02-1	2.89E-02	2.47E+02	7.38E+03	1.59E+04	1.05E-04	3.10E-04
PB4-02-2	1.65E-04	1.63E+02	4.56E+03	9.94E+03	5.98E-07	1.81E-04
PB4-02-3	2.90E-03	1.55E+02	4.49E+03	9.62E+03	1.05E-05	2.18E-04
PB4-03-1	4.59E+00	6.19E+02	2.29E+04	4.48E+04	1.24E-02	1.65E-03
PB4-03-2	2.90E-01	5.94E+02	1.38E+04	3.63E+04	1.05E-03	4.97E-04
PB4-03-3	1.21E-01	5.56E+02	1.38E+04	3.27E+04	3.85E-04	3.67E-04
PB4-04-1	1.13E-01	6.74E+02	1.54E+04	4.38E+04	3.91E-04	6.08E-04
PB4-04-2	3.28E-01	6.22E+02	1.52E+04	3.81E+04	1.16E-03	6.27E-04
PB4-04-3	1.11E+00	6.15E+02	1.53E+04	3.80E+04	3.73E-03	1.26E-03
PB4-05-1	5.02E-03	6.24E+02	1.55E+04	3.89E+04	1.82E-05	5.87E-04
PB4-05-2	3.32E-04	2.41E+02	6.71E+03	1.41E+04	1.20E-06	1.98E-04
PB4-05-3	--------	--------	--------	--------	--------	--------
PB4-06-1	1.53E+01	1.56E+03	4.10E+04	1.06E+05	2.58E-02	4.02E-03
PB4-06-2	1.61E+01	1.73E+03	3.61E+04	1.09E+05	3.20E-02	5.10E-03
PB4-06-3	1.28E+01	1.86E+03	3.87E+04	1.15E+05	2.93E-02	4.03E-03
PB4-07-1	3.27E+00	1.54E+03	3.25E+04	9.85E+04	9.95E-03	2.62E-03
PB4-07-2	5.61E+00	1.54E+03	2.70E+04	9.29E+04	1.60E-02	1.73E-03
PB4-07-3	2.31E+00	1.58E+03	2.84E+04	9.46E+04	7.85E-03	1.13E-03

Table 4.3-5 (Continued)
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - High PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB4-08-1	3.59E-01	1.48E+03	2.45E+04	9.01E+04	1.29E-03	1.06E-03
PB4-08-2	1.48E+00	9.56E+02	2.04E+04	5.81E+04	5.01E-03	1.17E-03
PB4-08-3	1.34E+00	1.04E+03	2.11E+04	6.18E+04	4.45E-03	6.32E-04
PB4-09-1	2.87E-02	1.25E+03	2.05E+04	7.46E+04	1.04E-04	4.77E-04
PB4-09-2	--------	--------	--------	--------	--------	--------
PB4-09-3	--------	--------	--------	--------	--------	--------
PB4-10-1	1.12E+02	5.77E+03	1.23E+05	3.25E+05	5.09E-02	2.51E-02
PB4-10-2	1.20E+02	4.89E+03	9.83E+04	2.85E+05	6.54E-02	1.91E-02
PB4-10-3	9.92E+01	4.73E+03	8.55E+04	2.82E+05	7.98E-02	1.55E-02
PB4-11-1	2.09E+01	3.78E+03	6.55E+04	2.30E+05	2.84E-02	1.06E-02
PB4-11-2	3.07E+01	3.29E+03	4.91E+04	1.99E+05	4.31E-02	3.93E-03
PB4-11-3	2.34E+01	3.16E+03	4.71E+04	1.89E+05	4.39E-02	3.55E-03
PB4-12-1	3.06E+00	2.93E+03	4.57E+04	1.80E+05	9.16E-03	3.87E-03
PB4-12-2	1.15E+01	1.96E+03	3.05E+04	1.17E+05	2.66E-02	1.45E-03
PB4-12-3	8.81E+00	2.26E+03	3.54E+04	1.35E+05	2.20E-02	1.39E-03
PB4-13-1	3.21E+02	1.08E+04	2.22E+05	5.78E+05	6.60E-02	3.28E-02
PB4-13-2	3.13E+02	1.01E+04	1.91E+05	5.48E+05	7.70E-02	2.66E-02
PB4-13-3	4.54E+02	9.13E+03	2.05E+05	5.14E+05	1.04E-01	2.93E-02
PB4-14-1	1.44E+02	7.11E+03	1.37E+05	4.06E+05	5.76E-02	2.25E-02
PB4-14-2	1.33E+02	5.23E+03	8.75E+04	3.14E+05	6.69E-02	7.92E-03
PB4-14-3	1.97E+02	6.13E+03	1.19E+05	3.64E+05	8.10E-02	1.64E-02

Table 4.3-5 (Concluded)
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - High PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB4-15-1	3.16E+01	5.38E+03	7.85E+04	3.22E+05	3.47E-02	4.86E-03
PB4-15-2	6.75E+01	4.36E+03	6.65E+04	2.62E+05	5.66E-02	3.94E-03
PB4-15-3	7.75E+01	4.27E+03	6.64E+04	2.57E+05	6.14E-02	3.93E-03
PB4-16-1	0.00E+00	7.33E+01	2.02E+03	4.33E+03	0.00E+00	9.94E-05
PB4-16-2	--------	--------	--------	--------	--------	--------
PB4-16-3	--------	--------	--------	--------	--------	--------
PB4-17-1	0.00E+00	2.43E+02	6.42E+03	1.50E+04	0.00E+00	1.86E-04
PB4-17-2	--------	--------	--------	--------	--------	--------
PB4-17-3	--------	--------	--------	--------	--------	--------
PB4-18-1	1.03E-03	8.20E+02	1.60E+04	4.86E+04	3.73E-06	3.13E-04
PB4-18-2	--------	--------	--------	--------	--------	--------
PB4-18-3	--------	--------	--------	--------	--------	--------
PB4-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-6
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - Low PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB3-01-1	4.41E-05	4.25E+02	1.24E+04	2.80E+04	1.60E-07	1.11E-04
PB3-01-2	0.00E+00	2.22E+02	6.69E+03	1.44E+04	0.00E+00	9.01E-05
PB3-01-3	3.44E-07	2.14E+02	6.35E+03	1.37E+04	1.25E-09	1.06E-04
PB3-02-1	1.10E-02	8.65E+02	2.99E+04	6.60E+04	3.44E-05	1.37E-04
PB3-02-2	7.40E-05	7.79E+02	1.72E+04	4.88E+04	2.69E-07	1.58E-04
PB3-02-3	2.18E-02	6.08E+02	1.53E+04	3.63E+04	6.95E-05	3.16E-04
PB3-03-1	5.50E-06	9.20E+02	1.94E+04	5.75E+04	1.99E-08	1.77E-04
PB3-03-2	1.38E-04	5.88E+02	1.53E+04	3.75E+04	5.00E-07	1.77E-04
PB3-03-3	--------	--------	--------	--------	--------	--------
PB3-04-1	4.71E-02	2.00E+03	5.03E+04	1.43E+05	9.45E-05	1.42E-04
PB3-04-2	3.84E-02	2.27E+03	4.32E+04	1.49E+05	9.90E-05	1.91E-04
PB3-04-3	9.43E-02	2.38E+03	4.57E+04	1.52E+05	3.03E-04	9.79E-04
PB3-05-1	7.20E-03	1.93E+03	3.90E+04	1.28E+05	2.37E-05	1.62E-04
PB3-05-2	1.09E-02	2.00E+03	3.34E+04	1.24E+05	3.68E-05	1.54E-04
PB3-05-3	3.79E-03	1.97E+03	3.34E+04	1.19E+05	1.37E-05	3.64E-04
PB3-06-1	6.40E-04	1.83E+03	2.83E+04	1.13E+05	2.32E-06	1.37E-04
PB3-06-2	3.11E-04	8.40E+02	1.86E+04	5.22E+04	1.12E-06	1.98E-04
PB3-06-3	1.39E-03	8.47E+02	1.94E+04	5.49E+04	4.94E-06	1.85E-04
PB3-07-1	4.13E-05	1.56E+03	2.28E+04	9.38E+04	1.50E-07	1.49E-04
PB3-07-2	--------	--------	--------	--------	--------	--------
PB3-07-3	--------	--------	--------	--------	--------	--------

Table 4.3-6 (Continued)
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - Low PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB3-08-1	7.33E-01	9.02E+03	1.67E+05	4.52E+05	2.36E-04	2.41E-04
PB3-08-2	3.48E-01	7.15E+03	1.23E+05	3.91E+05	2.82E-04	4.33E-04
PB3-08-3	3.81E+00	6.29E+03	1.06E+05	3.73E+05	1.08E-02	3.76E-03
PB3-09-1	7.25E-02	5.04E+03	8.36E+04	3.08E+05	1.13E-04	1.57E-04
PB3-09-2	6.40E-02	4.12E+03	5.93E+04	2.53E+05	1.39E-04	1.88E-04
PB3-09-3	3.90E-01	3.89E+03	5.48E+04	2.37E+05	1.33E-03	1.01E-03
PB3-10-1	8.60E-03	3.73E+03	5.56E+04	2.34E+05	2.86E-05	1.42E-04
PB3-10-2	1.81E-02	2.51E+03	3.61E+04	1.52E+05	5.65E-05	1.34E-04
PB3-10-3	8.20E-03	2.82E+03	4.21E+04	1.69E+05	2.84E-05	2.59E-04
PB3-11-1	1.78E+01	1.74E+04	2.88E+05	7.75E+05	3.06E-04	2.91E-04
PB3-11-2	4.99E+00	1.56E+04	2.46E+05	7.31E+05	4.18E-04	1.20E-03
PB3-11-3	9.35E+00	1.34E+04	2.33E+05	6.54E+05	1.52E-02	4.81E-03
PB3-12-1	1.01E+00	9.68E+03	1.62E+05	5.13E+05	2.72E-04	2.71E-04
PB3-12-2	2.76E-01	6.34E+03	9.27E+04	3.84E+05	2.62E-04	2.22E-04
PB3-12-3	5.12E-01	7.83E+03	1.29E+05	4.48E+05	5.29E-04	8.75E-04
PB3-13-1	1.03E-01	6.45E+03	8.79E+04	3.94E+05	1.41E-04	1.92E-04
PB3-13-2	1.15E-01	5.14E+03	7.41E+04	3.12E+05	1.88E-04	2.06E-04
PB3-13-3	1.14E-01	4.95E+03	7.12E+04	3.01E+05	1.84E-04	2.07E-04
PB3-14-1	0.00E+00	1.03E+02	2.89E+03	6.15E+03	0.00E+00	9.28E-05
PB3-14-2	--------	--------	--------	--------	--------	--------
PB3-14-3	--------	--------	--------	--------	--------	--------

Table 4.3-6 (Concluded)
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - Low PGA
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB3-15-1	0.00E+00	3.33E+02	8.91E+03	2.09E+04	0.00E+00	1.07E-04
PB3-15-2	--------	--------	--------	--------	--------	--------
PB3-15-3	--------	--------	--------	--------	--------	--------
PB3-16-1	6.15E-07	1.07E+03	1.89E+04	6.38E+04	2.23E-09	1.76E-04
PB3-16-2	--------	--------	--------	--------	--------	--------
PB3-16-3	--------	--------	--------	--------	--------	--------
PB3-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-7
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - High PGA - No CF at T=0
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB2-01-1	0.00E+00	7.39E+01	2.16E+03	4.67E+03	0.00E+00	1.26E-04
PB2-01-2	0.00E+00	5.54E+01	1.62E+03	3.26E+03	0.00E+00	1.15E-04
PB2-01-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-02-1	5.68E-02	3.13E+02	9.13E+03	2.01E+04	2.05E-04	3.56E-04
PB2-02-2	4.24E-03	3.04E+02	7.58E+03	1.82E+04	1.54E-05	2.19E-04
PB2-02-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-03-1	5.13E+00	6.29E+02	2.30E+04	4.52E+04	1.33E-02	1.56E-03
PB2-03-2	5.68E-01	5.77E+02	1.37E+04	3.53E+04	2.05E-03	4.94E-04
PB2-03-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-04-1	9.36E-02	6.64E+02	1.50E+04	4.31E+04	3.15E-04	5.86E-04
PB2-04-2	6.28E-02	4.74E+02	1.20E+04	2.86E+04	2.27E-04	3.99E-04
PB2-04-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-05-1	5.05E-03	6.82E+02	1.61E+04	4.19E+04	1.83E-05	5.43E-04
PB2-05-2	4.36E-04	2.34E+02	6.51E+03	1.38E+04	1.58E-06	1.86E-04
PB2-05-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-06-1	1.52E+01	1.57E+03	4.10E+04	1.06E+05	2.57E-02	3.97E-03
PB2-06-2	2.00E+01	1.66E+03	3.44E+04	1.02E+05	3.58E-02	4.29E-03
PB2-06-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-7 (Continued)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - High PGA - No CF at T=0
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB2-07-1	2.43E+00	1.62E+03	3.22E+04	1.02E+05	7.79E-03	2.09E-03
PB2-07-2	6.09E+00	1.54E+03	2.70E+04	9.27E+04	1.70E-02	1.82E-03
PB2-07-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-08-1	3.21E-01	1.48E+03	2.39E+04	8.98E+04	1.15E-03	1.02E-03
PB2-08-2	1.41E+00	9.38E+02	1.99E+04	5.69E+04	4.53E-03	1.10E-03
PB2-08-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-09-1	2.76E-02	1.24E+03	2.04E+04	7.40E+04	1.00E-04	4.81E-04
PB2-09-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-09-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-10-1	2.83E+01	5.18E+03	7.90E+04	3.10E+05	3.32E-02	7.23E-03
PB2-10-2	7.83E+01	4.62E+03	7.32E+04	2.76E+05	6.01E-02	1.06E-02
PB2-10-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-11-1	9.29E+00	3.22E+03	5.61E+04	2.00E+05	2.25E-02	8.44E-03
PB2-11-2	3.08E+01	2.91E+03	4.69E+04	1.75E+05	4.31E-02	3.55E-03
PB2-11-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-12-1	3.33E+00	2.80E+03	4.39E+04	1.71E+05	9.69E-03	3.40E-03
PB2-12-2	9.47E+00	2.02E+03	3.09E+04	1.20E+05	2.40E-02	1.38E-03
PB2-12-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-7 (Concluded)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - High PGA - No CF at T=0
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB2-13-1	2.80E+02	8.44E+03	1.70E+05	4.67E+05	6.11E-02	2.32E-02
PB2-13-2	4.52E+02	9.72E+03	2.07E+05	5.46E+05	8.04E-02	2.57E-02
PB2-13-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-14-1	1.31E+02	6.96E+03	1.31E+05	3.99E+05	5.66E-02	2.15E-02
PB2-14-2	1.65E+02	6.01E+03	9.66E+04	3.60E+05	7.01E-02	1.01E-02
PB2-14-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-15-1	0.00E+00	6.87E+01	1.87E+03	4.07E+03	0.00E+00	9.58E-05
PB2-15-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-15-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-16-1	0.00E+00	2.45E+02	6.52E+03	1.50E+04	0.00E+00	1.77E-04
PB2-16-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-16-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-17-1	1.04E-03	8.26E+02	1.56E+04	4.89E+04	3.78E-06	3.08E-04
PB2-17-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-17-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB2-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-8
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - Low PGA - No CF at T=0
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB1-01-1	0.00E+00	8.92E+01	2.74E+03	5.91E+03	0.00E+00	7.21E-05
PB1-01-2	0.00E+00	7.42E+01	2.23E+03	4.42E+03	0.00E+00	9.55E-05
PB1-01-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-02-1	6.25E-05	4.89E+02	1.39E+04	3.18E+04	2.26E-07	1.17E-04
PB1-02-2	1.44E-07	3.76E+02	9.84E+03	2.31E+04	5.20E-10	1.32E-04
PB1-02-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-03-1	1.50E-02	8.86E+02	3.14E+04	6.73E+04	4.35E-05	1.38E-04
PB1-03-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-03-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-04-1	1.89E-03	9.86E+02	2.59E+04	7.12E+04	6.80E-06	1.24E-04
PB1-04-2	1.63E-04	7.62E+02	1.71E+04	4.73E+04	5.90E-07	1.57E-04
PB1-04-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-05-1	4.82E-06	1.02E+03	1.97E+04	6.23E+04	1.75E-08	1.89E-04
PB1-05-2	1.51E-06	6.81E+02	1.60E+04	4.13E+04	5.45E-09	1.95E-04
PB1-05-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-06-1	4.72E-02	2.02E+03	5.03E+04	1.44E+05	9.45E-05	1.43E-04
PB1-06-2	4.42E-02	2.13E+03	4.08E+04	1.36E+05	1.10E-04	1.53E-04
PB1-06-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-07-1	4.79E-03	2.11E+03	3.82E+04	1.35E+05	1.64E-05	1.50E-04
PB1-07-2	1.10E-02	1.99E+03	3.35E+04	1.24E+05	3.75E-05	1.53E-04
PB1-07-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-8 (Continued)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - Low PGA - No CF at T=0
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB1-08-1	5.75E-04	1.81E+03	2.79E+04	1.12E+05	2.07E-06	1.30E-04
PB1-08-2	1.25E-03	1.17E+03	2.27E+04	7.29E+04	4.41E-06	1.89E-04
PB1-08-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-09-1	3.89E-05	1.54E+03	2.23E+04	9.29E+04	1.41E-07	1.50E-04
PB1-09-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-09-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-10-1	6.11E-01	8.26E+03	1.52E+05	4.32E+05	2.24E-04	2.04E-04
PB1-10-2	2.01E-01	5.88E+03	8.74E+04	3.51E+05	2.39E-04	2.32E-04
PB1-10-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-11-1	2.55E-02	4.40E+03	7.17E+04	2.82E+05	7.05E-05	1.42E-04
PB1-11-2	6.10E-02	3.64E+03	5.69E+04	2.25E+05	1.35E-04	1.80E-04
PB1-11-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-12-1	1.00E-02	3.50E+03	5.45E+04	2.17E+05	3.18E-05	1.38E-04
PB1-12-2	1.36E-02	2.57E+03	3.72E+04	1.54E+05	4.54E-05	1.30E-04
PB1-12-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-13-1	4.75E+00	1.25E+04	2.06E+05	6.05E+05	2.79E-04	2.60E-04
PB1-13-2	2.78E+00	1.46E+04	2.39E+05	7.04E+05	3.74E-04	6.45E-04
PB1-13-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-14-1	9.36E-01	9.47E+03	1.56E+05	5.05E+05	2.74E-04	2.67E-04
PB1-14-2	3.76E-01	7.51E+03	1.07E+05	4.48E+05	2.88E-04	2.50E-04
PB1-14-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4.3-8 (Concluded)
Mean Consequence Results for Seismic Initiators
LLNL Hazard Distribution - Low PGA - No CF at T=0
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB1-15-1	9.65E-02	6.39E+03	8.64E+04	3.89E+05	1.36E-04	1.95E-04
PB1-15-2	9.75E-02	5.29E+03	7.46E+04	3.22E+05	1.74E-04	2.03E-04
PB1-15-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-16-1	0.00E+00	1.02E+02	2.86E+03	6.11E+03	0.00E+00	9.07E-05
PB1-16-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-16-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-17-1	0.00E+00	3.31E+02	8.82E+03	2.07E+04	0.00E+00	1.11E-04
PB1-17-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-17-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-18-1	6.00E-07	1.08E+03	1.87E+04	6.43E+04	2.16E-09	1.72E-04
PB1-18-2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-18-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PB1-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

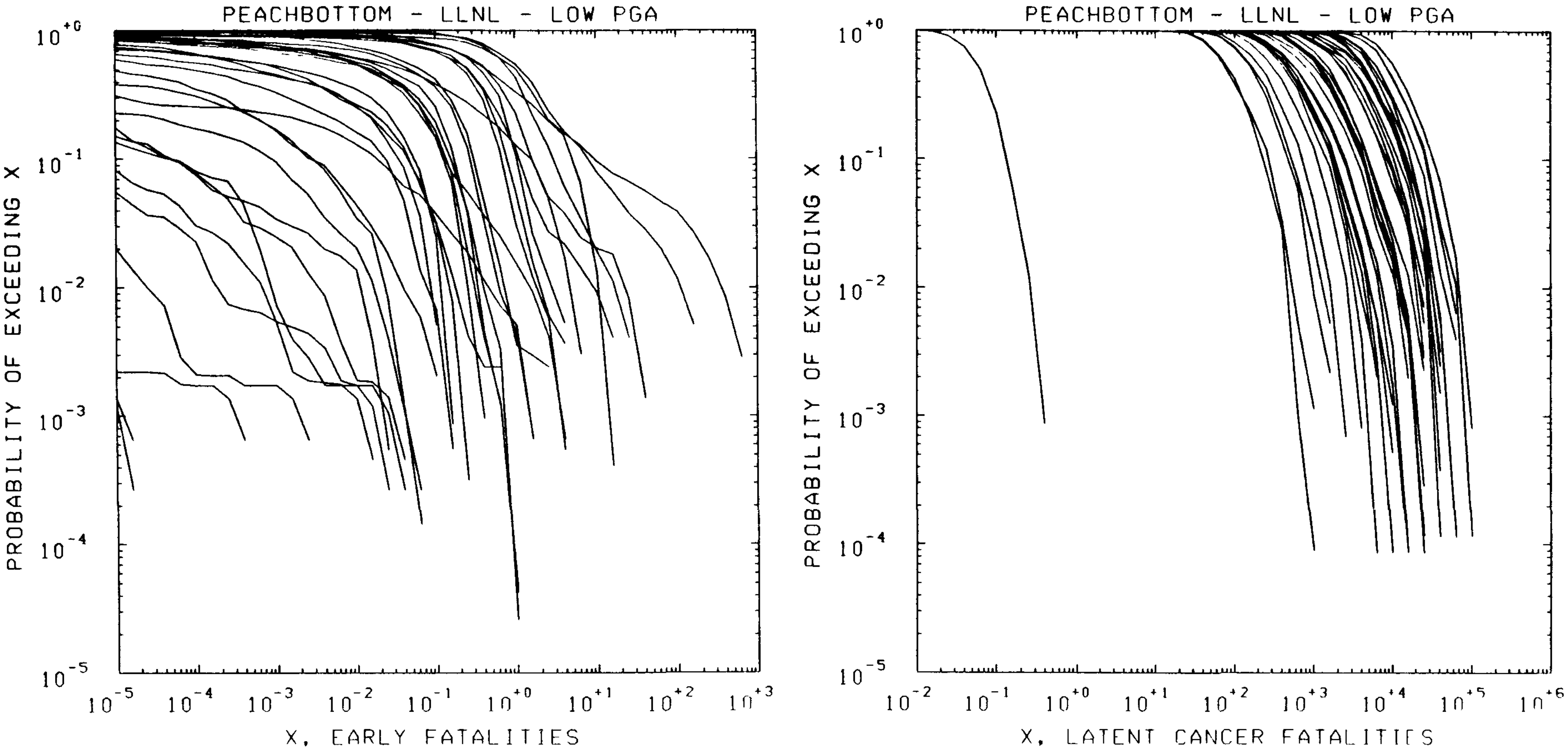


Figure 4.3-3 Consequence CCDFs for LLNL Low PGA Source Term Groups

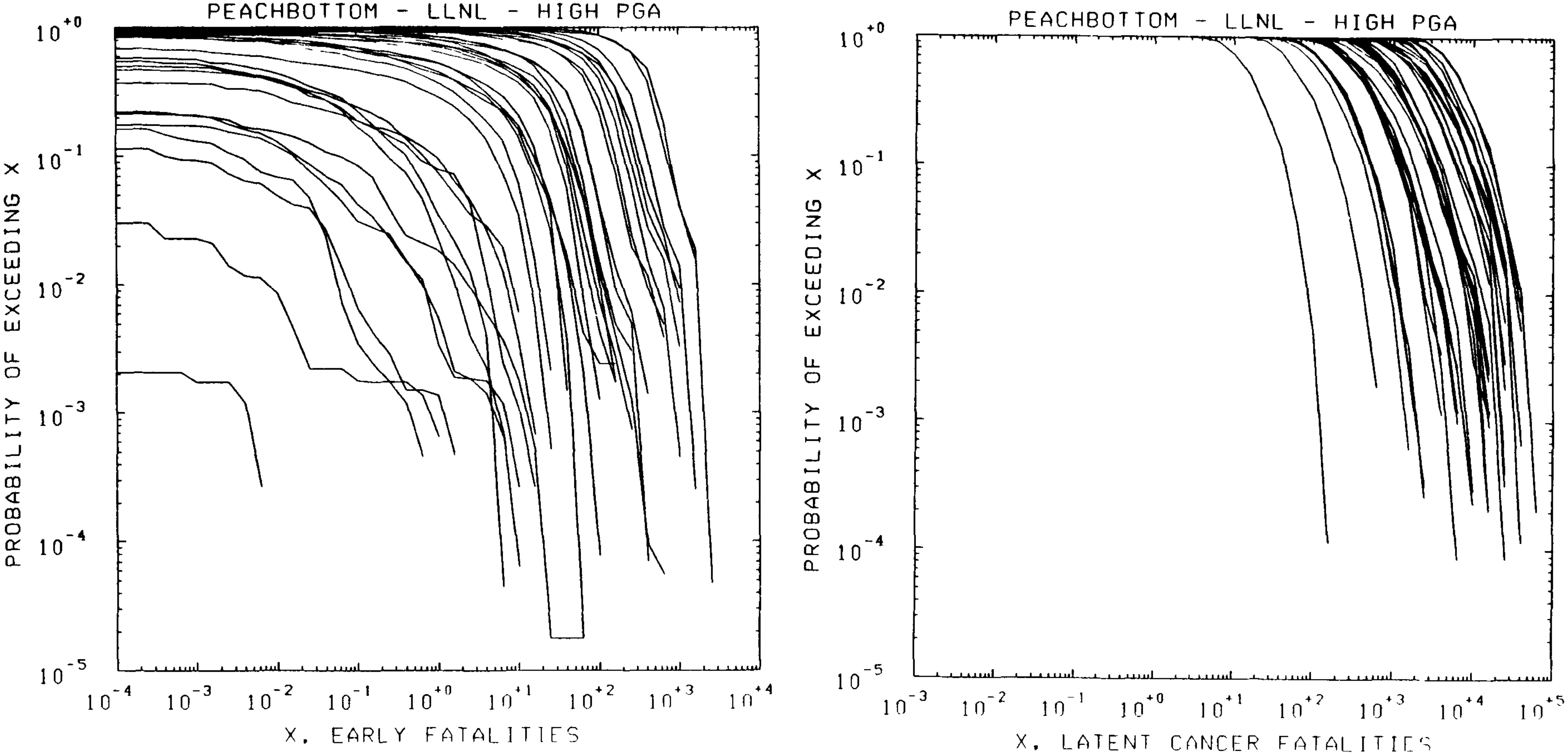


Figure 4.3-4 Consequence CCDFs for LLNL High PGA Source Term Groups

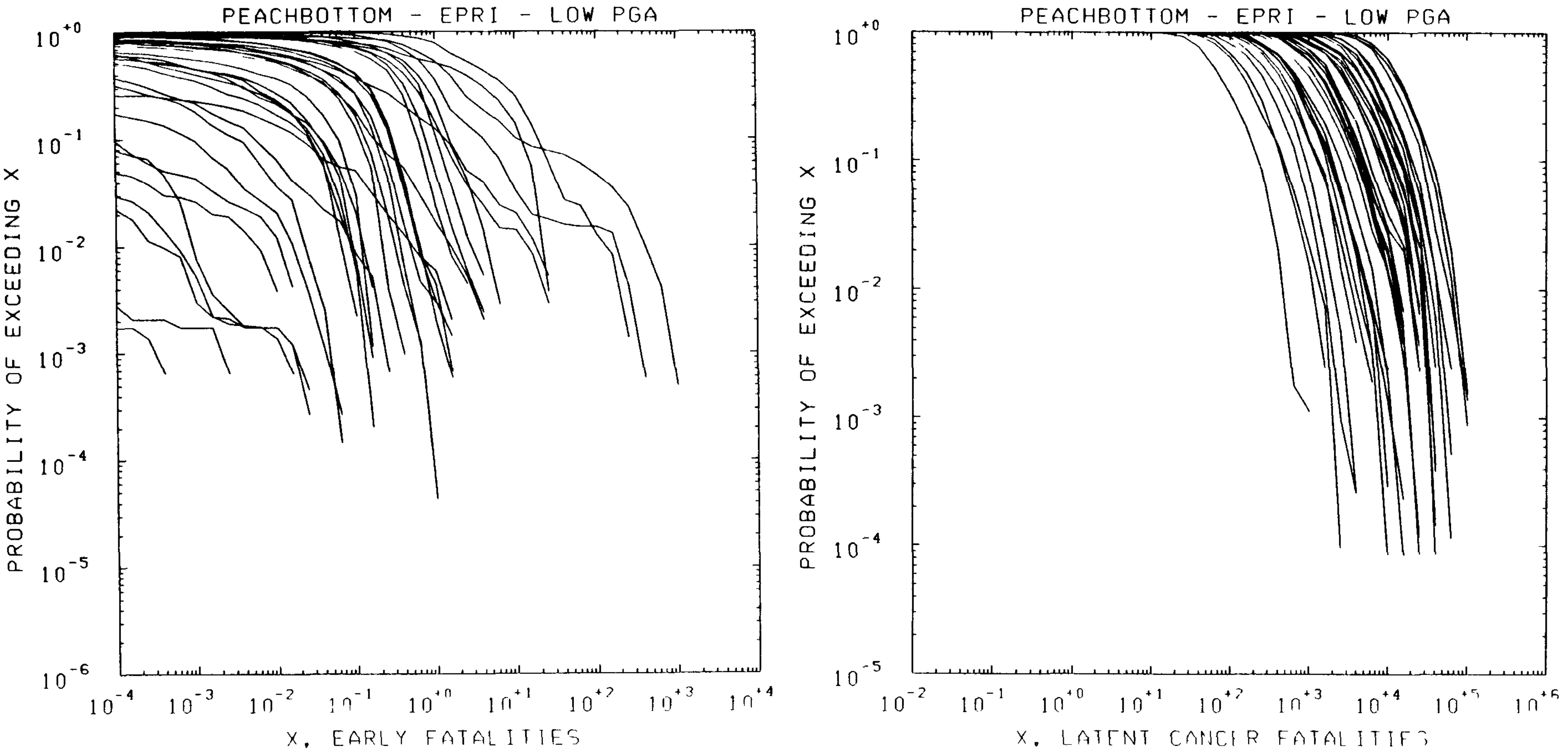


Figure 4.3-5 Consequence CCDFs for EPRI Low PGA Source Term Groups

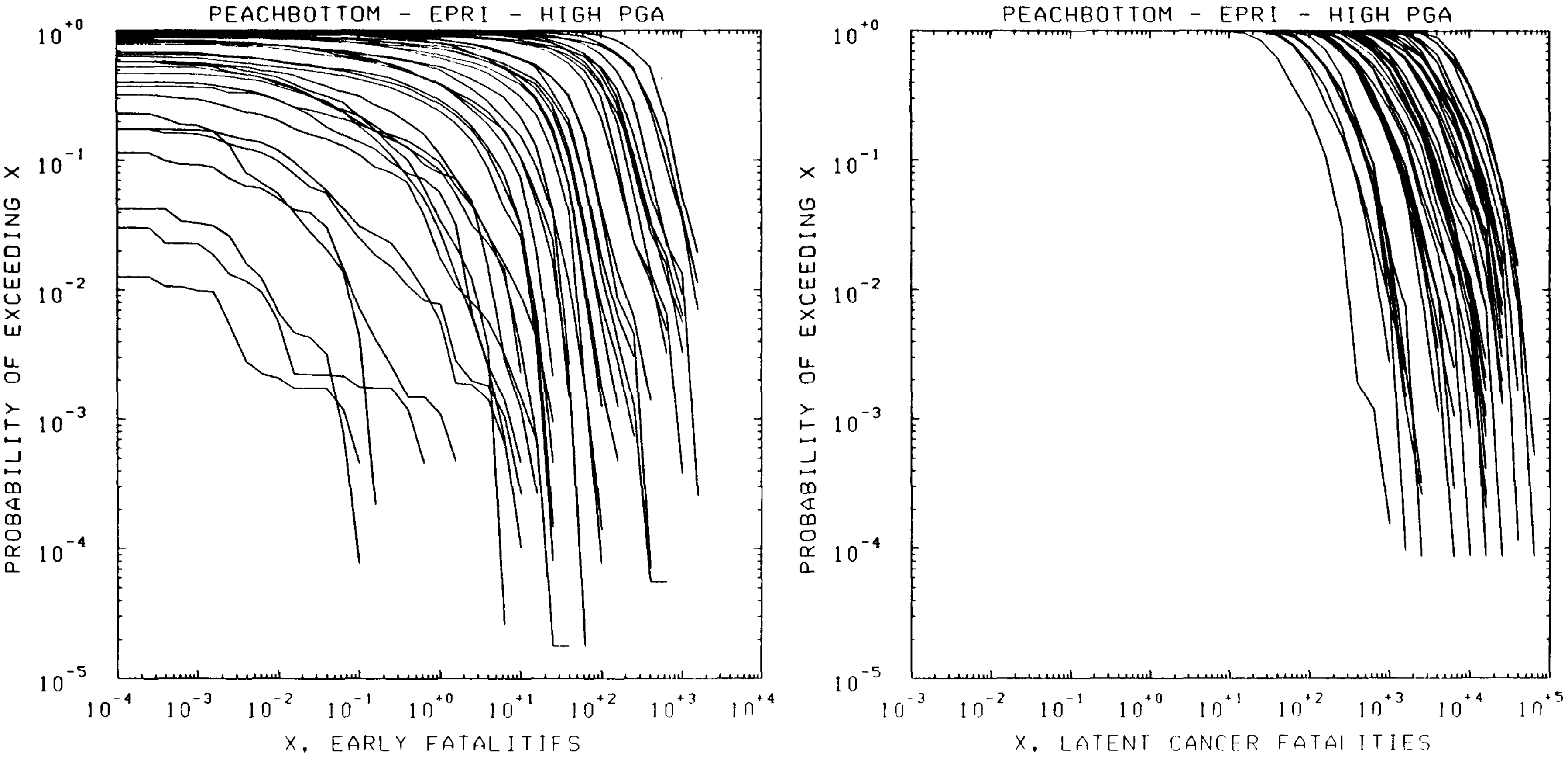


Figure 4.3-6 Consequence CCDFs for EPRI High PGA Source Term Groups

is relocated 24 hours after the accident. The CCDFs are not shown for this sensitivity.

4.3.5.2 Normal Evacuation Speed for EPRI Low PGA

Table 4.3-9 contains the mean consequence results for the source term subgroups for low PGA earthquakes. The high PGA earthquake mean consequences are identical with the base case results. The source terms designated PB5-I-J arise from earthquakes with PGAs less than 0.6 g, and the source terms designated PB4-I-J (see Table 4.3-5) arise from earthquakes with PGAs greater than 0.6 g. For low PGA seisms, 99.5% of the population evacuates (with the normal evacuation delay time and speed as opposed to the base case where the delay time is 1.5 normal and the speed is 1/2 normal) and 0.5% continues normal activities. For high PGA seisms, there is no evacuation. The population that would have evacuated is relocated 24 hours after the accident. The CCDFs are not shown for this sensitivity.

4.4 References

1. D. I. Chanin, J. L. Sprung, L. T. Ritchie, and H.-N. Jow, "MELCOR Accident Consequence Code System (MACCS): User's Guide," NUREG/CR-4691, SAND86-1562, Volume 1, Sandia National Laboratories, Albuquerque, NM, February 1990.

2. H.-N. Jow, J. L. Sprung, J. A. Rollstin, L. T. Ritchie, and D. I. Chanin, "MELCOR Accident Consequence Code System (MACCS): Model Description," NUREG/CR-4691, SAND86-1562, Volume 2, Sandia National Laboratories, Albuquerque, NM, February 1990.

3. J. A. Rollstin, D. I. Chanin, and H.-N. Jow, "MELCOR Accident Consequence Code System (MACCS): Programmer's Reference Manual," NUREG/CR-4691, SAND86-1562, Volume 3, Sandia National Laboratories, Albuquerque, NM, February 1990.

4. R. L. Iman, J. D. Johnson, and J. C. Helton, "PRAMIS: Probabilistic Risk Assessment Model Integration System, User's Guide," NUREG/CR-5262, SAND88-3093, Sandia National Laboratories, Albuquerque, NM, May 1990.

Table 4.3-9
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - Low PGA - Normal Evacuation
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB5-01-1	8.95E-06	2.99E+02	8.26E+03	1.90E+04	3.24E-08	9.92E-05
PB5-01-2	0.00E+00	1.57E+02	4.55E+03	9.94E+03	0.00E+00	7.82E-05
PB5-01-3	1.38E-07	1.51E+02	4.33E+03	9.46E+03	5.00E-10	8.66E-05
PB5-02-1	3.72E-03	5.74E+02	1.89E+04	4.09E+04	1.31E-05	1.15E-04
PB5-02-2	1.01E-05	5.69E+02	1.32E+04	3.49E+04	3.65E-08	1.27E-04
PB5-02-3	8.17E-03	4.49E+02	1.14E+04	2.66E+04	2.96E-05	2.14E-04
PB5-03-1	4.52E-07	6.93E+02	1.56E+04	4.27E+04	1.64E-09	1.70E-04
PB5-03-2	1.14E-05	4.42E+02	1.18E+04	2.77E+04	4.12E-08	1.64E-04
PB5-03-3	--------	--------	--------	--------	--------	--------
PB5-04-1	1.46E-02	1.43E+03	3.39E+04	9.82E+04	4.21E-05	1.50E-04
PB5-04-2	1.10E-02	1.57E+03	3.09E+04	1.03E+05	3.72E-05	1.61E-04
PB5-04-3	2.51E-02	1.76E+03	3.52E+04	1.12E+05	9.06E-05	4.34E-04
PB5-05-1	1.79E-03	1.44E+03	2.94E+04	9.40E+04	6.35E-06	1.65E-04
PB5-05-2	2.68E-03	1.54E+03	2.59E+04	9.46E+04	9.60E-06	1.62E-04
PB5-05-3	2.43E-04	1.55E+03	2.70E+04	9.29E+04	8.80E-07	2.66E-04
PB5-06-1	8.00E-05	1.45E+03	2.34E+04	8.87E+04	2.90E-07	1.61E-04
PB5-06-2	3.29E-05	6.27E+02	1.52E+04	3.86E+04	1.19E-07	1.95E-04
PB5-06-3	1.13E-04	6.26E+02	1.52E+04	3.99E+04	4.06E-07	1.77E-04
PB5-07-1	4.31E-06	1.24E+03	2.00E+04	7.41E+04	1.57E-08	1.61E-04
PB5-07-2	--------	--------	--------	--------	--------	--------
PB5-07-3	--------	--------	--------	--------	--------	--------

Table 4.3-9 (Continued)
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - Low PGA - Normal Evacuation
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB5-08-1	1.30E-01	4.91E+03	9.40E+04	2.87E+05	1.52E-04	1.73E-04
PB5-08-2	1.20E-01	4.41E+03	7.35E+04	2.68E+05	1.90E-04	1.53E-04
PB5-08-3	2.80E-01	4.31E+03	6.83E+04	2.67E+05	9.37E-04	9.56E-04
PB5-09-1	1.33E-02	3.50E+03	5.71E+04	2.23E+05	4.04E-05	1.29E-04
PB5-09-2	2.54E-02	3.12E+03	4.40E+04	1.91E+05	7.30E-05	1.42E-04
PB5-09-3	3.19E-02	3.06E+03	4.26E+04	1.85E+05	1.13E-04	3.82E-04
PB5-10-1	1.70E-03	2.82E+03	4.20E+04	1.75E+05	6.10E-06	1.49E-04
PB5-10-2	7.05E-03	1.97E+03	2.90E+04	1.18E+05	2.45E-05	1.28E-04
PB5-10-3	2.22E-03	2.21E+03	3.27E+04	1.32E+05	7.95E-06	1.92E-04
PB5-11-1	8.36E-01	9.49E+03	1.60E+05	5.06E+05	2.38E-04	2.44E-04
PB5-11-2	4.11E-01	8.87E+03	1.40E+05	4.88E+05	2.88E-04	2.00E-04
PB5-11-3	6.80E-01	8.01E+03	1.37E+05	4.46E+05	8.19E-04	1.15E-03
PB5-12-1	2.04E-01	6.33E+03	1.04E+05	3.73E+05	1.93E-04	2.24E-04
PB5-12-2	1.35E-01	4.87E+03	7.19E+04	2.94E+05	1.98E-04	1.73E-04
PB5-12-3	1.85E-01	5.59E+03	9.26E+04	3.38E+05	2.55E-04	3.79E-04
PB5-13-1	3.69E-02	5.23E+03	7.03E+04	3.14E+05	8.05E-05	1.74E-04
PB5-13-2	5.45E-02	4.17E+03	5.92E+04	2.50E+05	1.27E-04	1.73E-04
PB5-13-3	5.30E-02	4.13E+03	5.82E+04	2.47E+05	1.21E-04	1.72E-04

Table 4.3-9 (Concluded)
Mean Consequence Results for Seismic Initiators
EPRI Hazard Distribution - Low PGA - Normal Evacuation
(Population Doses in Sv)

SOURCE TERM	EARLY FATALITIES	TOTAL LATENT CANCERS	EDEWBODY POP DOSE, (SV)<50 MI	EDEWBODY POP DOSE, (SV)<1000 MI	EARLY FATALITY RISK, 0-1 MI	TOTAL LATENT CANCER RISK, 0-10 MI
PB5-14-1	0.00E+00	7.60E+01	2.04E+03	4.49E+03	0.00E+00	8.03E-05
PB5-14-2	--------	--------	--------	--------	--------	--------
PB5-14-3	--------	--------	--------	--------	--------	--------
PB5-15-1	0.00E+00	2.40E+02	6.28E+03	1.48E+04	0.00E+00	1.00E-04
PB5-15-2	--------	--------	--------	--------	--------	--------
PB5-15-3	--------	--------	--------	--------	--------	--------
PB5-16-1	2.65E-08	8.17E+02	1.57E+04	4.83E+04	9.60E-11	1.87E-04
PB5-16-2	--------	--------	--------	--------	--------	--------
PB5-16-3	--------	--------	--------	--------	--------	--------
PB5-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. RISK RESULTS FOR PEACH BOTTOM

In this chapter, we will present the results of the risk calculation on the internal, fire, and seismic analyses performed on the Peach Bottom nuclear power plant as part of the analysis supporting NUREG-1150. We will discuss the actual risk results for various risk measures and will try to determine the plant characteristics and physical parameters that drive the absolute value of the results. We will evaluate the importance of uncertain parameters and certain but variable parameters on the uncertainty in the risk results.

Section 5.1 gives the risk results for Peach Bottom. Section 5.1.1 gives the results for internal initiators, section 5.1.2 gives the results for fire initiators, section 5.1.3 gives the results for seismic initiators using the LLNL hazard curve, and section 5.1.4 gives the results for seismic initiators using the EPRI hazard curve.

Section 5.2 discusses the important contributors to the absolute value of the final risk results for each of the analyses (internal, fire, and seismic) from each stage of the analysis (core damage, accident progression, source term, and consequence). Section 5.2.1 discusses the important contributors for the internal initiators, Section 5.2.2 discusses the important contributors for the fire initiators, and Section 5.2.3 discusses the important contributors for the seismic initiators.

Section 5.3 discusses the important contributors to the uncertainty in the final risk results. Section 5.3.1 discusses this for internal initiators, Section 5.3.2 for fire initiators, and 5.3.3 for seismic initiators.

Section 5.4 discusses the results of the sensitivity analyses carried through to risk results. There are only two; both connected with the seismic analysis. For the LLNL hazard curve, the sensitivity involving no initial containment failure at the start of the accident was analyzed through to risk and, for the EPRI hazard curve, the sensitivity involving the use of normal delay and evacuation speed for the low PGA cases was analyzed through to risk.

Risk is determined by bringing together the results of the four constituent analyses: accident frequency analysis, accident progression analysis, source term analysis, and consequence analysis. The way in which these analyses contribute to risk analysis is summarized in Section 1.4 of this volume. More detail on the methods used in calculating risk can be found in Volume 1, Part 1 of this report on methodology.

The figures in this section present only a very small portion of the total risk output available. Detailed listings of results are available on computer media by request.

5.1 Results of Risk Calculations

This section describes the results of the integrated risk analysis of the Peach Bottom plant. Section 5.1.1 is a discussion of basic risk results for internal initiators. Section 5.1.2 is a discussion of the basic results for fire initiators. Section 5.1.3 is a discussion of the basic results for the LLNL seismic hazard curve and Section 5.1.4 is a discussion of the basic results for the EPRI seismic hazard curve.

5.1.1 Risk Results for Internal Initiators

Figure 5.1-1 shows the basic results of the integrated risk analysis for internal initiators at Peach Bottom. This figure shows the complementary cumulative distribution functions (CCDFs) for early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of early fatality within one mile of the site boundary, and individual risk of latent cancer fatality within 10 miles. The CCDFs display the relationship between the frequency of the consequence and the magnitude of the consequence. As there are 200 observations in the sample for Peach Bottom, the complete set of risk results, at the most basic level, consists of 200 CCDFs for each consequence measure. Plots showing these 200 curves are contained in Appendix D; only four statistical measures of the 200 curves are shown in Figure 5.1-1. These measures are generated by analyzing the plots in the vertical direction. For each consequence value on the abscissa, there are 200 values of the exceedance frequency (one for each observation or sample element) and, from these 200 values, the mean, median, 95th percentile, and 5th percentile values of the frequency are calculated. When this is done for each value of the consequence measure, the curves in Figure 5.1-1 are obtained. Thus, Figure 5.1-1 gives the relationship between the magnitude of the consequence and the frequency at which the consequence is exceeded, as well as the variation in that relationship.

Although the abscissa in the last two plots in Figure 5.1-1 is labeled "Risk", this reflects historical usage and is not really correct. The x-axis in these plots actually represents conditional probability: specifically, the probability that an individual, randomly located in the spatial interval according to the population distribution, will die given that the accident occurs. The ordinate gives the frequency of an accident that produces a conditional probability that exceeds the value on the abscissa. The actual risk measure (i.e., product of the consequence and its associated frequency) does not result until the curves in the last two plots of Figure 5.1-1 are reduced to single values.

The curves for latent cancer fatalities in Figure 5.1-1 are relatively flat from 0.001 to 90 fatalities. This means that latent cancer fatalities in this range are very unlikely. Any type of containment failure is likely to lead to more than 90 delayed fatalities; it is extremely unlikely, however, that an accident will result in more than 60,000 delayed fatalities. If

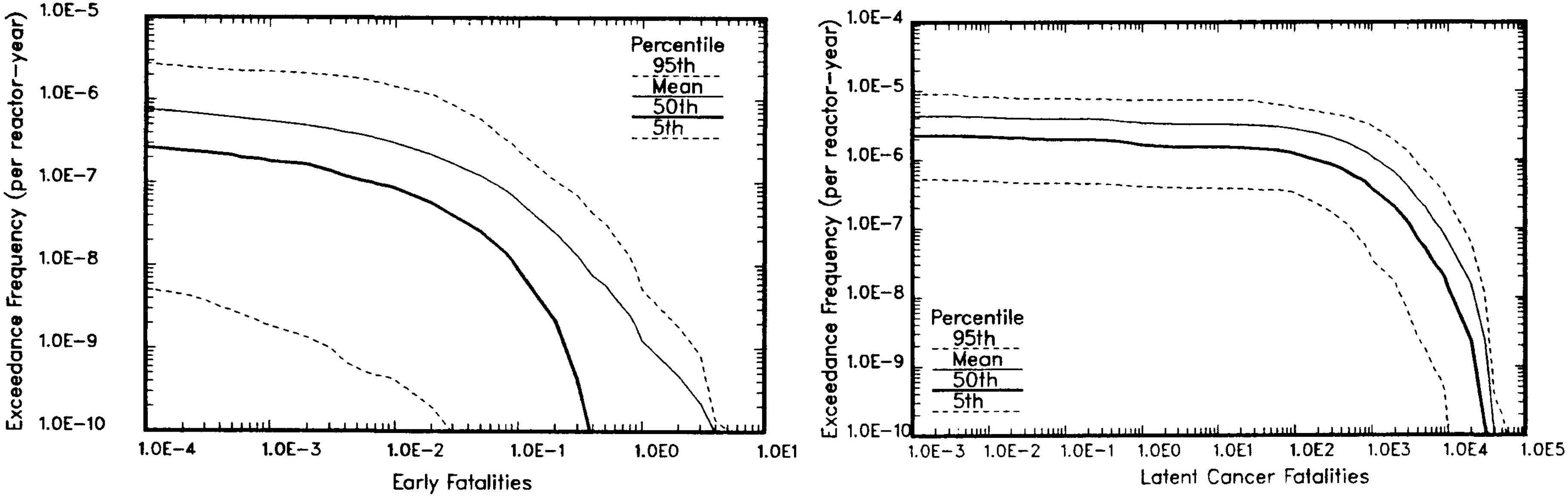


Figure 5.1-1a
Peach Bottom: Internal Events
Early Fatalities and Latent Cancer Risk

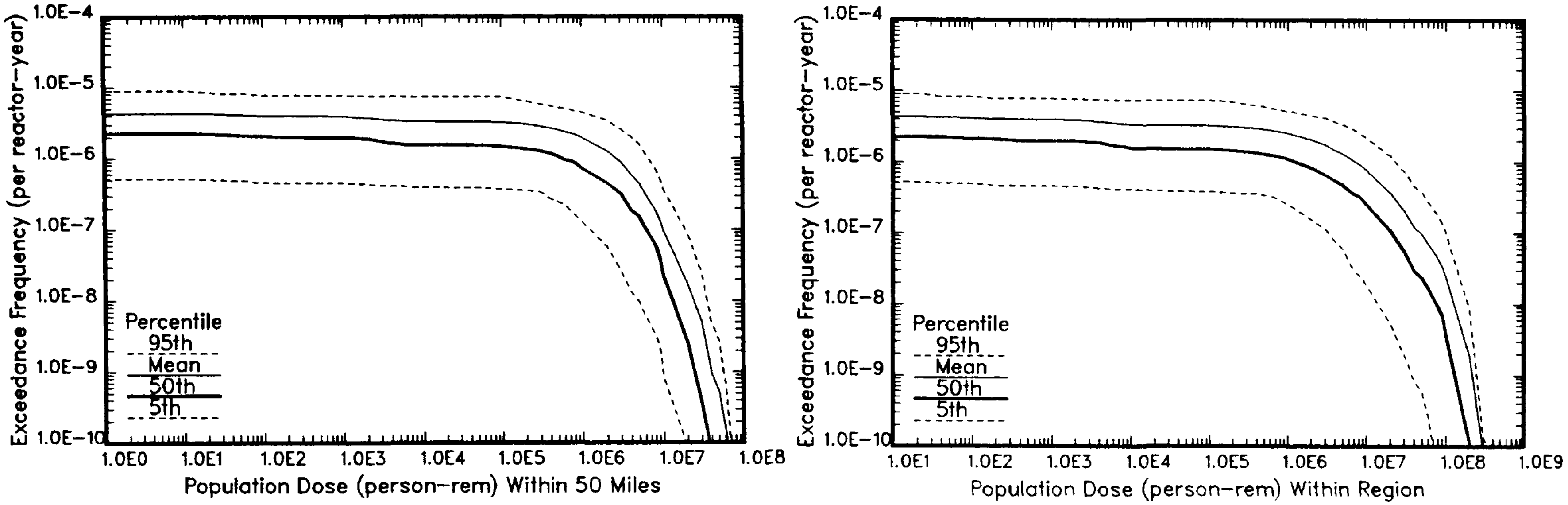


Figure 5.1-1b
Peach Bottom: Internal Events
Population Dose Within 50 Mi. and Region

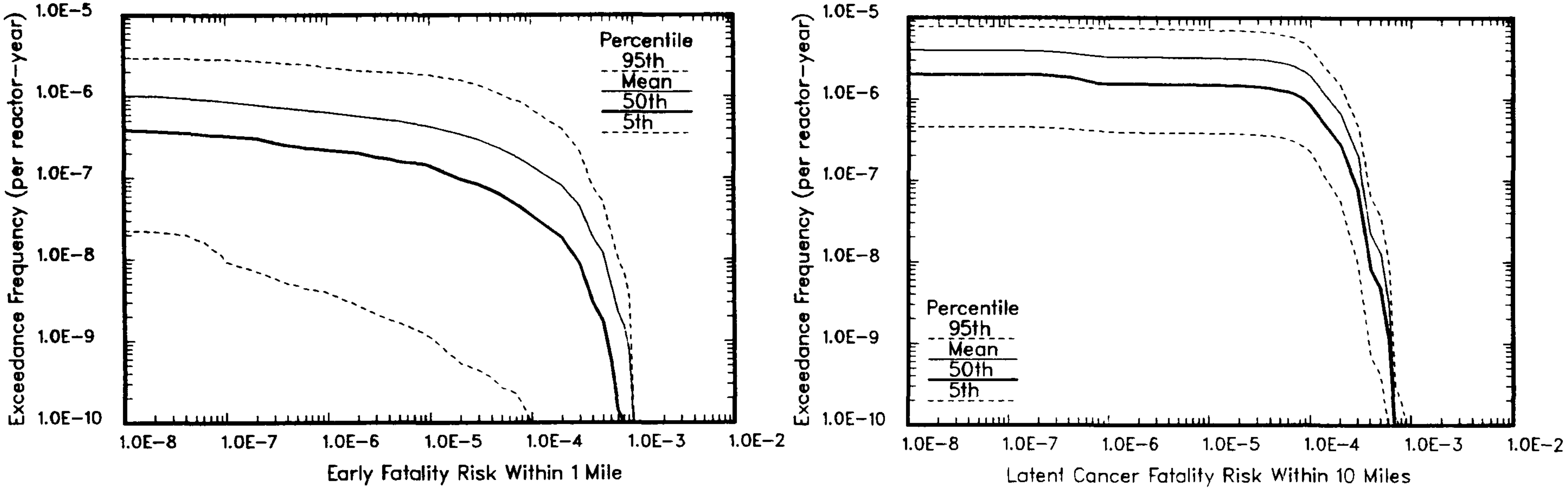


Figure 5.1-1c
Peach Bottom: Internal Events
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

the containment does not fail, the eventual release of the noble gases (Xe and Kr) from the containment due to design basis leakage will probably cause less than 1.0 latent cancer fatalities.

The variation from the 5th to the 95th percentiles indicates the uncertainty in the risk estimates due to uncertainty in the basic parameters in the three sampled constituent analyses (the accident frequency, accident progression, and source term analyses). The variation along a curve in Figure 5.1-1 (or along one of the individual curves in Appendix D) is indicative of the variation in risk due to different types of accidents and due to different weather conditions at the time of the accident. Thus the individual curves in Appendix D can be viewed as representing stochastic variability (i.e., the effects of probabilistic events in which it is possible for the accident to develop in more than one way) and the variability between curves can be seen as representing the effects of imprecisely known parameters and processes that are mostly non-stochastic. As the magnitude of the consequence measure increases, the mean curve typically approaches or exceeds the 95th percentile curve. This results when the mean is dominated by a few large observations, which often happens for large values of the consequences because only a few observations have non-zero exceedance frequencies for these large consequences. Figure 5.1-1 shows the following mean and median exceedance frequencies for fixed values of early fatalities (EF) and latent cancer fatalities (LCF):

	Exceedance Frequency (1/R-yr)	
Consequence	Mean	Median
1 EF	1E-09	2E-12
100 EF	0E-00	0E-00
100 LCF	3E-06	1E-06
5000 LCF	2E-07	5E-08

Although the latent cancer fatality values mentioned above may appear large, they must be considered in perspective; the calculated latent cancer fatalities occur throughout the entire region and over several decades. Between 400,000 to 500,000 deaths due to cancer occur every year in the U.S. The population within 350 miles of the plant is about 68 million and the population within 1000 miles of the plant is about 154 million. When spread over two or three decades, even tens of thousands of additional latent cancer fatalities are statistically indistinguishable from the general background morbidity due to malignant neoplasms in such a large population.

Although the CCDF for each observation conveys the most information about risk, a single number may be generated for each consequence measure for each observation. This value, denoted annual risk, is determined by summing the product of the frequencies and consequences for all the points that are used to construct the CCDF for each observation in the sample. The construction of annual risk has the effect of averaging over the different weather states as well as over the different types of accidents that can occur. Since the complete analysis consisted of a sample of 200 observations, there are 200 values of annual risk for each consequence measure. These 200 values may be ordered and plotted as histograms, which is done in Figure 5.1-2. The four statistical measures utilized above are shown on these plots and are also reported in Table 5.1-1. Note that considerable information has been lost in going from the CCDFs in Appendix D to the histograms of annual values in Figure 5.1-2; the relationship between the size of the consequence and its frequency has been sacrificed to obtain a single value for risk for each observation.

The plots in Figure 5.1-2 show the variation in the annual risk for six consequence measures. Where the mean is close to the 95th percentile, it may be inferred that a relatively small number of observations dominate the mean value. This is more likely to occur for the early fatality consequence measures than for the latent cancer fatality or population dose consequence measures due to the threshold effect for early fatalities. In essence, Figure 5.1-2 shows the probability density functions of the logarithms of the consequence measures. Equivalent density functions could be generated for the consequence measures themselves, but would appear quite different due to the change in scale. Another alternative, but equivalent display, for the results in Figure 5.1-2 would be to use cumulative distribution functions

The safety goals are expressed in terms of individual fatality risks, which is really an individual's probability of becoming a casualty of a reactor accident in a given year. The individual early fatality risk within one mile is the frequency (per year) that a person living within one mile of the site boundary will die within a year due to the accident. The individual latent cancer fatality risk within 10 miles is the frequency (per year) that a person living within 10 miles of the plant will die many years later from cancer due to radiation exposure received from the accident. A single value for individual fatality risk for each observation is obtained by reducing the CCDF for each observation to a single value. The density distribution of these 200 values is plotted in the last two frames of Figure 5.1-2. The plots for individual risk in Figure 5.1-2 show that both risk distributions for Peach Bottom fall well below the safety goal.

A single measure of risk for the entire sample may be obtained by taking the average value from the histograms in Figure 5.1-2. This measure of risk is commonly called mean risk, although it is actually the average of the annual risk, or the mean value of the mean risk. The mean risk values for the six consequence measures reported here are displayed in Figure 5.1-2. The important contributors to mean risk are considered in section 5.2.

Table 5.1-1
Distributions for Annual Risk at Peach Bottom Due to Internal Initiators
(All values per reactor-year)
(Population doses in person-rem)

Risk Measure	5th%tile	Median	Mean	95th%tile
Core Damage	5.2E-07	2.3E-06	4.3E-06	9.0E-05
Early Fatalities	1.7E-11	5.1E-09	2.6E-08	1.3E-07
Latent Cancer Fat.	2.3E-04	1.6E-03	4.6E-03	1.3E-02
Population Dose 50 mi.	5.5E-01	3.1E+00	7.9E+00	2.3E+01
Population Dose Entire Region	1.5E+00	1.0E+01	2.8E+01	8.0E+01
Ind. Early Fat. Risk 0-1 mile	6.1E-14	1.3E-11	4.7E-11	2.4E-10
Ind. L. C. Fatality Risk 0-10 miles	5.3E-11	2.0E-10	4.3E-10	9.1E-10

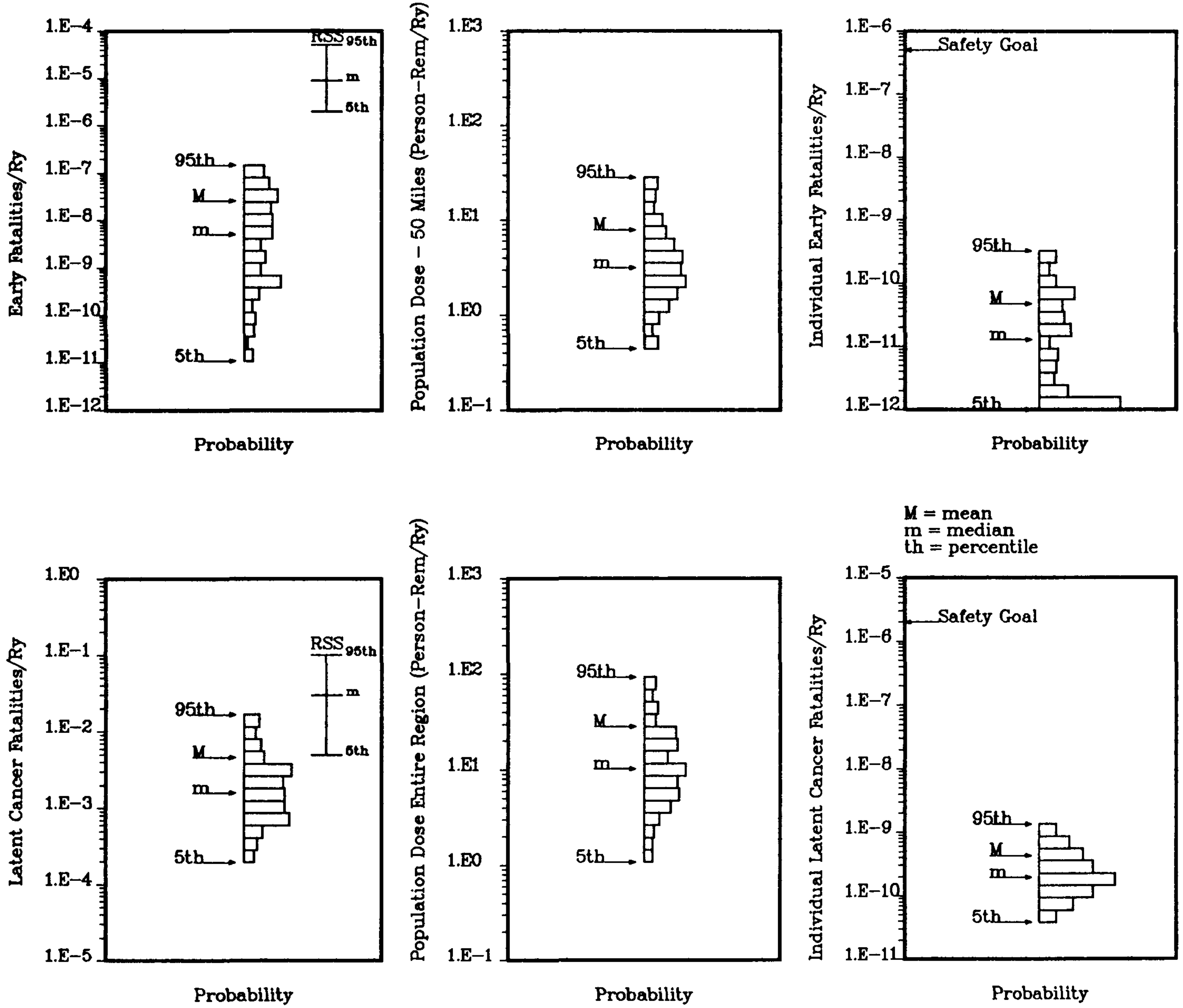


Figure 5.1-2
Peach Bottom: Internal Events Mean Risk Distributions

The early fatality risk at Peach Bottom is relatively low, both with respect to the safety goals and with respect to the PWR plants analyzed in NUREG-1150. There are several factors that lead to these low values for risk. First, the core damage frequency for Peach Bottom is very low. The mean core damage frequency is 4.3E-06/yr. and the risk is roughly proportional to the core damage frequency. Second, although it is likely that the containment will fail given that core damage occurs, there are several features of the Peach Bottom plant and the surrounding area that tend to reduce the consequences, since the early fatality risk depends on the magnitude of the release, the timing of containment failure, and the number of people exposed to the release.

There is a threshold effect associated with early fatalities. That is, to cause an early fatality, the release must be of a certain magnitude (i.e., above a certain threshold). There are several features of the Peach Bottom plant that reduce the magnitude of the source term. First, in the majority of the accidents analyzed, the in-vessel releases are scrubbed by the suppression pool. Second, because one of the dominant PDS groups (Slow SB, PDS 5 = 42% of the mean core damage frequency) is a long-term SBO, there is a significant probability that AC power will be recovered and coolant injection will be restored to the core such that the core damage process is arrested before the vessel fails. Third, given that the vessel does fail, it is likely that either the core debris released from the vessel will be cooled or if CCI is initiated it will occur with water being sprayed upon it.

If the containment fails early in the accident it is more likely that a portion of the population will be exposed to the release than if the containment fails after the nearby population has been evacuated. For the long-term station blackout accidents that are one of the two dominant PDSs, there is a long time to core damage and, therefore, a long time in which to evacuate the nearby population. The containment is most likely to fail at or near vessel breach and a general emergency would have been called long before that time.

Also, the low early fatality risk can, in part, be attributed to the fast evacuation of the population around the plant. Even if the accidents are from the other dominant PDS (ATWS, PDS 8 = 33% of the mean core damage frequency), the population in the vicinity of the plant is fairly sparse and can be evacuated ahead of the plume. This is due to a short evacuation delay and a fast evacuation speed. Thus, in many of the accidents analyzed, most of the population was evacuated in such a way that they were not exposed to the plume from the accident.

For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers. Because the total conditional probability of containment failure is high (i.e., the containment is likely to fail some time during the accident, either early or late), the low values for latent cancer fatalities can be attributed to the low core damage frequency.

5.1.2 Risk Results for Fire Initiators

Figure 5.1-3 shows the basic results of the integrated risk analysis for fire initiators at Peach Bottom. This figure shows the complementary cumulative distribution functions (CCDFs) for early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of early fatality within one mile of the site boundary, and individual risk of latent cancer fatality within 10 miles.

As for internal initiators, the curves for latent cancer fatalities in Figure 5.1-3 are relatively flat for low fatalities (i.e., from 0.001 to 500 fatalities). This means that latent cancer fatalities in this range are very unlikely. Any type of containment failure is likely to lead to more than 500 delayed fatalities; it is extremely unlikely, however, that an accident will result in more than 70,000 delayed fatalities. If the containment does not fail, the eventual release of the noble gases (Xe and Kr) from the containment due to design basis leakage will probably cause less than 1.0 latent cancer fatalities, since the fraction of no containment failures is smaller for fires than for internal initiators the effect on the risk results is even less. These results for latent cancers are similar to the results for internal initiators except that the exceedance frequencies are higher for the fire results roughly in proportion to the PDSs frequencies and the point at which the curves begin to drop off has increased from 90 to 500 because the fire PDSs have less variability and, in general, are more serious than the internal PDSs. For the early fatalities the exceedance frequencies are also higher roughly in proportion to the increase in core damage frequency, since the dominant accidents for the fire analysis have similar characteristics to the dominant accidents in the internal analysis (i.e., the relationship between evacuation speed, warning time, and accident type is similar).

Figure 5.1-3 shows the following mean and median exceedance frequencies for fixed values of early fatalities (EF) and latent cancer fatalities (LCF):

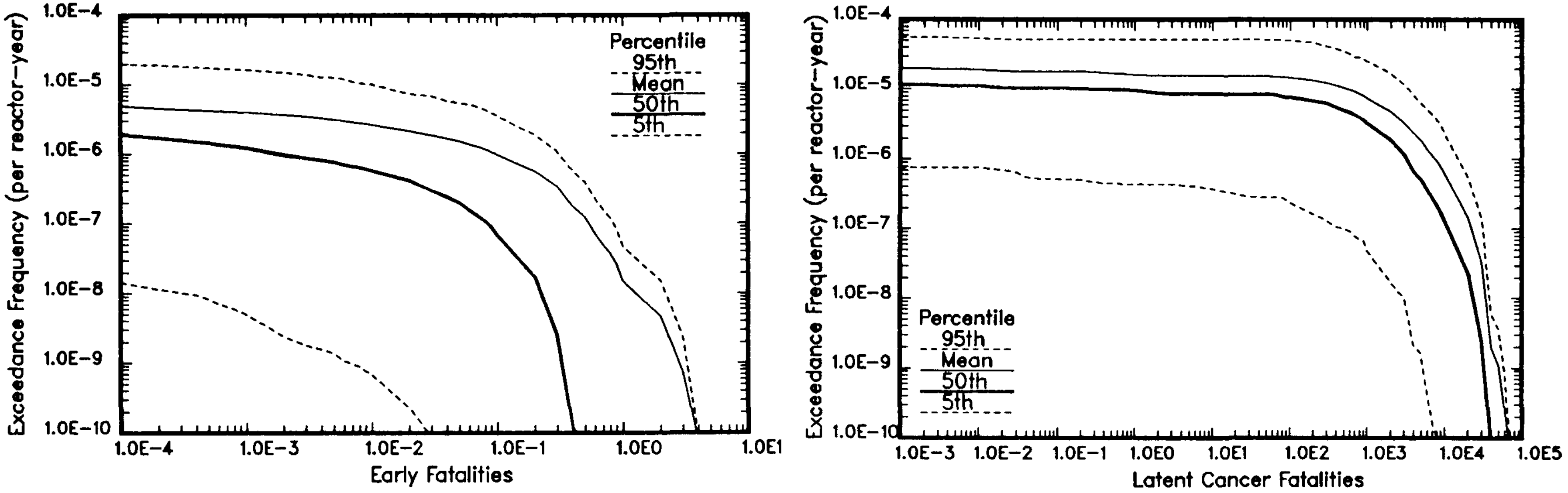


Figure 5.1-3a
Peach Bottom: Fire
Early Fatalities and Latent Cancer Risk

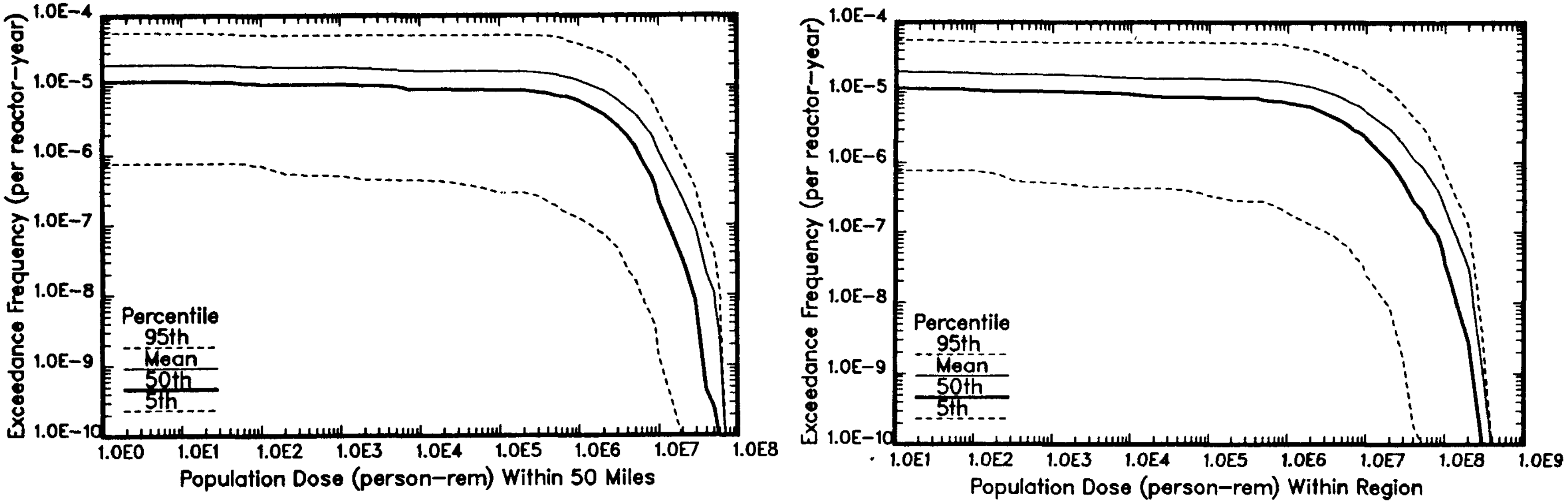


Figure 5.1-3b
Peach Bottom: Fire
Population Dose Within 50 Mi. and Region

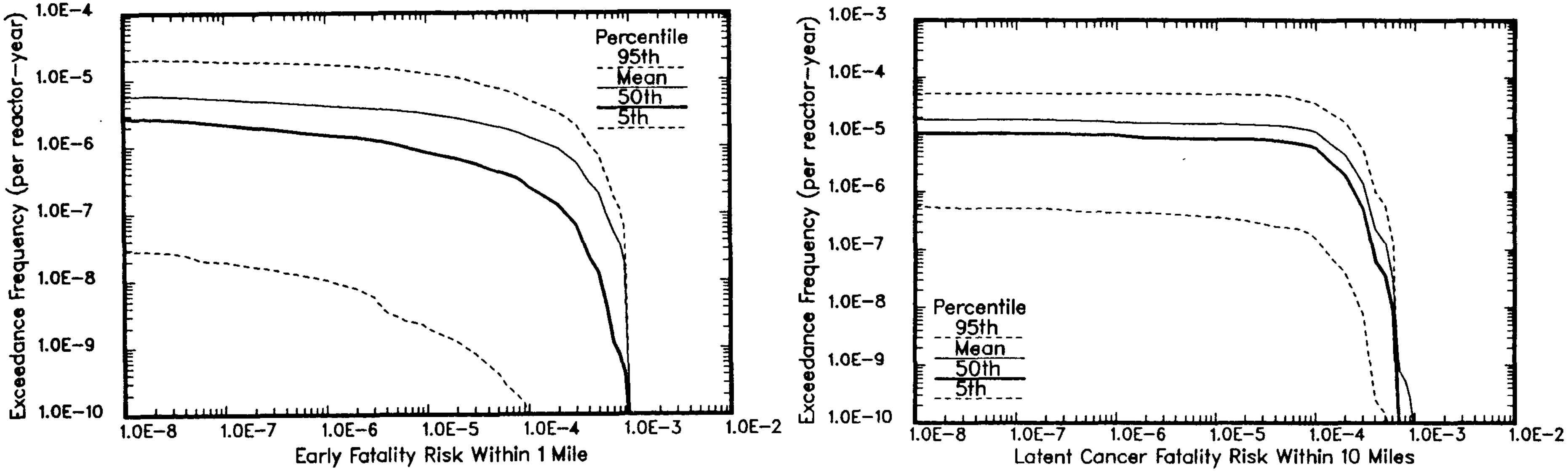


Figure 5.1-3c
Peach Bottom: Fire
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

	Exceedance Frequency (1/R-yr)	
Consequence	Mean	Median
1 EF	2E-08	<2E-12
100 EF	0E-00	0E-00
100 LCF	2E-05	8E-06
5000 LCF	2E-06	5E-07

These values are about a factor of ten more likely than the corresponding results for the internal initiators and can be directly associated with the fact that the core damage frequency is about ten times higher. Although these values appear large, as for internal initiators, they are statistically indistinguishable from the general background morbidity in such a large population.

As for internal initiators, the 200 curves making up these plots may each be reduced to a single annual risk number and the values may be ordered and plotted as histograms, which is done in Figure 5.1-4. The four statistical measures utilized above (5th, 50th, mean, and 95th) are shown on these plots and are also reported in Table 5.1-2.

The early fatality risk at Peach Bottom is relatively low, both with respect to the safety goals and with respect to the PWR plants analyzed in NUREG-1150. There are several factors that lead to these low values for risk. First, the fire core damage frequency for Peach Bottom is relatively low. The mean core damage frequency is 2.0E-05/yr. and the risk is roughly proportional to the core damage frequency. Even though this is a factor of five larger than the internal initiator frequency, it is still very low. Second, although it is likely that the containment will fail given that core damage occurs, there are several features of the Peach Bottom plant and the surrounding area that tend to reduce the consequences, since the early fatality risk depends on the magnitude of the release, the timing of containment failure, and the number of people exposed to the release.

There is a threshold effect associated with early fatalities. That is, to cause an early fatality, the release must be of a certain magnitude (i.e., above a certain threshold). There are several features of the Peach Bottom plant that reduce the magnitude of the source term. First, in the majority of the accidents analyzed, the in-vessel releases are scrubbed by the suppression pool. Second, because the dominant PDS group for fire (PDS 1 = 34% of the mean core damage frequency) is a fast transient, there is a significant probability that injection will be recovered and vessel breach avoided. Third, given that the vessel does fail, for the dominant PDS, it is likely that either the core debris released from the vessel will be cooled or if CCI is initiated it will occur with water being sprayed upon it.

Table 5.1-2
Distributions for Annual Risk at Peach Bottom Due to Fire Initiators
(All values per reactor-year)
(Population doses in person-rem)

Risk Measure	5th%tile	Median	Mean	95th%tile
Core Damage	7.6E-07	1.1E-05	2.0E-05	5.6E-05
Early Fatalities	3.1E-11	3.7E-08	3.5E-07	1.3E-06
Latent Cancer Fat.	3.1E-04	1.3E-02	3.4E-02	1.2E-01
Population Dose 50 mi.	6.4E-01	2.3E+01	5.7E+01	2.0E+02
Population Dose Entire Region	1.9E+00	8.0E+01	2.1E+02	7.1E+02
Ind. Early Fat. Risk 0-1 miles	1.1E-13	8.8E-11	4.8E-10	1.7E-09
Ind. L. C. Fatality Risk 0-10 miles	4.0E-11	1.2E-09	2.4E-09	8.1E-09

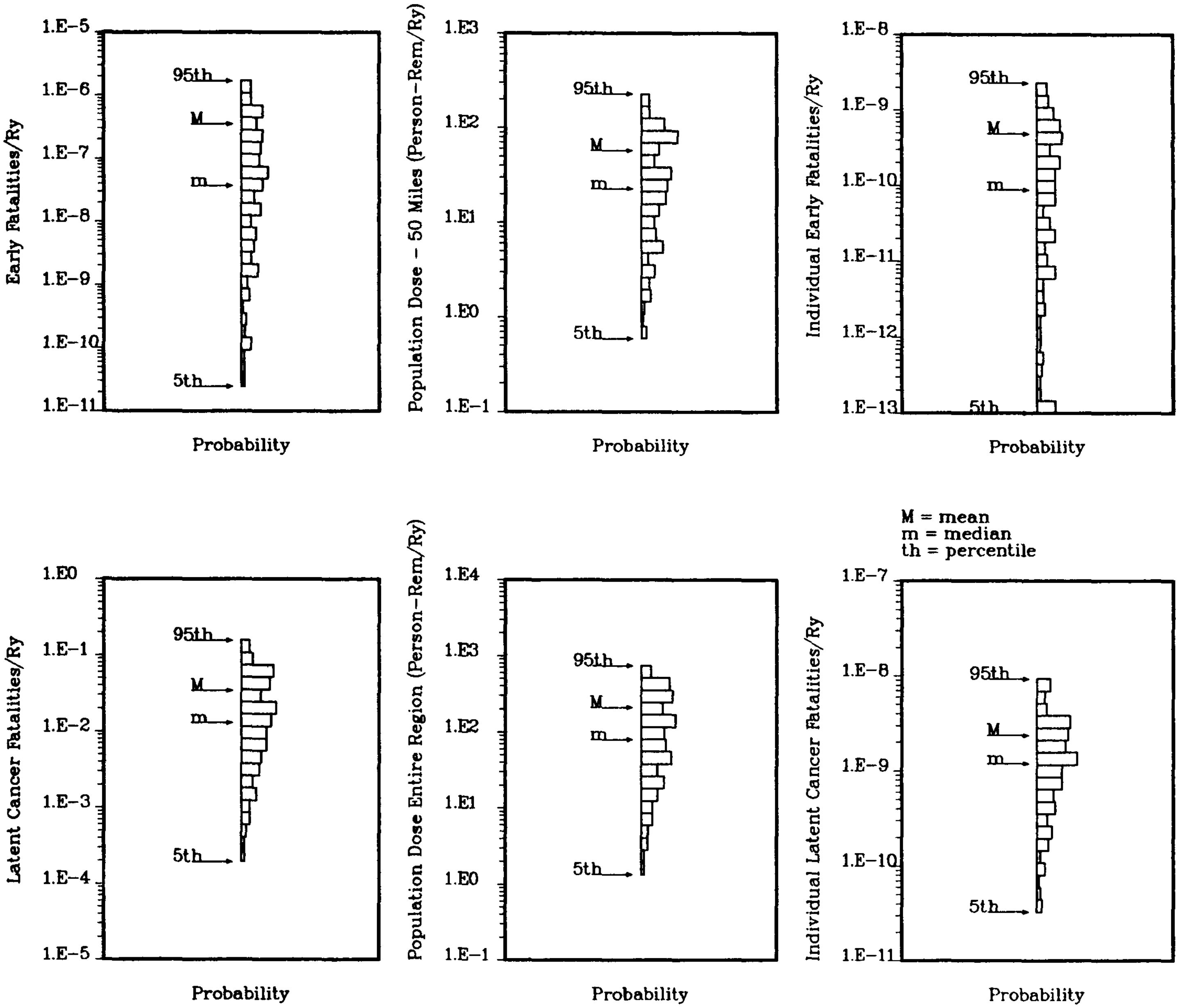


Figure 5.1-4
Peach Bottom: Fire Mean Risk Distributions

If the containment fails early in the accident it is more likely that a portion of the population will be exposed to the release than if the containment fails after the nearby population has been evacuated. For the long-term station blackout accidents and the long-term containment heat removal PDSs that are three of the four dominant PDSs for fire (PDSs 2,3,4 = 30%, 29%, and 5.5%% of the mean core damage frequency, respectively), there is a long time to core damage and, therefore, a long time in which to evacuate the nearby population. The containment is most likely to fail at or near vessel breach and a general emergency would have been called long before that time.

Also, the low early fatality risk can, in part, be attributed to the fast evacuation of the population around the plant. Even if the accidents are from PDS 1 which has a relatively short time to vessel breach, the population in the vicinity of the plant is fairly sparse and can be evacuated ahead of the plume. This is due to a short evacuation delay and a fast evacuation speed. Thus, in many of the accidents analyzed, most of the population was evacuated in such a way that they were not exposed to the plume from the accident.

For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather to whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers. Because the total conditional probability of containment failure is high (i.e., the containment is likely to fail some time during the accident, either early or late), the low values for latent cancer fatalities can be attributed to the low core damage frequency.

5.1.3 Risk Results for Seismic Initiators: LLNL Hazard Curve

Figure 5.1-5 shows the basic results of the integrated risk analysis for seismic initiators at Peach Bottom using the LLNL hazard curve. This figure shows the complementary cumulative distribution functions (CCDFs) for early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of early fatality within one mile of the site boundary, and individual risk of latent cancer fatality within 10 miles.

As for internal and fire initiators, the curves for latent cancer fatalities in Figure 5.1-5 are relatively flat for low fatalities (i.e., from 0.001 to 1000 fatalities). This means that latent cancer fatalities in this range are very unlikely. Any type of containment failure is likely

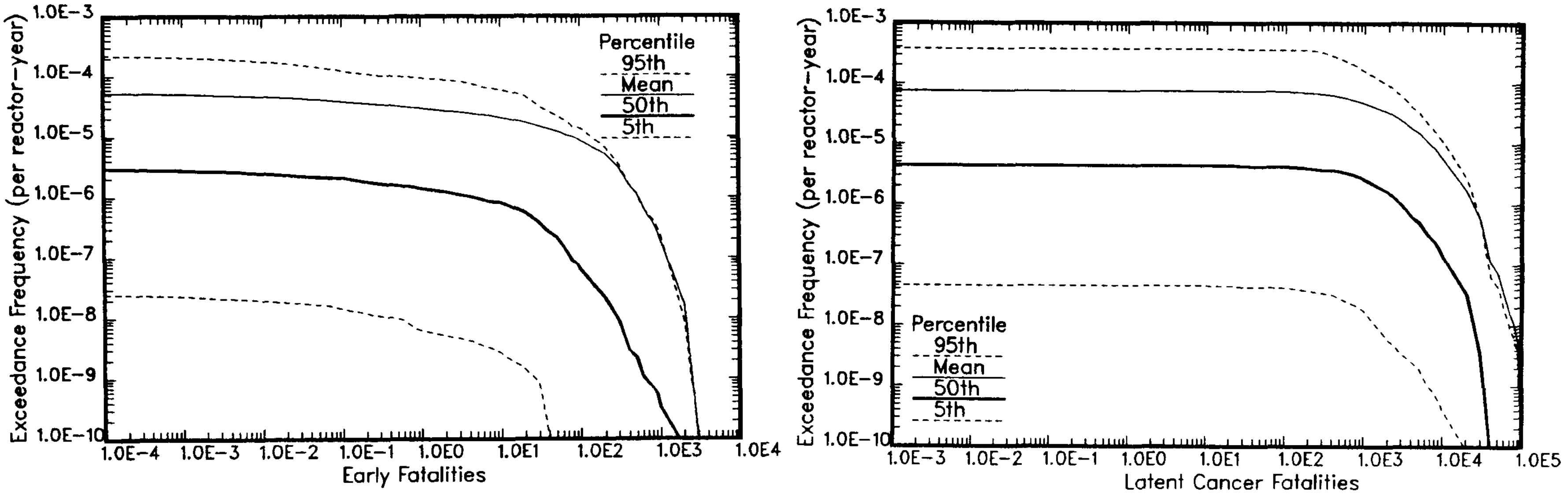


Figure 5.1-5a
Peach Bottom: LLNL Hazard Curve
Early Fatalities and Latent Cancer Risk

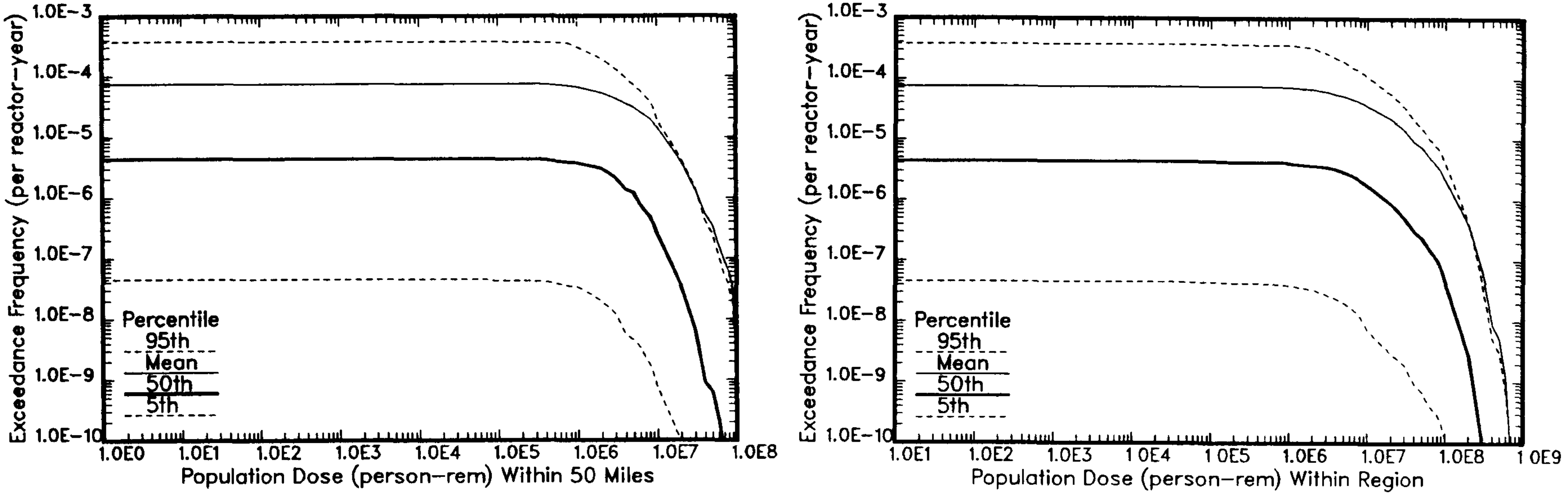


Figure 5.1-5b
Peach Bottom: LLNL Hazard Curve
Population Dose Within 50 Mi. and Region

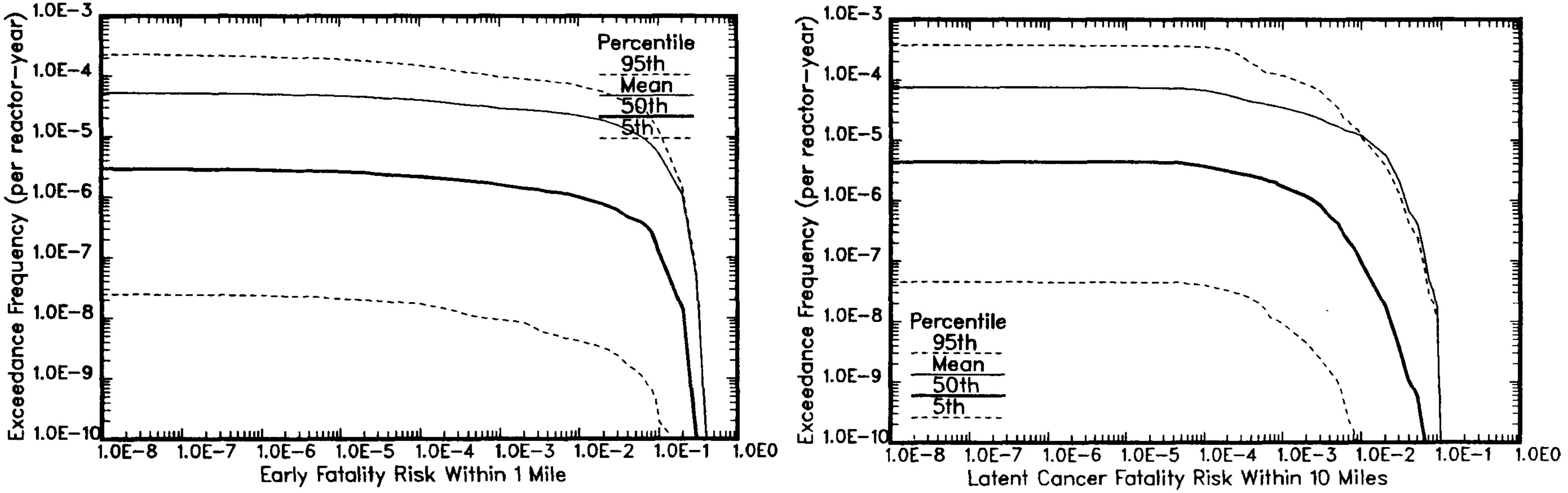


Figure 5.1-5c
Peach Bottom: LLNL Hazard Curve
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

to lead to more than 1000 delayed fatalities; it is extremely unlikely, however, that an accident will result in more than 100,000 delayed fatalities. In all of the seismic PDSs, the containment ultimately fails, since recovery of containment cooling is very unlikely. These results for latent cancers are similar to the results for internal initiators except that the exceedance frequencies are higher for the seismic results roughly in proportion to the PDS frequencies and the point at which the curves begin to drop off has increased from 90 to 1000 because the seismic PDSs have less variability and, in general, are more serious than the internal PDSs. For the early fatalities the exceedance frequencies are much larger, since the results depend critically upon the relationship between evacuation speed, warning time, and accident type and, for seismic accidents, we either have reduced evacuation speeds or no evacuation for the first 24 hours and then relocation. In addition, some of the PDSs have containment failure at the start of the accident as a result of the seismic initiator.

Figure 5.1-5 shows the following mean and median exceedance frequencies for fixed values of early fatalities (EF) and latent cancer fatalities (LCF):

	Exceedance Frequency (1/R-yr)	
Consequence	Mean	Median
1 EF	3E-05	1E-06
100 EF	9E-06	6E-08
100 LCF	7E-05	4E-06
5000 LCF	2E-05	5E-07

The latent cancer values are about a factor of ten to one hundred times more likely than the corresponding results for the internal initiators. Although these values appear large, as for internal initiators, they are still statistically indistinguishable from the general background morbidity in such a large population. The early fatality risk is much higher than either the internal or the fire results since the evacuation speed has been reduced or set to zero and many people are being caught in the plume.

As for internal initiators, the 200 curves making up these plots may each be reduced to a single annual risk number and the values may be ordered and plotted as histograms, which is done in Figure 5.1-6. The four statistical measures utilized above (5th, 50th, mean, and 95th) are shown on these plots and are also reported in Table 5.1-3.

The mean early fatality risk at Peach Bottom is greater than the safety goal and greater than the PWR plant analyzed in NUREG-1150 (Surry). There are several factors that lead to these relatively high values for risk. First, the core damage frequency for Peach Bottom is fairly high from seismic events using the LLNL hazard curve and the distribution tends to

Table 5.1-3
Distributions for Annual Risk at Peach Bottom Due to Seismic Initiators
LLNL Hazard Distributions
(All values per reactor-year)
(Population Doses in person-rem)

Risk Measure	5th%tile	Median	Mean	95th%tile
Core Damage	4.5E-08	4.3E-06	7.5E-05	3.7E-04
Early Fatalities	1.4E-07	4.9E-05	3.0E-03	4.5E-03
Latent Cancer Fat.	6.9E-05	1.1E-02	2.5E-01	7.2E-01
Population Dose 50 mi.	1.2E-01	2.1E+01	4.6E+02	1.4E+03
Population Dose Entire Region	4.2E-01	7.0E+01	1.5E+03	4.5E+03
Ind. Early Fat. Risk 0-1 mile	2.3E-10	5.6E-08	1.6E-06	4.3E-06
Ind. L. C. Fatality Risk 0-10 mile	5.2E-11	1.0E-08	3.4E-07	6.4E-07

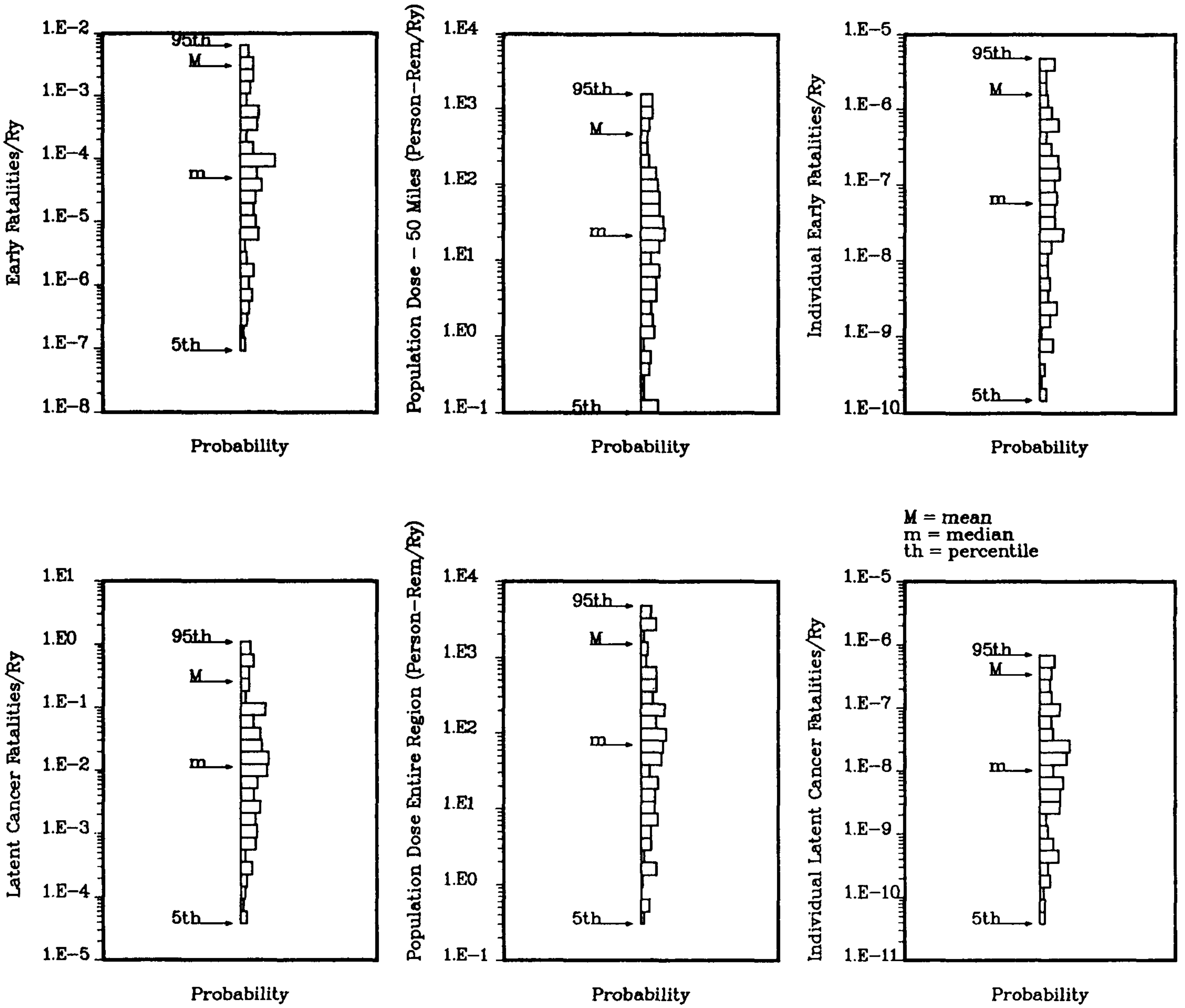


Figure 5.1-6
Peach Bottom: LLNL Hazard Curve Mean Risk Distributions

favor the high PGA cases because of the long tail on the distribution. The mean core damage frequency is 7.5E-05/yr. and the early fatalities are roughly proportional to the core damage frequency for seismic events because of the evacuation assumptions. Even though this is a factor of seventeen larger than the internal initiator frequency, it is still relatively low as core damage frequencies go (i.e., even adding up the seismic, fire, and internal mean core damage frequencies, the total core damage frequency is about 1.0E-04/yr. which is within the NRC's core damage frequency goal). Second, the evacuation assumptions guarantee that a large part of the nearby population will receive significant exposure given that an event occurs.

The latent cancer fatality risk is less than the safety goal at Peach Bottom but still greater than the corresponding risk at the PWR plant (Surry). For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather to whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers (for high PGA cases this is moot because the population does not evacuate). Because the total conditional probability of containment failure is certain for seismic events, the low values for latent cancer fatalities can be attributed to the low core damage frequency.

5.1.4 Risk Results for Seismic Initiators: EPRI Hazard Curve

Figure 5.1-7 shows the basic results of the integrated risk analysis for seismic initiators at Peach Bottom using the EPRI hazard curve. This figure shows the complementary cumulative distribution functions (CCDFs) for early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of early fatality within one mile of the site boundary, and individual risk of latent cancer fatality within 10 miles.

As for internal and fire initiators, the curves for latent cancer fatalities in Figure 5.1-7 are relatively flat for low fatalities (i.e., from 0.001 to 500 fatalities). This means that latent cancer fatalities in this range are very unlikely. Any type of containment failure is likely to lead to more than 500 delayed fatalities; it is extremely unlikely, however, that an accident will result in more than 100,000 delayed fatalities. In all of the seismic PDSs, the containment ultimately fails, since recovery of containment cooling is very unlikely. These results for latent cancers are similar to the results for internal initiators except that the exceedance frequencies are higher for the seismic results roughly

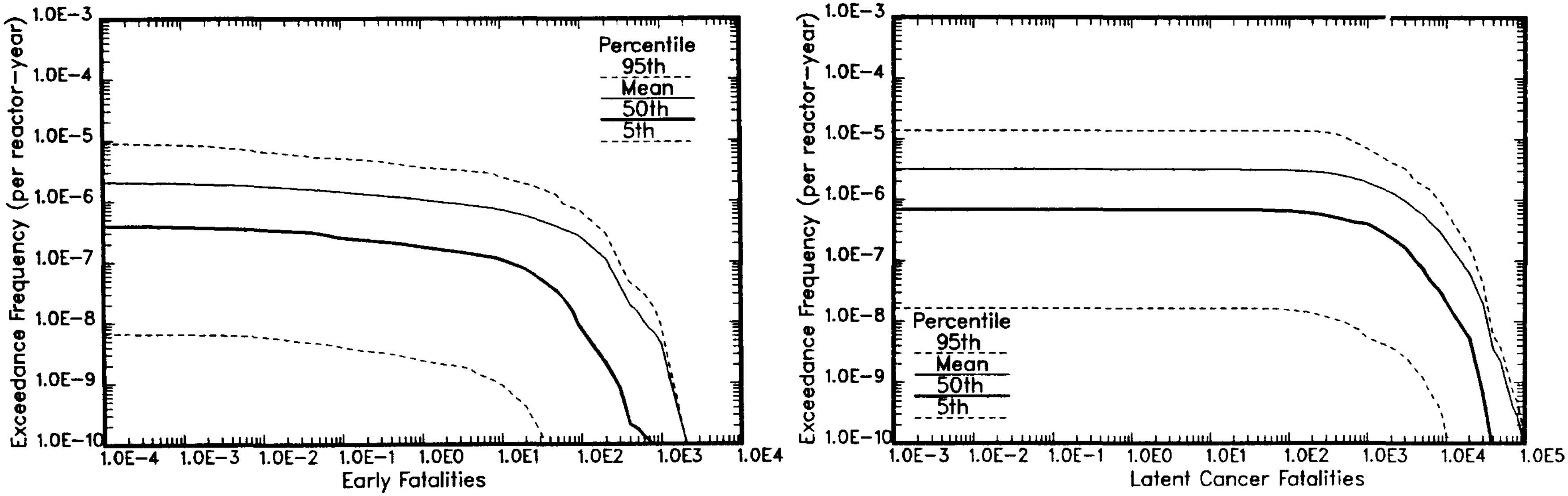


Figure 5.1-7a
Peach Bottom: EPRI Hazard Curve
Early Fatalities and Latent Cancer Risk

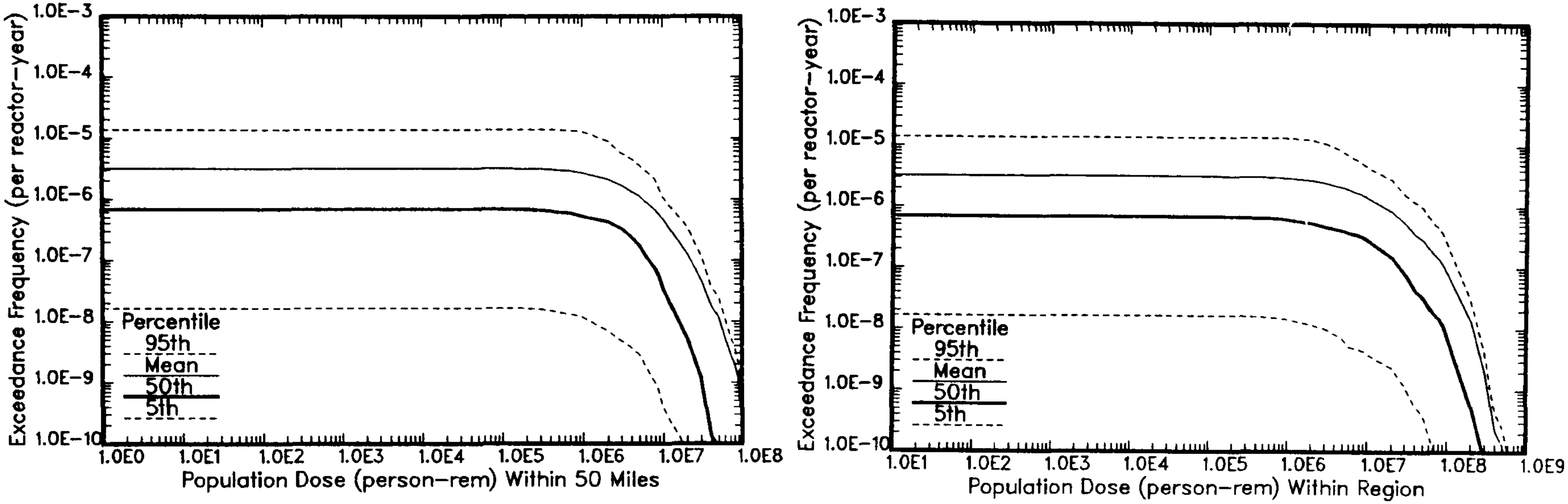


Figure 5.1-7b
Peach Bottom: EPRI Hazard Curve
Population Dose Within 50 Mi. and Region

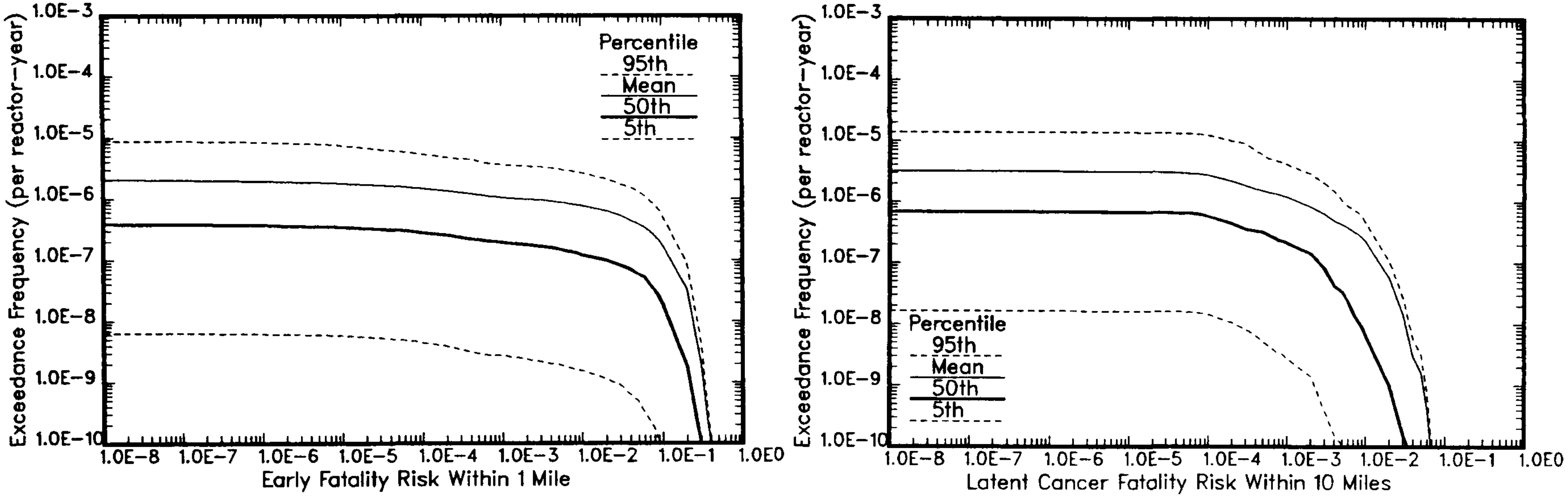


Figure 5.1-7c
Peach Bottom: EPRI Hazard Curve
Early Fatalities 0-1 Mi and Latent Cancer 0-10 Mi Risk

in proportion to the PDS frequencies and the point at which the curves begin to drop off has increased from 90 to 1000 because the seismic PDSs have less variability and, in general, are more serious than the internal PDSs. For the early fatalities the exceedance frequencies are much larger, since the results depend critically upon the relationship between evacuation speed, warning time, and accident type and, for seismic accidents, we either have reduced evacuation speeds or no evacuation for the first 24 hours and then relocation. In addition, some of the PDSs have containment failure at the start of the accident as a result of the seismic initiator.

Figure 5.1-7 shows the following mean and median exceedance frequencies for fixed values of early fatalities (EF) and latent cancer fatalities (LCF):

	Exceedance Frequency (1/R-yr)	
Consequence	Mean	Median
1 EF	1E-06	2E-07
100 EF	3E-07	8E-09
100 LCF	3E-06	7E-07
5000 LCF	2E-07	2E-08

The mean latent cancer values are about the same as the corresponding results for the internal initiators, since the core damage frequency for the EPRI results is about the same as that for the internal initiators. Although these values appear large, as for internal initiators, they are still statistically indistinguishable from the general background morbidity in such a large population. The early fatality risk is much higher than either the internal or the fire results since the evacuation speed has been reduced or set to zero and many people are being caught in the plume. If we compare this with the LLNL results, we see the early fatality risk and the latent cancer risk are roughly lower by the decrease in the core damage frequency.

As for internal initiators, the 200 curves making up these plots may each be reduced to a single annual risk number and the values may be ordered and plotted as histograms, which is done in Figure 5.1-8. The four statistical measures utilized above (5th, 50th, mean, and 95th) are shown on these plots and are also reported in Table 5.1-4.

The mean early fatality risk at Peach Bottom is less than the safety goal (although the upper bound is close to the goal) and greater than the PWR plant analyzed in NUREG-1150 (Surry). There are several factors that lead to these relatively low values for risk. First, the core damage frequency for Peach Bottom is fairly low from seismic events using the EPRI hazard curve and the distribution tends to favor the low PGA cases more than the LLNL hazard curve because the tail of the distribution drops off faster

Table 5.1-4
Distributions for Annual Risk at Peach Bottom Due to Seismic Initiators
EPRI Hazard Distributions
(All values per reactor-year)
(Population Doses in person-rem)

Risk Measure	5th%tile	Median	Mean	95th%tile
Core Damage	1.6E-08	6.8E-07	3.2E-06	1.4E-05
Early Fatalities	4.5E-08	6.6E-06	8.8E-05	2.5E-04
Latent Cancer Fat.	2.8E-05	1.8E-03	9.9E-03	3.2E-02
Population Dose 50 mi.	5.7E-02	3.3E+00	1.7E+01	5.2E+01
Population Dose Entire Region	1.7E-01	1.1E+01	5.8E+01	1.9E+02
Ind. Early Fat. Risk 0-1 mile	8.8E-11	8.0E-09	5.3E-08	1.8E-07
Ind. L. C. Fatality Risk 0-10 mile	2.5E-11	1.4E-09	1.1E-08	3.0E-08

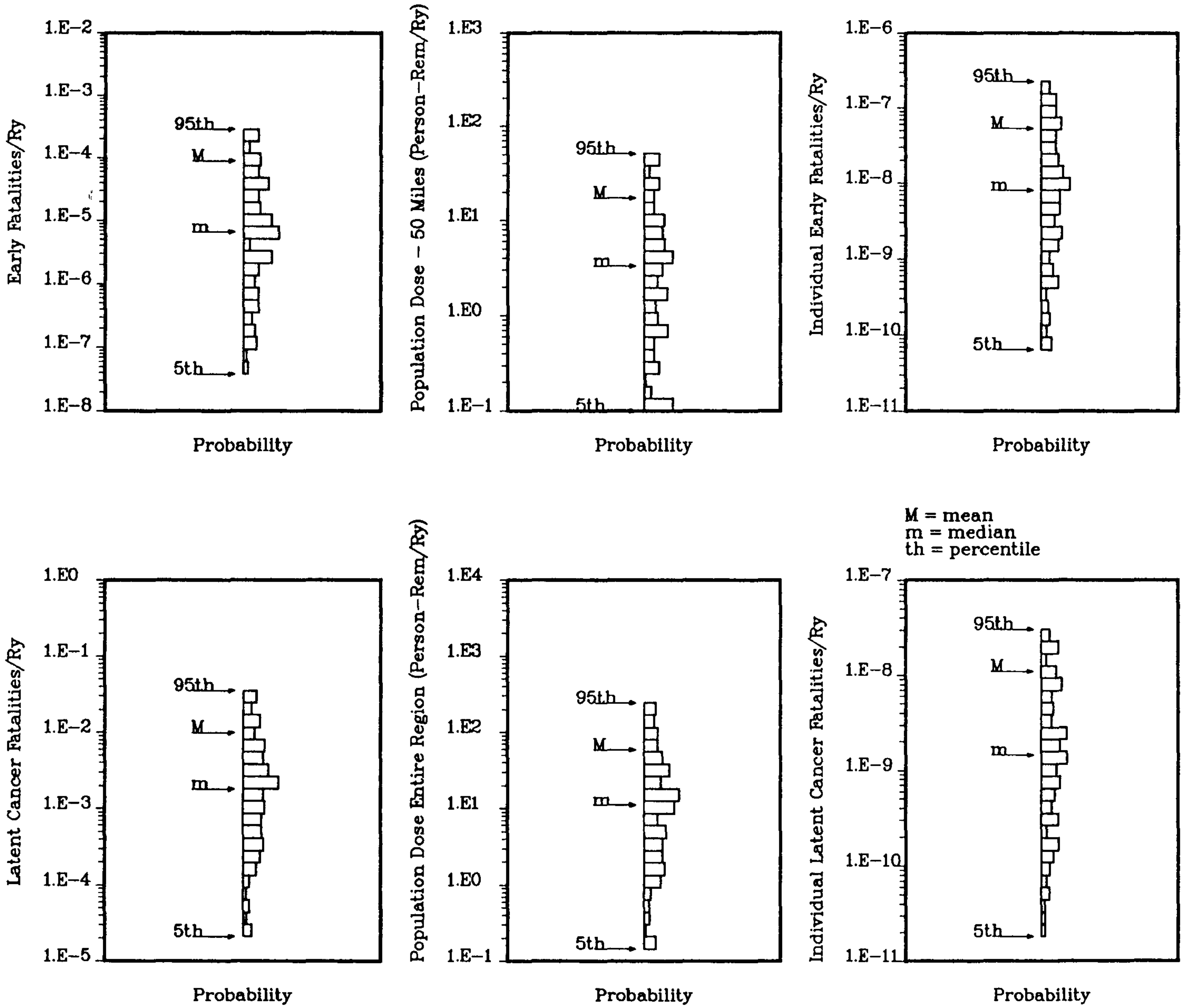


Figure 5.1-8
Peach Bottom: EPRI Hazard Curve Mean Risk Distributions

with the EPRI curve than with the LLNL curve. The mean core damage frequency is 3.2E-06/yr. and the early fatalities are roughly proportional to the core damage frequency for seismic events because of the evacuation assumptions. Second, while the evacuation assumptions guarantee that a large part of the nearby population will receive significant exposure given that an event occurs, in the low PGA cases, which constitute 8% more of the core damage frequency than in the LLNL case, some people can still evacuate before the plume reaches them.

The latent cancer risk is also less than the safety goal using the EPRI curve. For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers (for high PGA cases this is moot because the population does not evacuate). Because the total conditional probability of containment failure is certain for seismic events, the low values for latent cancer fatalities can be attributed to the low core damage frequency.

Table 5.1-5 shows a comparison between the LLNL and EPRI risk results for the various risk measures. The EPRI results are generally a factor of ten to one hundred lower depending upon the risk measure.

5.2 Contributors to Risk

There exist two distinct ways to calculate contribution to risk. To facilitate their definition, the following quantities are introduced:

rC_j = risk (units: consequences/reactor-year) for consequence measure j,

rC_{ij} = value for rC_j obtained for observation i,

rC_{jk} = risk (units: consequences/reactor-year) for consequence measure j due to PDS group k,

rC_{ijk} = value for rC_{jk} obtained for observation i, and

nLHS = number of observations in the Latin Hypercube Sample.

The notation used here is similar to that used in Section 1.4 The value of nLHS is 200 for Peach Bottom. The risk rC_{ij} is the j^th^ element of the vector rC_i in Equation (1.9) of Section 1.4. The risk rC_{ijk} is the j^{th}

Table 5.1-5
Distributions for Annual Risk at Peach Bottom Due to Seismic Initiators
(All values per reactor-year)
(Population Doses in person-rem)

Risk Measure	Hazard Distrb.	5th %ile	Median	Mean	95th %ile
Core Damage	LLNL	4.5E-08	4.3E-06	7.5E-05	3.7E-04
	EPRI	1.6E-08	6.8E-07	3.2E-06	1.4E-05
Early Fatalities	LLNL	1.4E-07	4.9E-05	3.0E-03	4.5E-03
	EPRI	4.5E-08	6.6E-06	8.8E-05	2.5E-04
Latent Cancer Fatalities	LLNL	6.9E-05	1.1E-02	2.5E-01	7.2E-01
	EPRI	2.8E-05	1.8E-03	9.9E-03	3.2E-02
Population Dose - 50 miles	LLNL	1.2E-01	2.1E+01	4.6E+02	1.4E+03
	EPRI	5.7E-02	3.3E+00	1.7E+01	5.2E+01
Population Dose - Entire Region	LLNL	4.2E-01	7.0E+01	1.5E+03	4.5E+03
	EPRI	1.7E-01	1.1E+01	5.8E+01	1.9E+02
Ind. Early Fat. Risk 0-1 mile	LLNL	2.3E-10	5.6E-08	1.6E-06	4.3E-06
	EPRI	8.8E-11	8.0E-09	5.3E-08	1.8E-07
Ind. L. C. Fat. Risk 0-10 mile	LLNL	5.2E-11	1.0E-08	3.4E-07	6.4E-07
	EPRI	2.5E-11	1.4E-09	1.1E-08	3.0E-08

element of the vector $\mathbf{rC_i}$ when the frequencies of all the PDS groups except group k in the vector $\mathbf{fPDS_i}$ are set to zero. The vector $\mathbf{fPDS_i}$ is equal to the product $\mathbf{fIE_i} * \mathbf{P_i(IE \rightarrow PDS)}$.

The result of the first method for computing contribution to risk is denoted the fractional contribution to mean risk and abbreviated FCMR. The contribution of PDS k to the risk for consequence measure j, $FCMR_{jk}$, is defined as the ratio of the annual risk due to PDS k to the total annual risk. That is, $FCMR_{jk}$ is defined by

$$FCMR_{jk} = E(\ rC_{jk}\ ) \ /\ E(\ rC_j\ ),$$

where E(x) represents the annual value of x. Computationally, $FCMR_{jk}$ is found by use of the relation

$$FCMR_{jk} = [\ \Sigma\ rC_{ijk} \ /\ nLHS\ ] \ /\ [\ \Sigma\ rC_{ij} \ /\ nLHS\ ]$$

$$= \Sigma\ rC_{ijk} \ /\ \Sigma\ rC_{ij},$$

where the summations are from i = 1 to i = nLHS.

The result of the second method for computing contribution to risk is denoted the mean fractional contribution to risk and abbreviated MFCR. The contribution of PDS k to the risk for consequence measure j, $FCMR_{jk}$, is defined as the annual value of ratio of the risk due to PDS k to the total risk. That is:

$$MFCR_{jk} = E(\ rC_{jk} \ /\ rC_j\ ).$$

Computationally, $MFCR_{jk}$ is found by use of the relation

$$MFCR_{jk} = \Sigma\ (\ rC_{ijk} \ /\ rC_{ij}\ ) \ /\ nLHS,$$

where the summation again is from i = 1 to i = nLHS.

For FCMR, the averaging over the observations is done before the ratio of PDS k risk to total risk is formed; for MFCR, the averaging over the observations is done after the ratio of PDS k risk to total risk is formed.

To determine the reproducibility of the integrated risk analyses performed for NUREG-1150, a second sample was run through the entire integrated risk analyses for Surry. The second sample is just as valid as the first sample, and differs from the first sample only in the fact that a different random seed was used in the LHS program. Therefore, the differences in the results between the two samples are an indication of the robustness of the analysis methods. In addition, a comparison of the two samples provides an indication of which method of calculating the contribution to risk tends to be more stable. The results from the second sample and a comparison of the two samples are presented in Volume 3 of this report on Surry. Several insights can be gleaned from this comparison. First, considering the early fatality and latent cancer fatality risk distributions, the agreement between the two samples is remarkably good. Differences between the two samples can generally be found at the extremes of the distribution, which is not surprising since the extremes are determined by a relatively few observations. Second, the variations between samples are higher for FCMR than for MFCR, indicating that MFCR is a more robust measure of the risk results than FCMR.

The FCMR measure of the contribution to mean risk tends to be less stable than the MFCR measure because often the annual risk for each observation is typically dominated by a few APBs which have both high frequency and high source terms and the mean risk is dominated by a few observations which have very large values of annual risk. The bulk of the mean risk is contributed by about 10 to 20 observations. While the sample as a whole is reproducible, the 10 to 20 observations that control mean risk are generally not reproducible. Since it is the exact nature of these 10 or so observations that determine the contributors to mean risk, it is not surprising that FCMR is not a robust measure of the entire risk analysis.

Both FCMR and MFCR are conceptually valid methods of computing the contributions to mean risk. However, given the overall structure of the PRAs performed for NUREG-1150, MFCR seems to be the more appropriate measure. The analysis performed for each observation in the sample can be viewed as a complete PRA. In a single observation, each sampled variable has a fixed value representing one possible value for an imprecisely known quantity. Each observation yields an estimate for the ratio rC_{jk}/rC_j (the fractional contribution of PDS k to the risk for consequence measure j) based on an internally consistent set of assumptions. Taken as a whole, the sample produces a distribution for fractional contributions to risk.

MFCR results from averaging over the sampled variables and is thus consistent with other annual values reported in this study. That is, for other quantities, a single value is obtained for each observation in the sample, and distributions and means are reported for these values. Thus, the calculation of MFCR is consistent with the manner in which mean risk values are calculated. The FCMR results are not consistent with this pattern of obtaining a complete result for each observation and then analyzing the distribution of results.

This is an appropriate place to remind the reader of a caveat made elsewhere in this report: a mean value is a summary measure and information is lost in generating it. Thus, considerable caution should be used in drawing conclusions solely from mean values. A mean is obtained by reducing an entire distribution to a single number.

5.2.1 Contributors to Risk for Internal Initiators

Table 5.2-1 gives the values of FCMR and MFCR for the four summary PDS used for reporting the internal initiator results in NUREG-1150. Not

Table 5.2-1
Fractional Summary PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Internal Initiators

Summary PDS Group	Method	Core Damage	Early Fatalities	Latent Cancer Fatalities	Population Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
LOCA	FCMR	3.5	2.9	2.4	2.5	2.4	3.3	2.2
	MFCR	6.4	4.9	3.3	3.6	3.3	5.0	3.7
LOSP	FCMR	4.2	3.0	1.8	2.1	1.8	3.4	1.9
	MFCR	6.5	3.9	2.7	3.1	2.8	4.1	3.3
TRANS	FCMR	48.0	47.8	58.7	55.7	58.3	44.0	50.2
	MFCR	46.6	45.9	54.2	52.7	53.9	45.5	49.7
ATWS	FCMR	44.4	46.7	37.0	39.7	37.4	49.3	45.9
	MFCR	40.5	45.7	39.9	40.7	40.0	45.4	43.3

surprisingly, the two methods of calculating contribution to risk yield different values. Both methods of computing the contributions to risk are conceptually valid, so the conclusion is clear: contributors to mean risk can only be interpreted in a very broad sense. That is, it is valid to say that the LOSP and ATWS groups both contribute relatively equally to mean early fatality risk at Peach Bottom, It is not valid to state that the LOSP contributes 48.0% and the ATWS group contributes 44.4% of the early fatality risk at Peach Bottom, since the values will differ by method and by LHS sample (i.e., a new sample will not give exactly the same result as the original sample). Although the exact values are different for each method, the basic conclusions that can be drawn from these results are the same if one does not try to be too precise. That is, both the mean early fatality risk and the mean latent cancer fatality risk are dominated by the LOSP and ATWS groups. The LOCA and Transient groups both contribute considerably less to these risk measures but are roughly equal to each other.

Pie charts for both methods of computing the contribution to risk are shown in Figure 5.2-1 for early fatalities and for latent cancer fatalities for the four summary PDS groups. The differences are readily apparent when this method of displaying the results is utilized, and suggest the level of confidence that these results warrant.

Table 5.2-2 and Figure 5.2-2 give the FCMR and MFCR for the nine internal PDSs. One can see that the contribution to risk is roughly proportional to the core damage frequency; indicating, that Level I characteristics are important contributors to the absolute value of risk.

The contributions of the summary accident progression bins (APBs) to mean risk can also be computed in two ways. Table 5.2-3 and Figure 5.2-3 display the results of these calculations.

Even though the measures for determining the contributors to mean risk are only approximate, the types of accidents that are the largest contributors to offsite risk at Peach Bottom are clear. For all of the consequence measures, the risk is dominated by long-term SBOs (PDS 5) and the ATWS core vulnerable sequence (PDS 8). These groups are the dominant contributors to the core damage frequency and both result in accidents that involve early containment failure in the drywell. Thus, these accidents are not only the most frequent but they also involve accidents that can potentially result in a large early release.

The bin that involves accidents in which the vessel does not fail makes a minor contribution to risk. It must be remembered that, although the vessel does not fail in these accidents, the containment can fail early by venting or late by venting or overpressure from decay heat if containment heat removal is not working. Failure of the containment will allow a portion of the in-vessel releases to escape into the environment. The combination of the threshold effect associated with early fatalities and

Table 5.2-2
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Internal Initiators

PDS	Method	Core Damage	Early Fatalities	Latent Cancer Fatalities	Population Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
1 LOCA	FCMR	3.5	2.9	2.4	2.5	2.4	3.3	2.2
	MFCR	6.4	4.9	3.3	3.6	3.3	5.0	3.7
2 Fast Trans	FCMR	4.1	2.9	1.8	2.0	1.8	3.3	1.8
	MFCR	6.4	3.8	2.6	3.0	2.7	4.0	3.2
3 Fast Trans	FCMR	0.06	0.06	0.04	0.05	0.04	0.07	0.06
	MFCR	0.11	0.08	0.06	0.08	0.06	0.09	0.11
4 Fast Blackout	FCMR	4.6	2.4	1.7	2.0	1.8	2.8	2.0
	MFCR	7.0	7.6	3.0	3.3	3.1	7.4	3.3
5 Slow Blackout	FCMR	43.4	45.2	57.0	53.7	56.5	41.2	48.2
	MFCR	39.6	38.0	51.2	49.4	50.8	38.1	46.4
6 Fast ATWS	FCMR	8.1	3.3	2.2	2.4	2.2	3.4	2.4
	MFCR	5.7	3.6	1.6	1.8	1.6	3.4	1.9
7 ATWS CV	FCMR	2.3	2.7	2.1	2.3	2.2	2.9	2.7
	MFCR	2.7	3.5	2.9	3.0	2.9	3.5	3.2
8 ATWS CV	FCMR	32.9	39.5	31.7	33.9	32.0	41.7	39.5
	MFCR	31.0	37.2	34.2	34.7	34.3	37.1	36.9
9 ATWS CV	FCMR	1.1	1.2	1.0	1.1	1.0	1.3	1.3
	MFCR	1.1	1.4	1.2	1.2	1.2	1.4	1.3

Table 5.2-3
Fractional APB Contributions (in percent) to Annual Risk at Peach Bottom Due to Internal Initiators

Summary Accident Progression	Method	Early Fatalities	Latent Cancer Fatalities	Population Dose Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
VB, Early CF, WW Failure, RPV>200 psia at VB	FCMR	0.24	0.96	1.2	0.97	0.4	2.0
	MFCR	0.35	1.9	2.1	1.9	0.44	3.0
VB, Early CF, WW Failure, RPV<200 psia at VB	FCMR	0.12	0.45	0.66	0.47	0.23	1.2
	MFCR	0.25	0.53	0.66	0.53	0.29	1.1
VB, Early CF, DW Failure, RPV>200 psia at VB	FCMR	64.2	67.1	61.2	66.5	58.4	45.6
	MFCR	55.6	58.9	55.6	58.6	54.5	48.0
VB, Early CF, DW Failure, RPV<200 psia at VB	FCMR	28.2	23.6	25.8	23.9	30.4	27.0
	MFCR	32.2	22.3	22.6	22.5	31.6	21.0
VB, Late CF, WW Failure	FCMR	0.0	0.1	0.13	0.09	0.0	0.32
	MFCR	0.01	0.18	0.22	0.19	0.01	0.44
VB, Late CF, DW Failure	FCMR	1.8	1.5	2.0	1.6	2.1	3.2
	MFCR	3.3	5.1	5.9	5.2	4.0	7.0
VB, Vent	FCMR	5.3	5.9	8.4	6.1	1.0	18.6
	MFCR	7.9	10.2	11.8	10.4	2.1	17.0
VB, No CF	FCMR	0.0	0.0	0.02	0.01	0.0	0.06
	MFCR	0.0	0.02	0.05	0.03	0.0	0.09
No VB	FCMR	0.22	0.37	0.58	0.37	0.36	2.1
	MFCR	0.38	0.81	1.0	0.81	0.39	2.5
No CD	FCMR	0.0	0.0	0.0	0.0	0.0	0.0
	MFCR	0.0	0.0	0.0	0.0	0.0	0.0

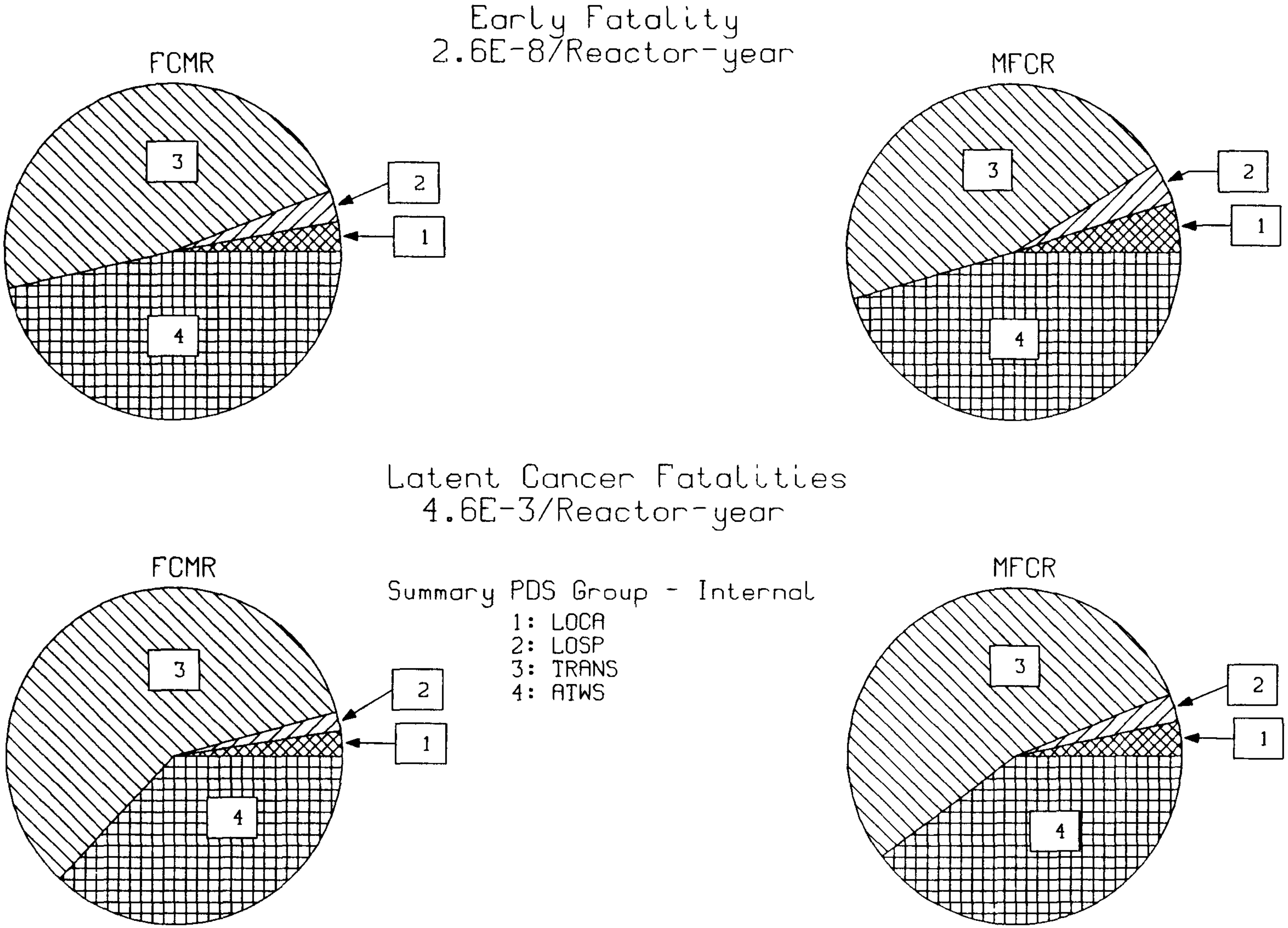


Figure 5.2-1
Peach Bottom Summary PDS Groups for Internal Initiators: Percent Contribution to Risk

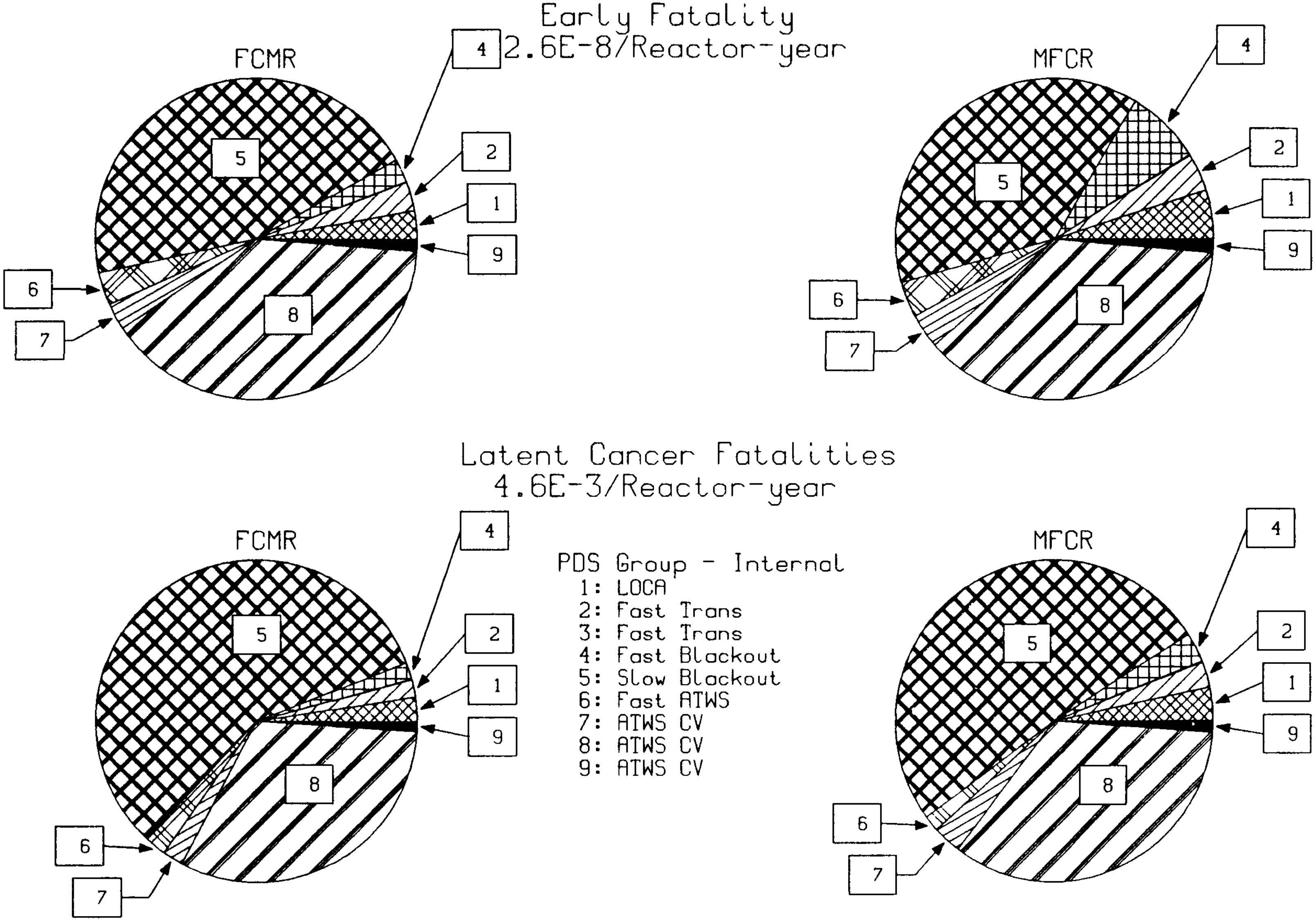


Figure 5.2-2
Peach Bottom PDSs for Internal Initiators: Percent Contribution to Risk

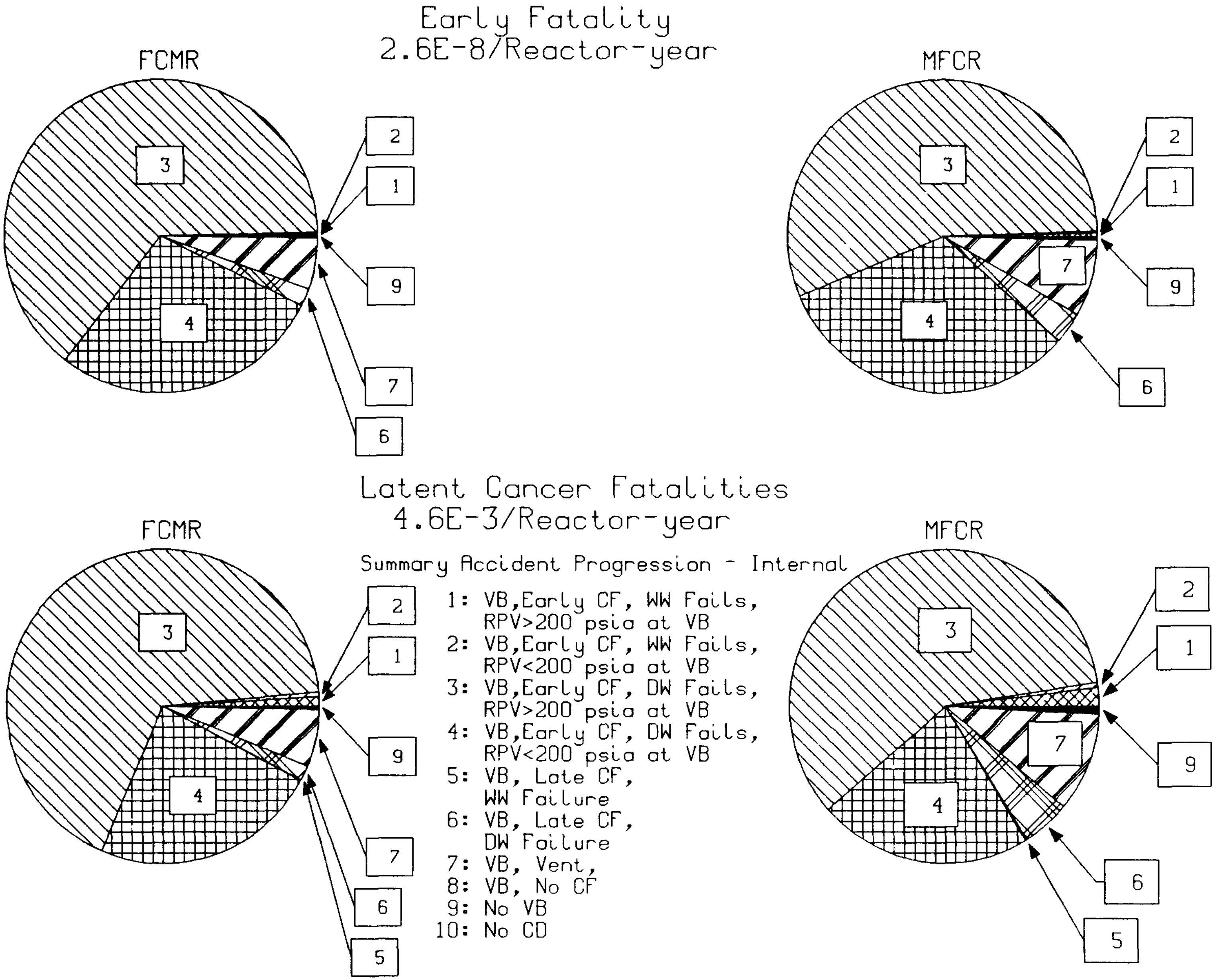


Figure 5.2-3
Peach Bottom Summary Accident Progression Bins for Internal Initiators: Percent Contribution to Risk

the fact that the releases associated with this bin are fairly small results in few early fatalities. For latent cancers, on the other hand, there is no threshold effect; but, since the release is small, the effect is more pronounced only in the 0-10 mile range.

The plant characteristics that determine the absolute value of the various risk measures come from each of the four areas of the analysis: 1) systems analysis, 2) containment response, 3) source term analysis, and 4) consequence analysis.

Systems (Level I) Analysis

If we look at the fractional contribution to the individual risk measures of the individual plant damage states, we see that the risk results are roughly proportional to the frequency of the plant damage states for the Peach Bottom internal events analysis. The implication that we draw from this is that, due to the plant design and the modeling of the containment, source term, and consequence characteristics, each plant damage state can evolve into accident progressions that cover the whole range of possible outcomes. This means that system analysis variables that are important for determining the absolute value of the plant damage state frequencies will also be important for determining the absolute value of the risk.

It is important here to point out that this result could easily have been different. Depending on plant design, some sequences which have fairly unique accident progression characteristics could have been responsible for most of the risk even though their frequency of occurrence was very low. One possible reason for not having this result is that the Peach Bottom plant has had several PRAs performed on it over the years and many changes have been made to both plant design, system operation, and procedures in order to eliminate any particularities that might lead to high risk scenarios. The accident sequences that remain dominant, therefore, all have a wide range of possible progression paths. Another possibility is that the sequences are all fundamentally of the same type with small differences so that the accidents all progress in the same general direction. In the fire and seismic analyses where the same level of analysis has not previously been done, we see some PDSs which have significantly different contributions to core damage frequency and to risk.

For the internal event analysis, we can determine the plant damage state characteristics that determine the frequency of core damage. The risk for the internal events is driven by PDS 5 and 8. PDS 5 is long term station blackout and PDS 8 is an ATWS with the possibility of going to low pressure injection. We will discuss each of these in turn.

The dominance of these two plant damage states is determined by both general BWR characteristics and plant specific design. BWRs in general have more redundant systems that can inject into the primary coolant system than PWRs and can very easily go to low pressure and use their low pressure injection systems. This means that the dominant plant damage states will be driven by events that fail a multitude of systems (i.e. reduce the redundancy through some common mode or support system failure) or events that only require a small number of systems to fail in order to get to core damage. The station blackout PDS satisfies the first of these requirements in that all systems ultimately depend upon AC power and a LOSP is a relatively high probability event. Diesel generator reliability is lower than most other types of components and recovery of LOSP is also relatively low. The total probability of losing AC power long enough to induce core damage is; therefore, relatively high, although still low for a plant with Peach Bottoms design. The ATWS scenario is driven by the small number of systems that are needed to fail and the high stress upon the operators in these sequences.

PDS 5 is a long term station blackout. It is composed of three sequences, one of which has a stuck open SRV. High pressure injection is initially working. AC power is not recovered and either: 1) the battery depletes, resulting in injection failure, reclosure of the ADS valves, and repressurization of the RPV (in those cases where an SRV is not stuck open), followed by boiloff of the primary coolant and core damage or 2) HPCI fails on high suppression pool temperature followed by boiloff and core damage at low RPV pressure (since DC has not failed, ADS is still possible). The containment is at high pressure but less than or equal to the saturation pressure corresponding to the temperature at which HPCI will fail (i.e. < about 40 psig) at the start of core damage. The variables most important to the absolute value of the PDS frequency are the T1 initiator frequency, the failure to recover LOSP, the probability of battery depletion before AC recovery, the DG failure to run or DG cooling failure, and failure of high pressure injection due to high suppression pool temperature.

PDS 8 is an ATWS sequence with loss of an AC bus or PCS failure followed by failure to scram. High pressure injection fails on high suppression pool temperature and the reactor either: 1) is not manually depressurized, followed by boiloff and core damage with the RPV at high pressure or 2) the operator depressurizes and uses low pressure injection systems until either the injection valves fail due to excessive cycling or the containment fails or is vented and the injection systems fail due to harsh environment in the reactor building or loss of NPSH (condensate can not supply enough water since the CST can only supply about 800 gpm to the condenser, condensate can only last a few minutes). Venting will not take place before core damage if the operator does not depressurize; but, it may, if he goes to low pressure systems. RHR and CSS are working until containment venting or failure occurs and containment pressure will begin to drop in case 1 or will level off at the venting or SRV reclosure pressure in case 2. The variables most important to the absolute value of the PDS frequency are the T3A initiator frequency, the failure to scram, and the operator failure to restore SLC after testing or failure to initiate SLC.

These two PDSs contribute 76% of the core damage frequency and about 85% of the risk. They are the dominant contributors to the LOSP and ATWS collapsed plant damage states. All other PDSs contribute <7% each to risk.

Accident Progression Event Tree Analysis

For PDS 5, the dominant parameter is the recovery of offsite power. If AC power is restored during core damage then the RPV can be depressurized and low pressure injection restored in time to have some chance of core damage arrest. Also the containment spray system can be used to decrease containment pressure, cool the debris bed, reduce the probability of drywell meltthrough and containment failure, and scrub fission products from the containment atmosphere (remember, that upon containment failure CSS will likely fail due to loss of NPSH or harsh environment). Also the RPV depressurization will reduce the possibility of DCH for those cases were an SRV is not stuck open. If AC power is not restored, then DC failure due to battery depletion before HPCI fails on high temperature is important since the RPV will repressurize on SRV closure and DCH will be possible if an SRV is not stuck open. Venting through the 6" line is important because it will bypass the reactor building but not the suppression pool. Ex-vessel steam explosions are fairly likely to fail the pedestal if water is present in the drywell. The dominant containment failure mode is drywell meltthrough.

For PDS 8, the dominant parameter is the harsh environment failure of low pressure injection upon venting through the 18" line in the wetwell or loss of NPSH due to the saturated pool. This in and of itself turns many of these sequences into core damage scenarios. The operator failure to depressurize is also fairly important as it produces the same result. For the high pressure case, the CSS operation will again help in preventing containment failure and scrubbing fission products. DCH will result in a significant chance of pedestal failure at vessel breach. For the low pressure case, recovery of low pressure injection after core damage begins, due to the reduction in containment pressure when the power level drops into the range in which RHR can handle it, results in a significant chance of core damage arrest. Drywell meltthrough is still the dominant mode of containment failure.

Source Term Analysis

The source term depends upon the interaction of many parameters but the most important appear to be: 1) the likelihood of CCI, 2) the location and size of containment failure, and 3) the time of containment failure. The likelihood of CCI is driven by the likelihood of having some injection sources dumping water onto the melt after vessel breach and the probability of the debris bed being in a coolable configuration. Before core damage there is not much likelihood of containment failure and the early release is dominated by the operator venting the containment in the wetwell; therefore, the source term for the early release will be small. During core damage, hydrogen burns are unlikely due to the containment being inerted and the dominant failure mode is by leakage or overpressurization either in the wetwell or drywell head, this will also lead to small source terms due to the extended time of release and the small size of the failure. At vessel breach the dominant modes will be drywell meltthrough or drywell rupture due to pedestal failure or fast overpressurization, this will result in a large puff release but the consequence will likely be small (see next paragraph). Late containment failure will most likely be a leak on overpressurization, this would also result in a small extended release.

Consequence Analysis

The consequence parameters that appear to have the most impact are: 1) the delay time between the time warning is given and evacuation begins and 2) the evacuation speed. At Peach Bottom, the delay time is short and the time between warning and release is usually fairly long for most sequences, so that people will have plenty of time to evacuate. If the release time is close to the warning time, the evacuation speed is high enough that most people still can get out before the release catches them. The early consequences will be very low as a result.

5.2.2 Contributors to Risk for Fire Initiators

Table 5.2-4 and Figure 5.2-4 give the FCMR and MFCR for the four fire PDSs. One can see that the contribution to risk is roughly proportional to the core damage frequency for two of the PDSs (PDS 2 and PDS 3) but not for the other two (PDS 1 and PDS 4); indicating, that Level I characteristics are important contributors to the absolute value of risk, but not as directly as in the internal events analysis.

The contributions of the summary accident progression bins (APBs) to mean risk can also be computed in two ways. Table 5.2-5 and Figure 5.2-5 display the results of these calculations.

Even though the measures for determining the contributors to mean risk are only approximate, the relative contributions of the types of accidents that are the largest contributors to offsite risk for fire initiators at Peach Bottom can be determined for each risk measure. Unlike the internal events analysis, one or two PDSs do not dominate the risk and, therefore, contribute to all risk measures. For example, using the contribution calculated based upon the MFCR method, for early fatalities, PDS 2 is about 33%, PDS 1 and 4 are about 26% each, and PDS 3 is about 16%. For latent cancers, PDS 2 is about 46%, PDS 3 is about 23%, PDS 1 is about 16%, and PDS 4 is about 13%. One can see that PDS 1 does not contribute as much as one might expect based upon the fact that it has the highest contribution to core damage frequency; while PDS 4 contributes much more to risk than its core damage frequency would suggest it might.

Table 5.2-4
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Fire Initiators

PDS	Method	Core Damage	Early Fatalities	Latent Cancer Fatalities	Population Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
1 Fast Trans	FCMR	30.0	8.4	7.4	8.8	7.7	10.8	10.6
	MFCR	37.9	25.2	16 8	18.5	17.1	25.2	21.4
2 Slow SBO	FCMR	30.4	37.1	40.2	39.3	40.0	36.8	38.8
	MFCR	36.1	32.4	46.3	46.0	46.2	33.8	46.5
3 Slow SBO	FCMR	34.8	39.9	42.2	42.2	42.2	38.9	44.0
	MFCR	20.2	15.2	23.0	23.0	23.0	16.0	23.7
4 Transient CV	FCMR	4.8	14.7	10.2	9.8	10 1	13.5	6.6
	MFCR	5.8	27.2	13.9	12.5	13.8	24.9	8.4

Table 5.2-5
Fractional APB Contributions (in percent) to Annual Risk at Peach Bottom Due to Fire Initiators

Summary Accident Progression	Method	Early Fatalities	Latent Cancer Fatalities	Population Dose Dose 50 miles	Population Dose Region	Ind. E. F. Risk-1 mile	Ind. L.C.F. Risk-10 mile
VB, Early CF, WW Failure, RPV>200 psia at VB	FCMR	0.44	2.0	2.5	2.0	0.93	5.0
	MFCR	1.2	3.1	3.6	3.2	1.5	5.3
VB, Early CF, WW Failure, RPV<200 psia at VB	FCMR	0.00	0.01	0.02	0.01	0.00	0.06
	MFCR	0.02	0.27	0.29	0.27	0.03	0.36
VB, Early CF, DW Failure, RPV>200 psia at VB	FCMR	92.0	87.9	86.1	87.7	89.4	77.3
	MFCR	81.2	77.7	74.9	77.4	79.9	68.3
VB, Early CF, DW Failure, RPV<200 psia at VB	FCMR	5.2	3.7	4.5	3.9	6.4	5.2
	MFCR	10.8	5.8	6.6	6.0	10.9	7.5
VB, Late CF, WW Failure	FCMR	0.01	0.5	0.74	0.49	0.01	2.5
	MFCR	0.01	0.46	0.57	0.46	0.01	1.1
VB, Late CF, DW Failure	FCMR	1.8	4.7	4.9	4.7	2.5	8.1
	MFCR	4.3	9.5	10.6	9.6	5.0	13.2
VB, Vent	FCMR	0.5	1.2	1.3	1.2	0.79	1.8
	MFCR	2.5	3.1	3.3	3.2	2.7	4.0
VB, No CF	FCMR	0.0	0.0	0.01	0.0	0.0	0.06
	MFCR	0.0	0.03	0.08	0.05	0.0	0.23
No VB	FCMR	0.0	0.0	0.0	0.0	0.0	0.01
	MFCR	0.0	0.0	0.01	0.0	0.0	0.02
No CD	FCMR	0.0	0.0	0.0	0.0	0.0	0.0
	MFCR	0.0	0.0	0.0	0.0	0.0	0.0

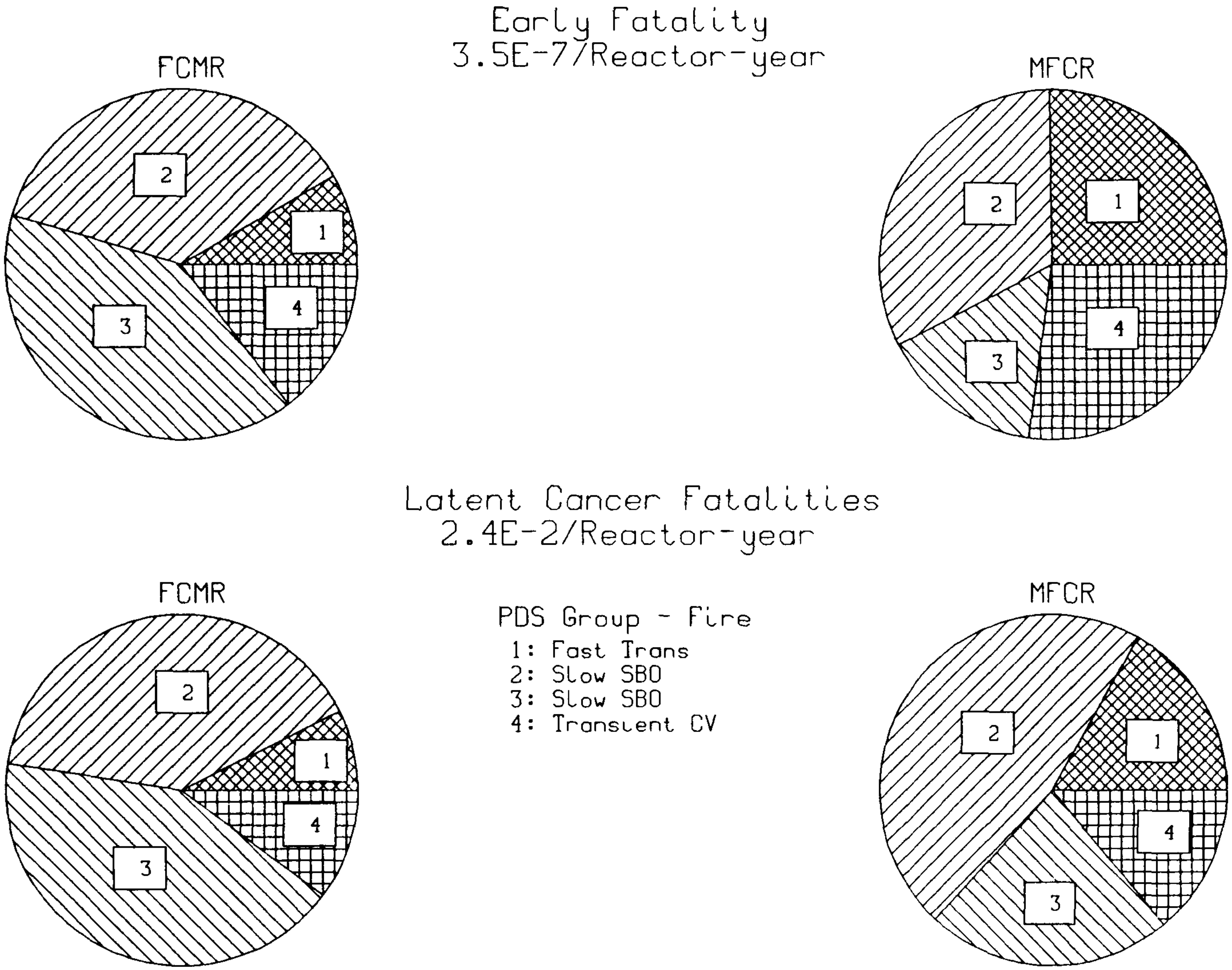


Figure 5.2-4
Peach Bottom PDSs for Fire Initiators: Percent Contribution to Risk

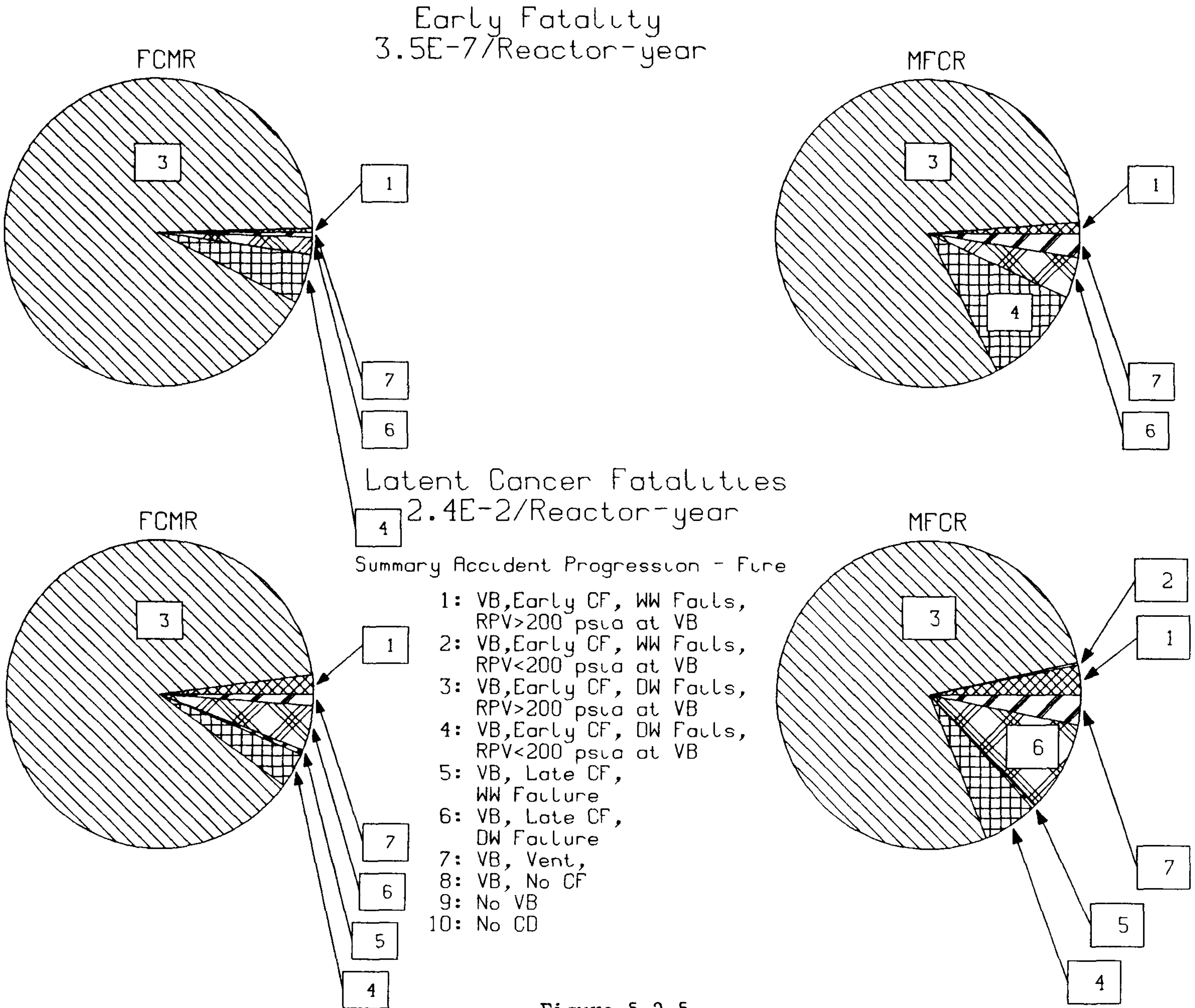


Figure 5.2-5

Peach Bottom Summary Accident Progression Bins for Fire Initiators: Percent Contribution to Risk

The bin that involves accidents in which the vessel does not fail makes a minor contribution to risk. It must be remembered that although the vessel does not fail in these accidents, the containment can fail early by venting or late by venting or overpressure from decay heat. Failure of the containment will allow a portion of the in-vessel releases to escape into the environment. The combination of the threshold effect associated with early fatalities and the fact that the releases associated with this bin are fairly small results in few early fatalities. For latent cancers, on the other hand, there is no threshold effect; but, since the release is small, the effect is more pronounced only in the 0-10 mile range.

The plant characteristics that determine the absolute value of the various risk measures come from each of the four areas of the analysis: 1) systems analysis, 2) containment response, 3) source term analysis, and 4) consequence analysis.

Systems (Level I) Analysis

In the fire analyses where the same level of analysis as in internal events has not previously been done, we see some PDSs which have significantly different contributions to core damage frequency and to risk. The PDSs are discussed in order of their importance to early fatalities.

PDS 2, this PDS is composed of eight fire scenarios in different emergency switchgear rooms (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D). All lead to a fire induced LOSP followed by a random loss of emergency service water due to valve failure resulting in early loss of all AC and station blackout. HPCI will work until it fails on battery depletion or high suppression pool temperatures. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the percentage of fires that exit the top of a cabinet, the ratio of 4160 cabinet area to total cabinet area, the percentage of fire suppressed manually, and the failure of emergency service water. This PDS contributes about 33% of the early risk and 46% of the latent.

PDS 4, this PDS is composed of two fire scenarios in emergency switchgear room 2C. The fires result in LOSP with failure of PCS, venting, and failure of most RHR trains. Random failures complete the failure of containment heat removal. The HPCI and LPCI systems succeed but core damage results when HPCI fails on high suppression pool temperature and LPCI fails when the SRVs reclose on high containment pressure. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the percentage of fires that exit the top of a cabinet, the ratio of 4160 cabinet area to total cabinet area, the percentage of fires suppressed manually, and the random failure of the alternate cooling system. This PDS contributes about 27% of the early risk and 13% of the latent.

PDS 1, this PDS is composed of three fire scenarios, two in the control room and one in the cable spreading room. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the failure to properly use the remote shutdown panel, and the probability smoke will force evacuation of the control room. This PDS contributes about 25% of the early risk and about 17% of the latent.

PDS 3, this PDS is composed of eight fire scenarios in different switchgear rooms (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D). All lead to fire induced LOSP followed by a random loss of emergency service water from DG failure to run resulting in a delayed station blackout. HPCI will work until failure on high suppression pool temperature. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the percentage of fires that exit the top of a cabinet, the ratio of 4160 cabinet area to total cabinet area, the percentage of fire suppressed manually, and the failure of the emergency diesel generators. This PDS contributes about 16% of the early risk and 23% of the latent.

Accident Progression Event Tree Analysis

PDS 2 is a station blackout and offsite power can not be recovered. In 64% of the cases, battery depletion occurs before core damage and core damage proceeds at high RPV pressure; otherwise, HPCI will fail on high suppression pool temperature and battery depletion will occur during core damage and the vessel will repressurize. Both DCH and ex-vessel steam explosions are possible. There is no injection and containment failure is most likely to occur at vessel breach. This PDS does not have a lot of variability due to the lack of recovery potential.

PDS 4 is a long-term loss of containment heat removal sequence in which core damage begins when the SRVs reclose on high containment pressure. Because of the high containment pressure at the time of vessel breach and the fact that LPCI fails due to the saturated suppression pool so there is no flooded CCIs and a high probability of drywell meltthrough, containment failure at vessel breach is almost certain. For this sequence, containment venting occurs during core damage and given the evacuation assumptions used in the consequence calculation, more people will be caught in the plume than in other cases were the containment failure occurs later. This sequence risk contribution is, therefore, higher than its frequency contribution.

PDS 1 has a high probability of recovery of injection during core damage (80%) and a significant probability of core damage arrest (22%). In these cases the release is very small. Containment spray will be available in many of the remaining scenarios which have injection recovery even if vessel breach is not prevented and containment failure may be prevented entirely or delayed until late in the accident. This means that PDS 1 should contribute less to the risk than its core damage frequency fraction would indicate.

PDS 3 is a long-term station blackout similar to PDS 2 but its frequency is lower.

Source Term Analysis

The source term depends upon the interaction of many parameters but the most important appear to be: 1) the likelihood of CCI, 2) the location and size of containment failure, and 3) the time of containment failure. The likelihood of CCI is driven by the likelihood of having some injection sources dumping water onto the melt after vessel breach and the probability of the debris bed being in a coolable configuration. Except for PDS 1, there is no injection or sprays at the time of vessel breach and drywell meltthrough and CCI proceed, at most, in a wet drywell (i.e., not flooded). This is more severe than in the internal event analysis where the accidents have more varied recovery potential and recovery can occur at different points in the accident progression. Before core damage, there is not much likelihood of containment failure and the early release is dominated by the operator venting the containment in the wetwell; therefore, the source term for the early release will be small. During core damage, hydrogen burns are unlikely due to the containment being inerted and the dominant failure mode is by leakage or overpressurization either in the wetwell or the drywell head or by venting, this will also lead to small source terms due to the extended time of release and the small size of the failure. At vessel breach the dominant modes will be drywell meltthrough or drywell rupture due to pedestal failure or fast overpressurization, this will result in a large puff release but the consequence will likely be small (see next paragraph). Late containment failure will most likely be a leak on overpressurization, this would also result in a small extended release.

Consequence Analysis

The consequence parameters that appear to have the most impact are: 1) the delay time between the time warning is given and evacuation begins and 2) the evacuation speed. At Peach Bottom, the delay time is short and the time between warning and release is usually fairly long for most sequences so that people will have plenty of time to evacuate. If the release time is close to the warning time, the evacuation speed is high enough that most people still can get out before the release catches them. The early consequences will be low as a result.

5.2.3 Contributors to Risk for Seismic Initiators

Tables 5.2-6 and 5.2-7 and Figures 5.2-6 and 5.2-7 give the FCMR and MFCR for the seven seismic PDSs for the LLNL and EPRI hazard curves, respectively. The results are broken down in the tables to show the low and high PGA contributions separately. One can see that the contribution to the latent cancer risk is roughly proportional to the core damage frequency for most of the PDSs. For early fatalities, the low PGA PDSs generally do not contribute significantly except for PDS 4. This indicates, that Level I characteristics are important contributors to the absolute value of risk, not as directly as in the internal events analysis, but more than in the fire analysis.

Table 5.2-6
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Seismic Initiators LLNL Hazard Distributions

PDS	PGA	Method	Core Damage	Early Fatalities	Latent Cancers
1	Low	FCMR	2.1	0.03	3.5
		MFCR	1.8	0.04	2.4
	High	FCMR	9.6	29.4	12.3
		MFCR	8.1	14.5	8.5
2	Low	FCMR	3.8	0.04	5.0
		MFCR	3.8	0.06	5.1
	High	FCMR	18.7	38.4	18.6
		MFCR	18.6	34.4	19.2
3	Low	FCMR	0.3	0.00	0.4
		MFCR	0.5	0.01	0.7
	High	FCMR	3.7	6.2	3.3
		MFCR	5.9	9.6	6.1
4	Low	FCMR	27.1	0.20	30.5
		MFCR	22.9	0.08	23.6
	High	FCMR	22.1	20.2	18.9
		MFCR	18.7	11.6	15.1
5	Low	FCMR	1.9	0.00	1.4
		MFCR	2.4	0.01	2.4
	High	FCMR	2.3	1.1	1.3
		MFCR	2.9	3.6	2.3
6	Low	FCMR	1.0	0.00	0.8
		MFCR	1.8	0.01	2.3
	High	FCMR	5.2	3.7	3.1
		MFCR	9.7	22.1	9.7
7	Low	FCMR	0.3	0.00	0.2
		MFCR	0.3	0.00	0.4
	High	FCMR	1.9	0.8	0.9
		MFCR	2.5	4.1	2.1

Table 5.2-7
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Seismic Initiators
EPRI Hazard Distributions

PDS	PGA	Method	Core Damage	Early Fatalities	Latent Cancers
1	Low	FCMR	2.5	0.07	4.1
		MFCR	2.2	0.07	3.0
	High	FCMR	7.9	27.4	10.0
		MFCR	7.0	14.6	7.3
2	Low	FCMR	4.2	0.1	5.6
		MFCR	4.1	0.1	5.5
	High	FCMR	16.0	38.1	16.0
		MFCR	15.5	33.4	15.9
3	Low	FCMR	0.5	0.01	0.5
		MFCR	0.6	0.02	0.8
	High	FCMR	3.7	7.4	3.3
		MFCR	4.6	8.7	4.8
4	Low	FCMR	31.1	0.2	33.9
		MFCR	29.1	0.1	30.0
	High	FCMR	19.9	18.7	16.6
		MFCR	18.6	13.9	14.7
5	Low	FCMR	3.3	0.01	2.6
		MFCR	3.3	0.01	3.4
	High	FCMR	2.9	1.8	1.7
		MFCR	2.9	4.1	2.3
6	Low	FCMR	1.2	0.01	1.1
		MFCR	1.9	0.02	2.5
	High	FCMR	4.7	4.8	3.2
		MFCR	7.7	21.0	7.6
7	Low	FCMR	0.3	0.00	0.3
		MFCR	0.4	0.00	0.4
	High	FCMR	1.9	1.5	1.1
		MFCR	2.2	4.0	1.8

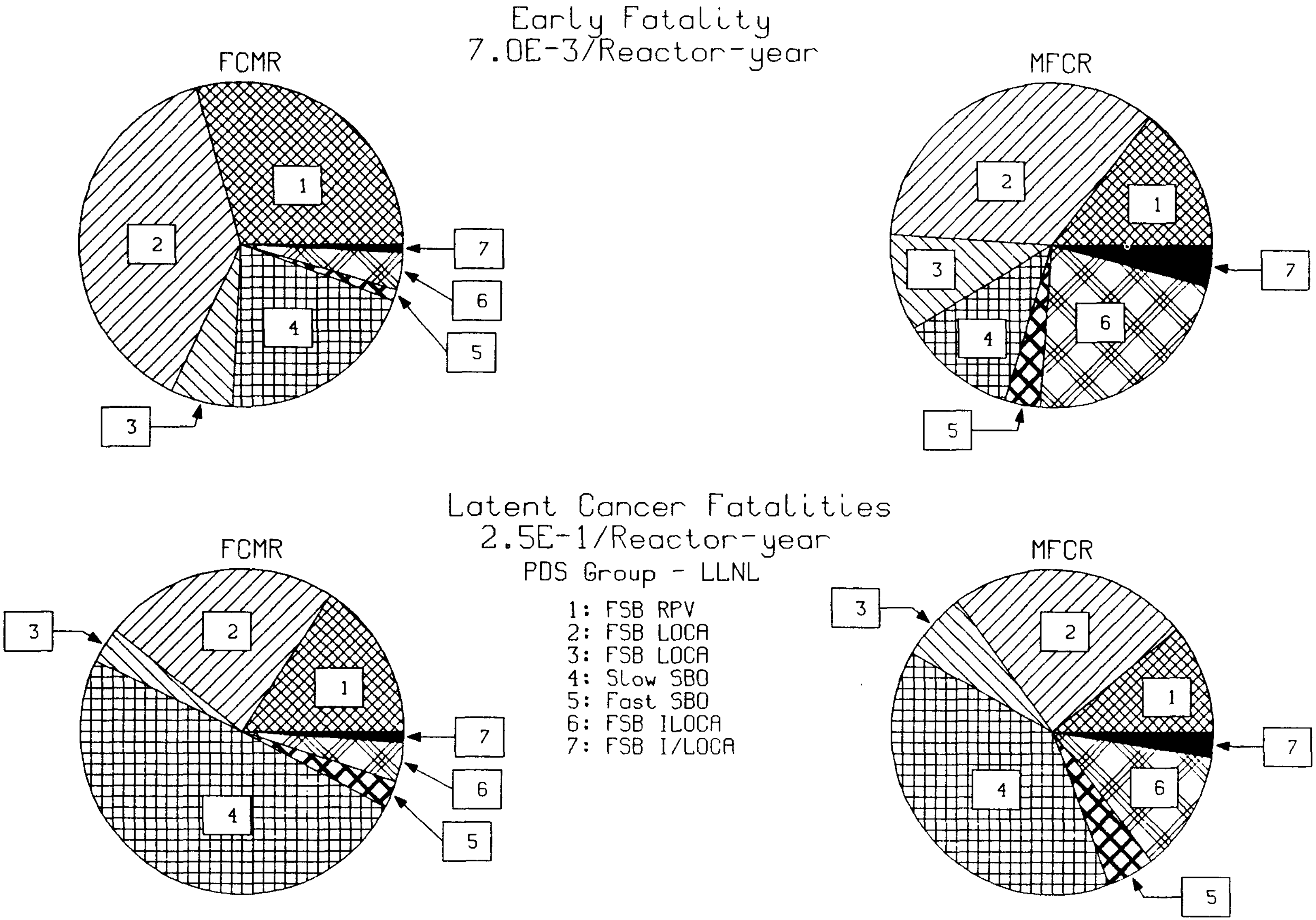


Figure 5.2-6
Peach Bottom PDSs for LLNL Seismic Initiators: Percent Contribution to Risk

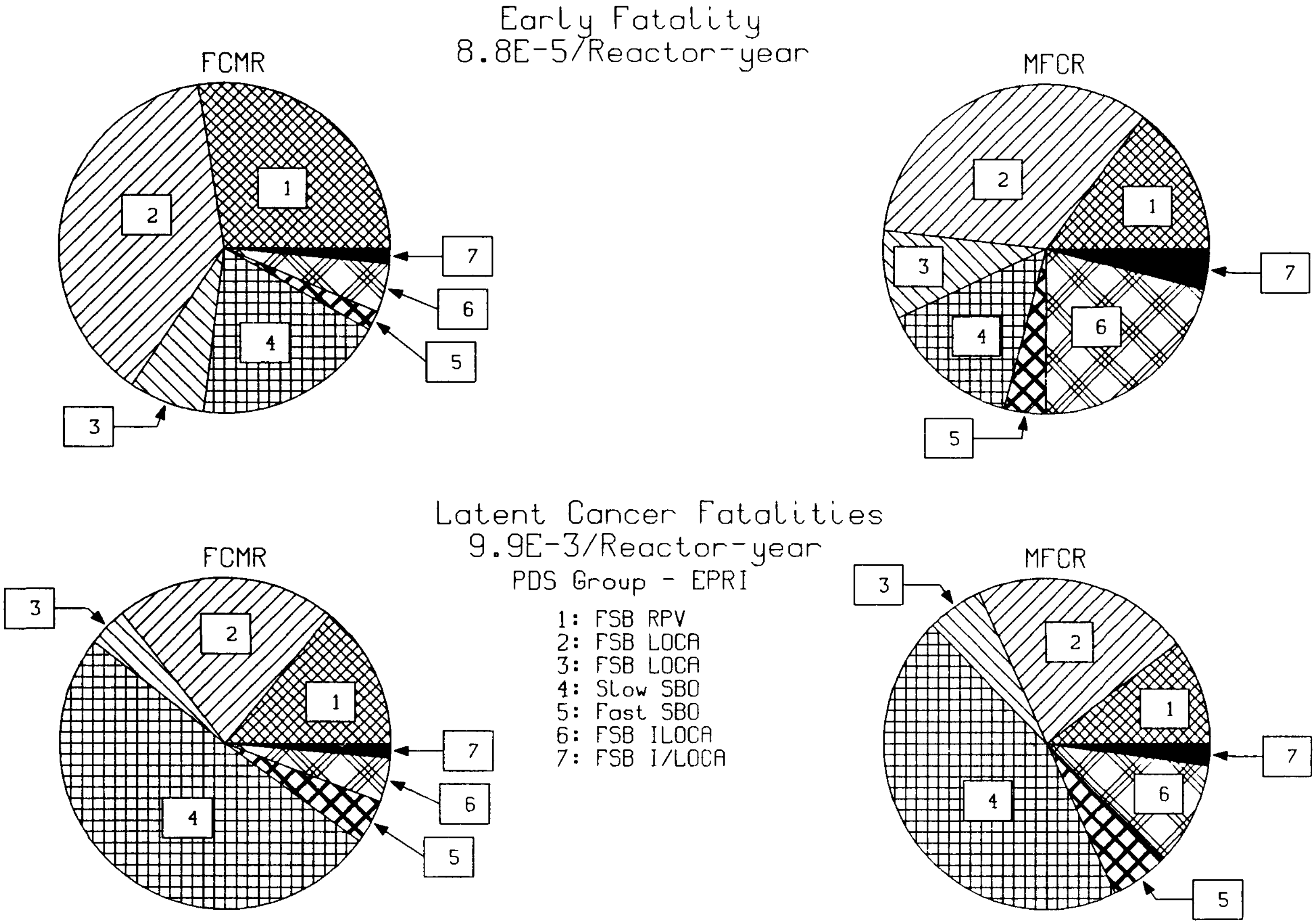


Figure 5.2-7
Peach Bottom PDSs for EPRI Seismic Initiators: Percent Contribution to Risk

The contributions of the summary accident progression bins (APBs) to mean risk can also be computed in two ways. Table 5.2-8 and Figures 5.2-8 and 5.2-9 display the results of these calculations for both the LLNL and EPRI hazard curves.

Table 5.2-9a shows the comparison of the LLNL and EPRI results to mean risk, also using both methods, combining the low and high PGA components for each PDS. Even given the differences in the hazard curves, each PDS's percentage contribution to the total seismic risk is roughly the same for both cases. This is because even though the hazard curve is lower for the EPRI analysis and the higher PGA levels are a smaller fraction of the total, the PDSs are still contributing in the same proportion and the high PGA PDSs still dominant the risk. Table 5.2-9b shows the overall comparison of the low and high PGA components to the various risk measures. One can see clearly the difference between the LLNL and EPRI hazard curves in the low versus high PGA split on the core damage frequency. Table 5.2-10 shows in different form some comparisons of the low and high PGA components for core damage, early fatalities, and latent cancers.

Even though the measures for determining the contributors to mean risk are only approximate, the relative contributions of the types of accidents that are the largest contributors to offsite risk for seismic initiators at Peach Bottom can be determined for each risk measure. Unlike the internal events analysis, one or two PDSs do not dominate the risk and, therefore, contribute to all risk measures. For example, using the contribution calculated based upon the MFCR method, for early fatalities, PDS 2 is about 34%, PDS 6 is about 22%, and PDSs 4 and 1 are each about 15%. For latent cancers, PDS 4 is about 40%, PDS 2 is about 22%, and PDSs 1 and 6 are about 11%. One can see that PDS 4 does not contribute as much as one might expect to the early fatality risk based upon the fact that it has the highest contribution to core damage frequency; while PDSs 2 and 6 contribute much more to risk than their core damage frequency would suggest they might.

The bin that involves accidents in which the vessel does not fail makes a minor contribution to risk. It must be remembered that although the vessel does not fail in these accidents, the containment can fail early by venting or late by venting or overpressure from decay heat. Failure of the containment will allow a portion of the in-vessel releases to escape into the environment. The combination of the threshold effect associated with early fatalities and the fact that the releases associated with this bin are fairly small results in few early fatalities. For latent cancers, on the other hand, there is no threshold effect; but, since the release is small, the effect is more pronounced only in the 0-10 mile range.

The plant characteristics that determine the absolute value of the various risk measures come from each of the four areas of the analysis: 1) systems analysis, 2) containment response, 3) source term analysis, and 4) consequence analysis.

Table 5.2-8
Fractional APB Contributions (in percent) to Annual Risk at Peach Bottom Due to Seismic Initiators

Summary Accident Progression Bin	Hazard Distrb.	Method	Early Fatal-ities	Latent Cancer Fatal-ities	Popu-lation Dose - 0-50 mi.	Popu-lation Dose - Region	Ind. E. F. Risk - 0-1 mi.	Ind. L.C.F. Risk - 0-10 mi.
VB, Early CF, WW Failure, RPV>200 psia at VB	LLNL	FCMR	1.5	5.0	7.2	5.9	4.9	3.7
	LLNL	MFCR	0.3	1.4	1.7	1.5	0.7	1.0
	EPRI	FCMR	1.2	3.9	5.6	4.6	3.5	2.9
	EPRI	MFCR	0.4	1.6	1.9	1.7	0.7	1.1
VB, Early CF, WW Failure, RPV<200 psia at VB	LLNL	FCMR	0.5	0.9	1.0	0.9	1.3	1.0
	LLNL	MFCR	0.6	1.1	1.4	1.2	0.9	1.1
	EPRI	FCMR	0.4	0.8	0.9	0.8	1.0	0.9
	EPRI	MFCR	0.6	1.0	1.1	1.0	0.9	1.0
VB, Early CF, DW Failure, RPV>200 psia at VB	LLNL	FCMR	19.5	43.1	40.8	41.9	18.7	30.9
	LLNL	MFCR	14.2	38.4	37.8	38.6	16.8	28.3
	EPRI	FCMR	19.0	47.0	44.8	46.3	18.9	30.5
	EPRI	MFCR	16.9	44.2	43.6	44.4	19.4	32.3
VB, Early CF, DW Failure, RPV<200 psia at VB	LLNL	FCMR	78.0	46.7	46.9	46.7	73.3	61.5
	LLNL	MFCR	83.1	54.5	54.2	54.1	79.4	65.8
	EPRI	FCMR	78.8	44.0	44.3	43.8	75.0	62.7
	EPRI	MFCR	80.2	48.0	47.6	47.6	76.7	61.2
VB, Late CF, WW Failure,	LLNL	FCMR	0.0	0.01	0.01	0.01	0.0	0.0
	LLNL	MFCR	0.0	0.08	0.1	0.08	0.0	0.07
	EPRI	FCMR	0.0	0.02	0.03	0.02	0.0	0.01
	EPRI	MFCR	0.0	0.1	0.2	0.1	0.0	0.09
VB, Late CF, DW Failure	LLNL	FCMR	0.4	4.1	3.8	4.3	1.4	2.6
	LLNL	MFCR	0.5	3.8	4.2	3.9	1.0	2.9
	EPRI	FCMR	0.4	4.0	3.9	4.2	1.2	2.6
	EPRI	MFCR	0.5	4.5	4.9	4.6	1.0	3.4
VB, Vent	LLNL	FCMR	0.2	0.3	0.3	0.3	0.4	0.3
	LLNL	MFCR	1.4	0.8	0.8	0.8	1.3	1.0
	EPRI	FCMR	0.2	0.3	0.4	0.3	0.4	0.4
	EPRI	MFCR	1.5	0.7	0.7	0.7	1.3	0.9
VB, No CF	Approximately Zero							
No VB	Approximately Zero							
No Core Damage	Approximately Zero							

Table 5.2-9a
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Seismic Initiators

Summary PDS	Hazard Distrb.	Method	Core Damage	Early Fatal-ities	Latent Cancer Fatal-ities	Popu-lation Dose - 0-50 mi.	Popu-lation Dose - Region	Ind. E. F. Risk - 0-1 mi.	Ind. L.C.F. Risk - 0-10 mi.
1	LLNL	FCMR	11.7	29.4	15.8	16.2	15.7	24.2	22.0
		MFCR	9.90	14.5	10.9	10.8	10.9	15.2	12.6
	EPRI	FCMR	10.4	27.5	14.1	14.3	13.9	22.8	20.6
		MFCR	9.20	14.7	10.3	10.1	10.2	15.4	12.3
2	LLNL	FCMR	22.5	38.5	23.5	23.7	23.5	36.4	30.6
		MFCR	22.4	34.5	24.3	24.4	24.1	33.8	28.8
	EPRI	FCMR	20.2	38.2	21.6	21.9	21.5	36.9	30.9
		MFCR	19.6	33.5	21.4	21.4	21.2	32.8	26.8
3	LLNL	FCMR	4.0	6.2	3.6	3.7	3.7	6.6	5.2
		MFCR	6.4	9.6	6.8	6.8	6.7	9.5	8.5
	EPRI	FCMR	4.2	7.4	3.9	4.0	3.9	7.6	6.2
		MFCR	5.2	8.7	5.6	5.6	5.5	8.6	7.5
4	LLNL	FCMR	49.2	20.3	49.4	49.1	49.2	22.9	35.4
		MFCR	41.6	11.7	38.8	38.8	39.1	14.6	28.4
	EPRI	FCMR	51.0	18.9	50.5	50.1	50.6	20.2	33.2
		MFCR	47.7	14.0	44.7	44.8	45.1	16.9	32.6
5	LLNL	FCMR	4.2	1.1	2.7	2.5	2.8	2.2	1.6
		MFCR	5.0	3.6	4.8	4.7	4.8	3.9	3.5
	EPRI	FCMR	6.2	1.9	4.3	4.1	4.4	3.4	2.5
		MFCR	6.2	4.1	5.7	5.7	5.7	4.4	4.1
6	LLNL	FCMR	6.2	3.7	3.9	3.8	4.0	6.3	4.2
		MFCR	11.5	22.1	12.0	11.9	11.9	19.3	15.0
	EPRI	FCMR	5.9	4.8	4.3	4.2	4.3	7.0	5.0
		MFCR	9.6	21.0	10.1	10.0	10.0	18.4	13.6
7	LLNL	FCMR	2.1	0.8	1.1	1.1	1.1	1.5	1.1
		MFCR	2.8	4.1	2.5	2.6	2.5	3.6	3.2
	EPRI	FCMR	2.2	1.5	1.4	1.4	1.4	2.0	1.6
		MFCR	2.6	4.0	2.2	2.3	2.2	3.6	3.2

Table 5.2-9b
Fractional PDS Contributions (in percent) to Annual
Risk at Peach Bottom Due to Seismic Initiators

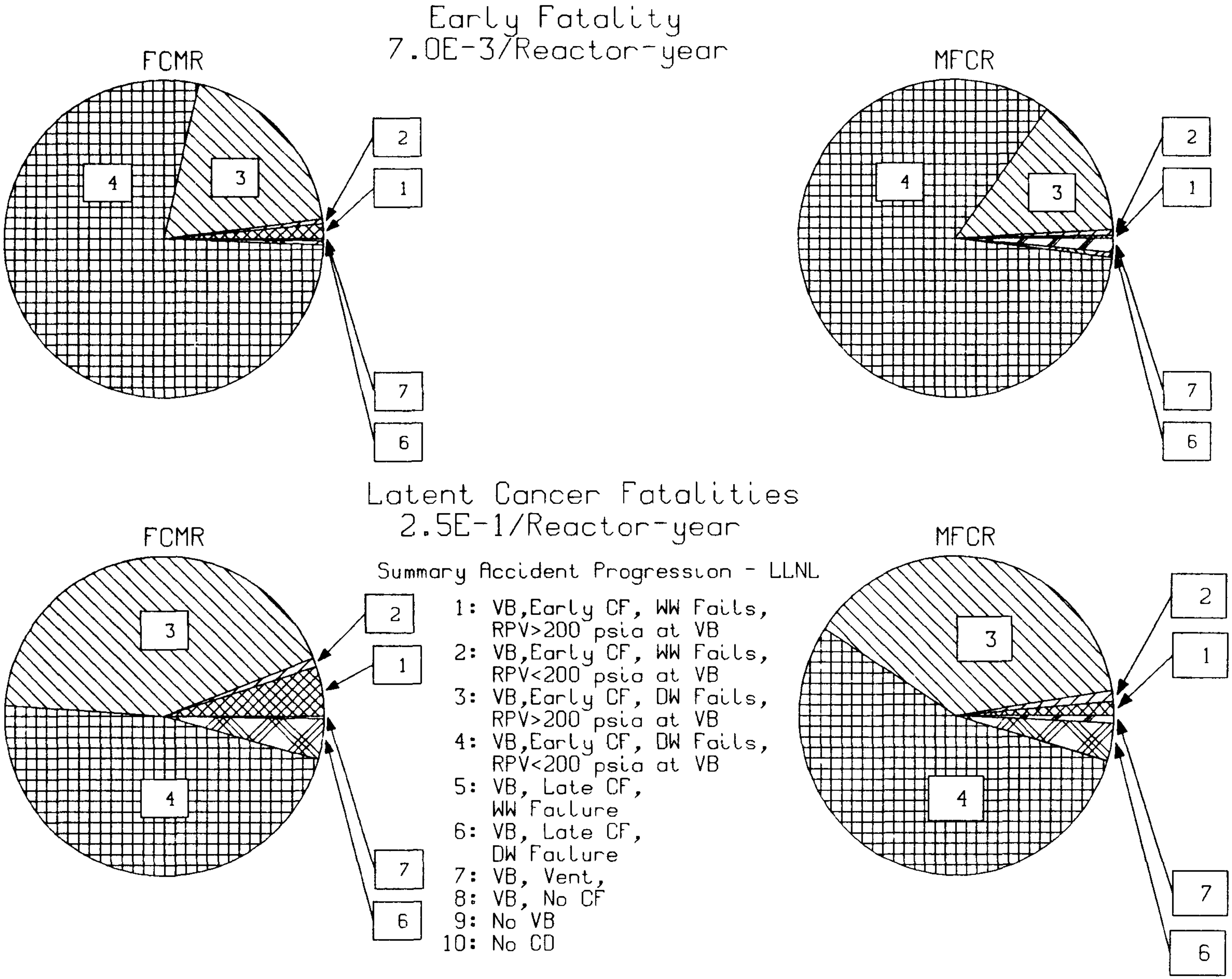
Summary PDS Group	Hazard Distrb.	Method	Core Damage	Early Fatal-ities	Latent Cancer Fatal-ities	Popu-lation Dose - 0-50 mi.	Popu-lation Dose - Region	Ind. E. F. Risk - 0-1 mi.	Ind. L.C.F. Risk - 0-10 mi.
Low PGA	LLNL	FCMR	36.5	0.3	41.6	39.2	41.0	0.3	1.9
		MFCR	33.6	0.2	37.0	35.7	37.2	0.3	4.7
	EPRI	FCMR	43.0	0.4	48.0	45.7	47.7	0.6	3.2
		MFCR	41.6	0.4	45.5	44.1	45.7	0.5	6.7
Hi PGA	LLNL	FCMR	63.5	99.7	58.4	60.8	59.0	99.7	98.1
		MFCR	66.4	99.8	63.0	64.3	62.8	99.7	95.3
	EPRI	FCMR	57.0	99.6	52.0	54.3	52.3	99.4	96.7
		MFCR	58.4	99.6	54.5	55.9	54.3	99.5	93.3

Table 5.2-10
Fractional Contributions (in percent) from Hi and Low PGA PDSs to Annual Risk at Peach Bottom Due to Seismic Initiators

	Core Damage			
	FCMR		MFCR	
	LLNL	EPRI	LLNL	EPRI
Low PGA	36.5	43.0	33.6	41.6
High PGA	63.5	57.0	66.4	58.4

	Early Fatalities			
	FCMR		MFCR	
	LLNL	EPRI	LLNL	EPRI
Low PGA	0.30	0.38	0.20	0.35
High PGA	99.7	99.6	99.8	99.7

	Latent Cancer Fatalities			
	FCMR		MFCR	
	LLNL	EPRI	LLNL	EPRI
Low PGA	41.6	48.0	37.0	45.5
High PGA	58.4	52.0	63.0	54.5



Early Fatality
7.0E-3/Reactor-year

Latent Cancer Fatalities
2.5E-1/Reactor-year

Figure 5.2-8
Peach Bottom Summary Accident Progression Bins for LLNL Seismic Initiators: Percent Contribution to Risk

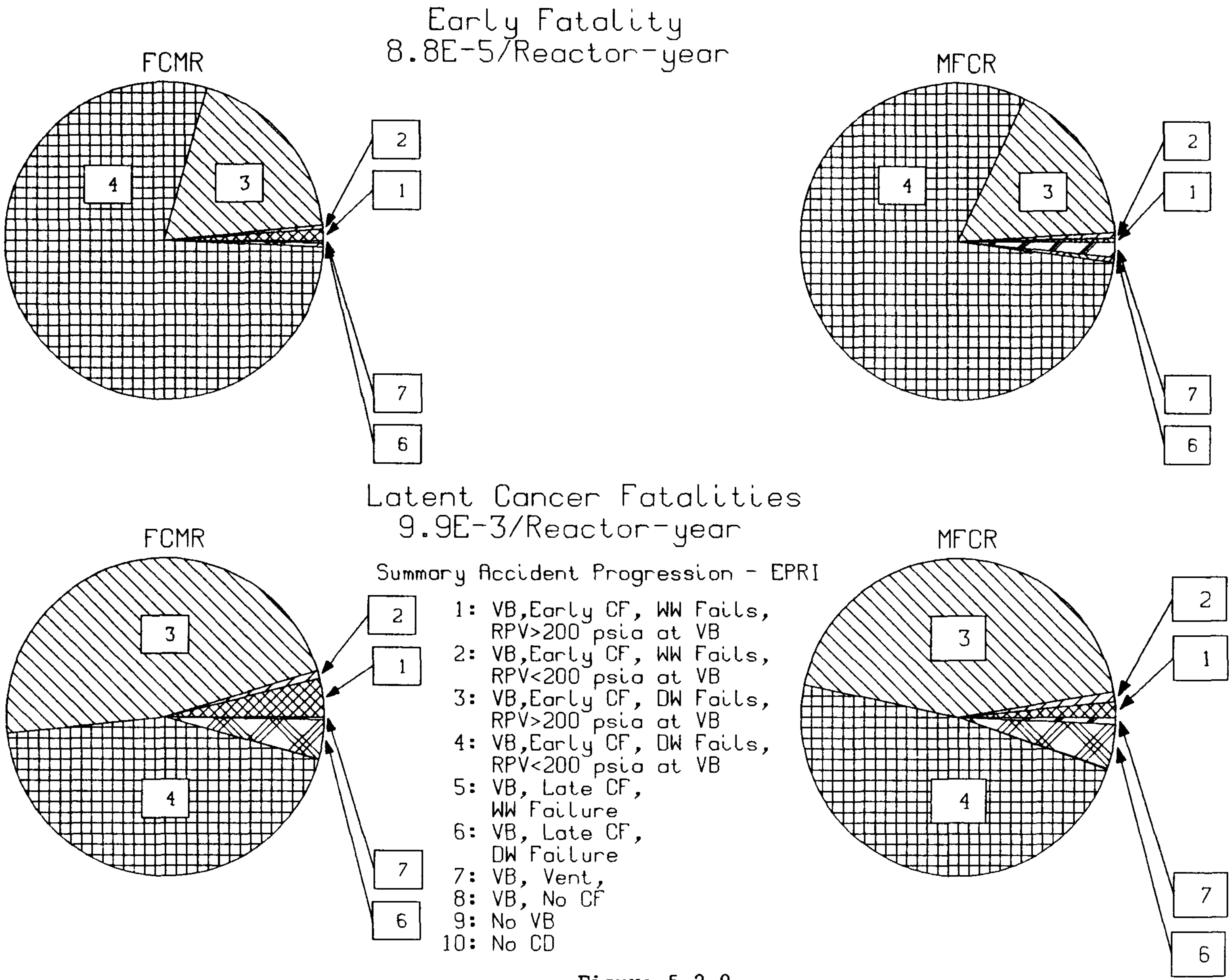


Figure 5.2-9
Peach Bottom Summary Accident Progression Bins for EPRI Seismic Initiators: Percent Contribution to Risk

Systems (Level I) Analysis

In the seismic analysis, the most important risk contributors are the PDSs with the highest frequencies. For early fatalities, PDSs 2, 6, and 1 are the most important. For latent cancers, PDSs 4, 2, and 6 are most important. As shown in Table 5.2-6 and 5.2-7, the low PGA PDSs do not contribute significantly to either early fatalities or latent cancers, except for PDS 4, for which the low PGA case dominates the latent cancer risk. The percentage risk contributions are roughly the same for either the LLNL or the EPRI hazard curve and we will discuss the PDSs only once.

PDS 2, this PDS is composed of one sequence with a seismic induced LOSP followed by loss of all AC leading to station blackout. A large LOCA is induced by the seismic event and early core damage results. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the probability of ceramic insulator failure leading to LOSP, the failure of the DG cooling water system leading to SB, and the induced failure of primary piping resulting in a large break. This PDS constitutes about 34% of the early fatality risk and 22% of the latent cancer risk.

PDS 6, this PDS is composed of one sequence with a seismic induced LOSP, failure of onsite AC due to cooling water failure, and a seismically induced intermediate LOCA. HPCI works until the primary system depressurizes. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the probability of ceramic insulator failure leading to LOSP, the failure of the DG cooling water system leading to SB, and the probability of an induced LOCA. This PDS constitutes about 22% of the early fatality risk and 11% of the latent cancer risk.

PDS 1, this PDS is composed of one sequence with a seismic induced LOSP followed by vessel rupture. Onsite AC is available. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the probability of ceramic insulator failure leading to LOSP, and the probability of reactor vessel rupture. This PDS constitutes about 15% of the early fatality risk and 10% of the latent cancer risk.

PDS 4, this PDS is composed of one sequence with a seismic induced LOSP followed by loss of all AC leading to a station blackout. HPCI succeeds until battery depletion or high suppression pool temperature results in HPCI failure and late core damage. The variables most important to the absolute value of the PDS frequency are the initiating frequency, the probability of ceramic insulator failure leading to LOSP, and the failure of the DG cooling water system leading to SB. This PDS constitutes about 12% of the early fatality risk and 40% of the latent cancer risk.

These four PDSs contribute about 85% of the risk. The other three PDSs contribute <10% each to the risk.

Accident Progression Event Tree Analysis

The APET results do not depend upon the level of the earthquake so each PDS's characteristics are discussed only once.

For PDS 2, the containment fails initially in the drywell as a result of the seismic event (leak or rupture). All injection is lost immediately and core damage proceeds with the RPV at low pressure as a result of the seismically induced LOCA. The drywell is wet (i.e., water up to the wetwell vents but no continuous water supply) and ex-vessel steam explosions are possible. No other recovery is possible.

For PDS 6, all injection is lost immediately and core damage proceeds with the RPV at low pressure as a result of the seismically induced LOCA. Ex-vessel steam explosions are possible in a wet drywell. The containment fails at vessel breach mostly by drywell meltthrough; otherwise, by overpressure. No other recovery is possible.

In PDS 1, the containment fails initially as a result of the seismic event. Since the RPV has ruptured and a station blackout has occurred no injection is available. Core damage proceeds with the RPV at low pressure. Ex-vessel steam explosions are possible in a wet drywell.

In PDS 4, injection continues for a while and late core damage results with the RPV at high pressure. DCH can occur and ex-vessel steam explosions are also possible due to the water on the drywell floor. Containment fails at vessel breach mostly by drywell meltthrough.

Source Term Analysis

The source term depends upon the interaction of many parameters but the most important appear to be: 1) the likelihood of CCI, 2) the location and size of containment failure, and 3) the time of containment failure. The likelihood of CCI is driven by the likelihood of having some injection sources dumping water onto the melt after vessel breach and the probability of the debris bed being in a coolable configuration. There is no injection or sprays at the time of vessel breach for any of the PDSs and drywell meltthrough and CCI proceed, at most, in a wet drywell (i.e., not flooded). This is even more severe than in the fire analysis where one of the dominant PDSs had some recovery potential. For the seismic accidents, the recovery potential is nil and no accidents lead to core damage arrest. Before core damage, PDSs 1, 2, and 3 have containment failure as a result of the seismic event in the drywell and all involve a LOCA with, therefore bypass of the suppression pool. As a result, the source term for the early release will be large for these PDSs. For the other PDSs, the early release from in-vessel will be small as the release will be directed through the SRV relief valves to the suppression pool. If the containment has not failed initially, then during core damage hydrogen burns are unlikely due to the containment being inerted and the dominant failure mode is by leakage or overpressurization either in the wetwell or drywell head, this will lead to small source terms due to the extended time of release and the small size of the failure. At vessel breach, the dominant modes will be drywell meltthrough or drywell rupture due to pedestal failure or fast overpressurization, this will result in a large puff release. Late containment failure will most likely be a leak on overpressurization, this would also result in a small extended release.

Consequence Analysis

The consequence parameters that appear to have the most impact are: 1) the delay time between the time warning is given and evacuation begins and 2) the evacuation speed. At Peach Bottom, the delay time is short and the time between warning and release is usually fairly long for most sequences so that people will have plenty of time to evacuate. However, in the seismic analysis only the low PGA sequences allow evacuation to proceed and, there, at a slower than usual speed (one-half the normal speed) and with an extended delay time (1.5 times the normal delay). Therefore more people will be caught by the plume than in either the fire or internal events analyses. This is not so important though because the high PGA cases are the dominant fraction of the core damage frequency in both the LLNL and EPRI analyses. The evacuation assumptions for the high PGA sequences are so severe that the high PGA cases dominant risk. In the high PGA sequences, the population within ten miles of the plant was assumed to remain outdoors because of building damage and then relocated after a 24 hour delay. This leads to much higher early fatality risk.

5.3 Contributors to Uncertainty in Risk

5.3.1 Contributors to Uncertainty in Risk for Internal Initiators

Figure 5.1-1 provides information on the frequency at which values for individual consequence measures will be exceeded. Specifically, mean, median, 5th percentile, and 95th percentile values are shown for these exceedance frequencies. Thus, Figure 5.1-1 can be viewed as presenting uncertainty analysis results for the risk at Peach Bottom due to internal initiators. The underlying exceedance frequency curves (CCDFs) for Figure 5.1-1 are contained in Appendix D.

As the curves in Figure 5.1-1 and in Appendix D show, there is significant uncertainty in the frequency at which a given consequence value will be exceeded. Due to the complexity of the underlying analysis and the concurrent variation of a large number of variables within this analysis, it is difficult to ascertain the cause of this uncertainty on the basis of a simple inspection of the results. However, numerical sensitivity analysis techniques provide a systematic way of investigating the observed variation in exceedance frequencies.

This section presents the results of using regression-based sensitivity analysis techniques to examine the variability in the consequences of internally initiated accidents at Peach Bottom. The dependent variable is the risk (units: consequences/year) for each consequence measure. For a given observation in the sample, this variable is obtained by multiplying each consequence value by its frequency and then summing these products. This variable can be viewed as the result of reducing each of the curves in Figure D.1 to a single number.

The uncertainty analysis techniques used in this study can be viewed as creating a mapping from analysis input to analysis results. The variables sampled in the generation of this mapping are presented in Tables 2.2-5, 2.3-3, and 3.2-2. These variables are the independent variables in the sensitivity studies presented in this section. Variables that are correlated to each other are treated as a single variable in sensitivity analysis. For example, in Table 2.3-3 the variables with LHS #133-158 representing the pressure rise at vessel breach (DPVB) are all correlated and, therefore, in the sensitivity analysis they are treated as a single variable (i.e. #133).

Sensitivity analysis results for the six consequence measures used to express risk are presented in Table 5.3-1. This table contains the results of performing a stepwise regression on the risk as expressed by: early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of early fatality within 1 mile, and individual risk of latent cancer fatality within 10 miles. The statistical package SAS^R was used to perform the regression and a simple linear model was used for the fit. It is clear that a linear model is a great simplification of the actual process used and that better results could have been obtained with more complicated non-linear models. However, as a first approximation, the linear model gives reasonably good results (i.e., it explains on the order of 70% of the variation).

For each consequence measure, Table 5.3-1 lists the variables in the order that they entered the regression analysis for the total internal results and for each PDS and shows the R^2 values that result with the entry of successive variables into the model.

The regression analyses account for > 66% of the observed variability. One can see that variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the internal analysis is dominated by source term variable uncertainty (FCOR, FCONC, and FCCI); but, for fire and seismic initiators, the result is different. The reason for this result in the internal analysis is that the risk is determined by two PDSs. The LOSP PDS does not have large uncertainties in the initiating event frequency or in recovery of LOSP. The ATWS PDS has a large uncertainty in the failure to scram frequency; but, since it only contributes one half the risk, that variable is only the 3rd to 4th most important. The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor drywell meltthrough is

Table 5.3-1a
Regression Results for Peach Bottom Internal Initiators
Early Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
X200	0.1904	0.0950	0.1079	0.1713	0.1724	0.1949	0.1634	0.1281	0.1281	0.1350
X205	0.1252	0.0624	0.0601	0.0752	0.0727	0.1568	0.0586	0.0792	0.0732	0.0842
X203	0.1081	0.0450	0.0413	0.0297	0.0546	0.1338	0.0434	0.1005	0.1005	0.1071
X12	0.0537						0.1500	0.1828	0.1828	0.1786
X159	0.0520	0.1118	0.1039	0.1420	0.0756	0.0193	0.1017	0.0295	0.0335	0.0285
X207	0.0383				0.0211	0.0211	0.0135	0.0373	0.0341	0.0345
X206	0.0368		0.0213			0.0153		0.0587	0.0556	0.0606
X13	0.0299						0.0408		0.0830	
X201	0.0172					0.0164				
X202	0.0170				0.0174	0.0235			0.0115	
X1	0.0120					0.0241				
X3		0.0904	0.0850							
X7			0.0423	0.1134						
X8				0.0309						
X209				0.0251						
X107				0.0233	0.0113					
X212				0.0212						
X54				0.0162						
X9					0.2050					
X10					0.0597					
X18					0.0185					
X11							0.0493			
X67								0.0188	0.0126	
TOTAL	0.6806	0.4046	0.4618	0.6483	0.7083	0.6052	0.6207	0.6349	0.7149	0.6285

* See Table 5.3-1g for a description of the variables.

Table 5.3-1b
Regression Results for Peach Bottom Internal Initiators
Early Fatalities Risk 0-1 Mile

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
X200	0.1647	0.0851	0.1020	0.1567	0.1439	0.1782	0.1419	0.1055	0.1055	0.1118
X205	0.1048	0.0561	0.0567	0.0668	0.0620	0.1387	0.0455	0.0632	0.0576	0.0677
X203	0.0860	0.0399	0.0358	0.0221	0.0370	0.1168	0.0349	0.0713	0.0869	0.0768
X12	0.0618						0.1665	0.2121	0.2121	0.2073
X159	0.0598	0.1077	0.1081	0.1522	0.0816	0.0221	0.1206	0.0303	0.0347	0.0291
X206	0.0525		0.0273	0.0169		0.0205	0.0173	0.0827	0.0711	0.0853
X207	0.0447				0.0205	0.0252	0.0133	0.0459	0.0423	0.0428
X13	0.0344						0.0492		0.0846	
X201	0.0181					0.0163				
X202	0.0170				0.0140	0.0244			0.0107	
X3	0.0143	0.0979	0.1001							
X123	0.0127									
X210		0.0226	0.0183							
X7			0.0451	0.1166						
X133			0.0202				0.0130			
X8				0.0330						
X107				0.0282	0.0156					
X209				0.0278						
X54				0.0233						
X212				0.0209						
X9					0.2330					
X10					0.0709					
X18					0.0220	0.0176				
X1						0.0263				
X11							0.0429			
X67								0.0146		
TOTAL	0.6708	0.4093	0.5136	0.6645	0.7005	0.5861	0.6451	0.6256	0.7055	0.6208

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* See Table 5.3-1g for a description of the variables.

Table 5.3-1c
Regression Results for Peach Bottom Internal Initiators
Total Latent Cancer Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
X12	0.1608						0.3610	0.5419	0.5419	0.5216
X200	0.1045	0.0216	0.0217	0.0292	0.0519	0.0737	0.0334	0.0468	0.0500	0.0515
X1	0.0706					0.1497				
X207	0.0698			0.0090	0.0159	0.0573	0.0110	0.0332	0.0311	0.0290
X159	0.0679	0.2232	0.2151	0.0724	0.0580	0.0334	0.1796	0.0273	0.0301	0.0240
X13	0.0495						0.0604		0.1245	
X205	0.0350	0.0346	0.0354	0.0416	0.0340	0.0665	0.0237	0.0169	0.0144	0.0195
X67	0.0271							0.0460	0.0330	0.0269
X18	0.0237			0.0524	0.0563	0.1482				
X203	0.0210				0.0060	0.0332		0.0158	0.0204	0.0188
X228	0.0177					0.0337				
X209	0.0144			0.0147				0.0146	0.0166	0.0151
X3		0.2685	0.2757							
X5		0.0758								
X4		0.0582								
X133		0.0288	0.0227				0.0200			
X171		0.0120								
X7			0.1853	0.3747						
X107				0.0908	0.0151		0.0086			
X54				0.0719						
X8				0.0678						
X112				0.0146						
X94				0.0081	0.0110		0.0097		0.0071	
X212				0.0057						
X9					0.4672					
X10					0.1195					
X229						0.0146				
X213						0.0136				
X11							0.1034			
X68								0.0113		
X211									0.0051	
TOTAL	0.6620	0.7227	0.7559	0.8529	0.8349	0.6239	0.8108	0.7538	0.8742	0.7064

* See Table 5.3-1g for a description of the variables.

Table 5.3-1d
Regression Results for Peach Bottom Internal Initiators
Total Latent Cancer Risk 0-10 Miles.

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
X12	0.3592						0.4909	0.8016	0.8016	0.7611
X1	0.1207					0.2598				
X13	0.0649						0.0633		0.1516	
X18	0.0502			0.0765	0.0906	0.2941				
X159	0.0478	0.1640	0.1597	0.0124	0.0542	0.0181	0.1711		0.0031	
X228	0.0259					0.0508				
X112	0.0154			0.0278	0.0153		0.0074			
X3	0.0135	0.3788	0.3780							
X5		0.1172								
X4		0.0691								
X133		0.0207	0.0159		0.0042		0.0186			
X171		0.0145	0.0089							
X205		0.0123	0.0139	0.0058	0.0068		0.0054			
X7			0.2501	0.4969						
X107				0.1195	0.0396		0.0214			
X54				0.0755						
X8				0.0823						
X9					0.5441					
X10					0.1263					
X200					0.0073				0.0019	
X229						0.0232				
X230						0.0140				
X11							0.1155			
X67								0.0068	0.0025	
X209									0.0030	
X203									0.0020	
TOTAL	0.6976	0.7766	0.8265	0.8967	0.8884	0.6600	0.8936	0.8084	0.9657	0.7611

* See Table 5.3-1g for a description of the variables.

Table 5.3-1e
Regression Results for Peach Bottom Internal Initiators
Population Dose within 50 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
X12	0.2020						0.3952	0.6070	0.6070	0.5848
X1	0.0824					0.1805				
X159	0.0742	0.2094	0.2016	0.0609	0.0654	0.0333	0.1845	0.0228	0.0241	0.0182
X200	0.0705	0.0258	0.0236	0.0273	0.0466	0.0481	0.0334	0.0310	0.0312	0.0323
X13	0.0639						0.0632		0.1398	
X207	0.0454				0.0101	0.0394	0.0079	0.0250	0.0232	0.0210
X205	0.0294	0.0320	0.0319	0.0318	0.0264	0.0560	0.0197	0.0133	0.0110	0.0157
X18	0.0284			0.0569	0.0635	0.1793				
X228	0.0221					0.0396				
X67	0.0218							0.0302	0.0227	0.0180
X203	0.0186				0.0055	0.0340	0.0057	0.0146	0.0191	0.0175
X209	0.0158			0.0151				0.0121	0.0142	0.0126
X3	0.0130	0.2985	0.3022							
X112	0.0129			0.0148	0.0054					
X206	0.0126									
X5		0.0837								
X4		0.0614								
X133		0.0250	0.0195				0.0181			
X171		0.0109	0.0074							
X7			0.2065	0.4068						
X107				0.0992	0.0202		0.0126			
X54				0.0695						
X8				0.0734						
X212				0.0066						
X9					0.4829					
X10					0.1209					
X94					0.0077		0.0064		0.0052	
X229						0.0185				
X11							0.1009			
X68								0.0085		
TOTAL	0.7130	0.7467	0.7927	0.8623	0.8546	0.6287	0.8476	0.7645	0.8975	0.7201

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* See Table 5.3-1g for a description of the variables.

Table 5.3-1f
Regression Results for Peach Bottom Internal Initiators
Population Dose Within Entire Region

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7	PDS8	PDS9
X12	0.1638						0.3642	0.5455	0.5455	0.5251
X200	0.1013	0.0234	0.0236	0.0305	0.0520	0.0713	0.0347	0.0452	0.0483	0.0496
X159	0.0706	0.2212	0.2130	0.0734	0.0573	0.0339	0.1815	0.0272	0.0301	0.0240
X1	0.0681					0.1492				
X207	0.0680			0.0084	0.0154	0.0561	0.0105	0.0329	0.0308	0.0287
X13	0.0511						0.0611		0.1265	
X205	0.0348	0.0343	0.0349	0.0404	0.0329	0.0666	0.0231	0.0167	0.0141	0.0192
X67	0.0257							0.0438	0.0310	0.0252
X18	0.0238			0.0525	0.0601	0.1495				
X203	0.0211					0.0339		0.0160	0.0206	0.0190
X228	0.0178					0.0339				
X209	0.0148			0.0151				0.0146	0.0166	0.0151
X3		0.2734	0.2803							
X5		0.0769								
X4		0.0588								
X133		0.0284	0.0220				0.0196			
X171		0.0114								
X7			0.1878	0.3757						
X107				0.0916	0.0154		0.0099			
X54				0.0721						
X8				0.0677						
X112				0.0145						
X94				0.0077	0.0105		0.0087		0.0070	
X212				0.0058						
X9					0.4669					
X10					0.1199					
X229						0.0144				
X11							0.1012			
X68								0.0109		
X211									0.0047	
TOTAL	0.6609	0.7278	0.7616	0.8554	0.8304	0.6088	0.8145	0.7528	0.8752	0.7059

* See Table 5.3-1g for a description of the variables.

Table 5.3-1g
Regression Results for Peach Bottom Internal Initiators
Variable Descriptions

VARIABLE	TYPE	DESCRIPTION
X1	FE-INT	DG FAILS TO RUN FOR 8 HR
X3	FE-INT	RV PRESSURE SENSORS MISCALIBRATED
X4	FE-INT	LARGE LOCA IE
X5	FE-INT	INTERMEDIATE LOCA IE
X7	FE-INT	TWO STUCK OPEN SRVS
X8	FE-INT	OPEN FAILURE OF HPSW
X9	FE-INT	BATTERY COMMON CAUSE FAULT (BASIC HARDWARE)
X10	FE-INT	BATTERY COMMON CAUSE BETA FACTOR
X11	FE-INT	OPERATOR FAILS TO DEPRESSURIZE IN ATWS
X12	FE-INT	MECHANICAL FAILURE TO SCRAM
X13	FE-INT	PCS AVAILABLE IE
X18	FE-INT	LOSP IE
X54	FE-INT	CHECK VALVE FAILS TO OPEN
X67	EVNTRE	Q36C1A RPV PRESSURE BEFORE CD - HARSH ENVIRONMENT FAILURE OF ADS TERMINAL BOX
X68	EVNTRE	Q36C1B RPV PRESSURE BEFORE CD - HARSH ENVIRONMENT FAILURE OF ADS VALVE
X94	EVNTRE	Q83C3 PROBABILITY OF ALPHA MODE FAILURE
X107	EVNTRE	Q86C2 PROBABILITY OF IN-VESSEL STEAM EXPLOSION RESULTING IN RV FAILURE
X112	EVNTRE	Q89C6 MODE OF VB, NO STEAM EXPLOSION
X123	EVNTRE	Q90C3 PROBABILITY OF HIGH PRESSURE MELT EJECTION
X133	EVNTRE	Q94C2P18 PRESSURE RISE AT VB
X159	EVNTRE	Q103C3 PROBABILITY OF DRYWELL MELTTHROUGH
X171	EVNTRE	Q125C1 AMOUNT OF CONCRETE THAT MUST BE ERODED TO CAUSE PEDESTAL FAILURE
X200	ST	FCOR - FRACTIONAL RELEASE FROM FUEL TO RV BEFORE VB
X201	ST	FVES - FRACTIONAL RELEASE FROM RV TO CONTAINMENT
X202	ST	FREVO - FRACTION REVAPORIZED FROM RV TO CONTAINMENT AFTER VB
X203	ST	FCCI - FRACTIONAL RELEASE FROM CCI
X205	ST	FCONC - FRACTION RELEASED FROM CONTAINMENT OF AMOUNT RELEASED FROM CCI
X206	ST	FLTI - FRACTIONAL LATE IODINE RE-EVOLUTION FROM SP AND DW WATER
X207	ST	RBDF - REACTOR BUILDING DECONTAMINATION FACTOR
X209	ST	DFPOOL - SUPPRESSION POOL DECONTAMINATION FACTOR
X210	ST	DFSPRAY - SPRAY DECONTAMINATION FACTOR
X211	ST	DFCAV - CAVITY DECONTAMINATION FACTOR
X212	ST	FEVSE - RELEASE FRACTION FROM AMOUNT OF CORE PARTICIPATING IN EXVSE
X213	FE-INT	Q48,Q110 FAILURE TO RECOVER LOSP (AT ANY TIME)
X228	FE-INT	BATTERY DEPLETION AT THREE HOURS
X229	FE-INT	BATTERY DEPLETION AT FIVE HOURS
X230	FE-INT	BATTERY DEPLETION AT SEVEN HOURS

almost certain to occur, its importance to uncertainty is lower than would be expected just based on its probability of occurrence.

5.3.2 Contributors to Uncertainty in Risk for Fire Initiators

This section presents the results of using regression-based sensitivity analysis techniques to examine the variability in the consequences of fire initiated accidents at Peach Bottom. The dependent variable is the risk (units: consequences/year) for each consequence measure. For a given observation in the sample, this variable is obtained by multiplying each consequence value by its frequency and then summing these products. This variable can be viewed as the result of reducing each of the fire curves corresponding to the internal initiator curves shown in Figure D.1 to a single number.

Sensitivity analysis results for the six consequence measures used to express risk are presented in Table 5.3-2. This table contains the results of performing a stepwise regression on the risk as expressed by: early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of an early fatality within 1 mile, and individual risk of a latent cancer fatality within 10 miles. The statistical package SAS^R was used to perform the regression and a simple linear model was used for the fit. It is clear that a linear model is a great simplification of the actual process used and that better results could have been obtained with more complicated non-linear models. However, as a first approximation, the linear model gives reasonably good results (i.e., it explains on the order of 70% of the variation).

For each consequence measure, Table 5.3-2 lists the variables in the order that they entered the regression analysis for the total internal results and for each PDS and shows the R^2 values that result with the entry of successive variables into the model.

The regression analyses account for > 65% of the observed variability. One can see that variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the fire analysis is dominated by source term variable uncertainty for early fatalities (FCOR, FCONC, and FCCI); but, for latent cancers, the Level I variables dominate (fire initiating event frequency and diesel generator failure to run). The reason for this result is that the early fatalities depend critically on the magnitude of the source term; but, the latent cancers depend mainly upon whether or not the accident occurs. The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor drywell meltthrough is almost certain to occur, its importance to uncertainty is lower than would be expected just based on its probability of occurrence.

Table 5.3-2a
Regression Results for Peach Bottom Fire Initiators
Early Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4
X200	0.1843	0.1750	0.0916	0.0822	0.1092
X21	0.1504		0.3397	0.2389	0.3073
X205	0.1070	0.0428	0.1127	0.0990	0.0818
X203	0.0951	0.0250	0.0971	0.0776	0.0901
X39	0.0396			0.1321	0.0258
X47	0.0234		0.0198		
X159	0.0210	0.1224			
X202	0.0207		0.0232	0.0234	0.0233
X52	0.0151		0.0204	0.0130	0.0192
X207	0.0131	0.0183	0.0269	0.0226	
X20		0.1148			
X23		0.0444			
X51		0.0232			
X212		0.0196			
X94		0.0166			
X31		0.0157			
X46			0.0156		
X35					0.0484
X36					0.0165
X79					0.0119
TOTAL	0.6697	0.6178	0.7470	0.6888	0.7335

* See Table 5.3-2g for a description of the variables.

Table 5.3-2b
Regression Results for Peach Bottom Fire Initiators
Early Fatality Risk 0-1 Mile

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4
X21	0.1986		0.3700	0.2572	0.3462
X200	0.1386	0.1573	0.0794	0.0710	0.0898
X205	0.0888	0.0397	0.0960	0.0833	0.0597
X203	0.0767	0.0172	0.0823	0.0640	0.0662
X39	0.0460			0.1425	0.0296
X47	0.0269		0.0225		
X159	0.0229	0.1389			
X202	0.0198		0.0204	0.0235	0.0211
X207	0.0173	0.0222	0.0306	0.0248	
X52	0.0172		0.0221	0.0131	0.0198
X20		0.1187			
X23		0.0443			
X212		0.0201			
X51		0.0201			
X206		0.0196			
X133		0.0188			
X31		0.0143			
X46			0.0185		
X49				0.0123	
X35					0.0537
X36					0.0197
X79					0.0103
TOTAL	0.6528	0.6312	0.7418	0.6917	0.7161

* See Table 5.3-2g for a description of the variables.

Table 5.3-2c
Regression Results for Peach Bottom Fire Initiators
Total Latent Cancer Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4
X21	0.4614		0.7443	0.4865	0.6446
X39	0.1082			0.2544	0.0405
X52	0.0893		0.0685	0.0492	0.0583
X200	0.0409	0.0505	0.0231	0.0136	0.0127
X46	0.0277		0.0556		
X205	0.0209	0.0246	0.0134	0.0082	0.0055
X207	0.0180	0.0130	0.0132	0.0151	
X34	0.0142		0.0077	0.0056	0.0075
X159	0.0141	0.1992			
X47	0.0086		0.0055		
X20		0.2151			
X23		0.0849			
X31		0.0259			
X133		0.0227			
X51		0.0226			
X212		0.0195			
X19		0.0145			
X24		0.0142			
X203			0.0056		0.0063
X49				0.0365	
X35					0.0942
X36					0.0284
X48					0.0118
X79					0.0033
TOTAL	0.8033	0.7067	0.9369	0.8691	0.9131

* See Table 5.3-2g for a description of the variables.

Table 5.3-2d
Regression Results for Peach Bottom Fire Initiators
Total Latent Cancer Risk 0-10 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4
X21	0.4668		0.8256	0.5129	0.6897
X39	0.1445			0.2801	0.0384
X52	0.1213		0.0837	0.0565	0.0676
X46	0.0365		0.0645		
X34	0.0153		0.0053	0.0039	0.0065
X23	0.0144	0.1182			
X159	0.0127	0.1896			
X20	0.0117	0.2822			
X31		0.0313			
X51		0.0270			
X19		0.0240			
X133		0.0229			
X107		0.0215			
X24		0.0186			
X200		0.0140	0.0009		
X212		0.0091			
X32			0.0024		0.0029
X49				0.0470	
X35					0.0904
X36					0.0317
X48					0.0139
X44					0.0021
TOTAL	0.8232	0.7584	0.9824	0.9004	0.9432

* See Table 5.3-2g for a description of the variables.

Table 5.3-2e
Regression Results for Peach Bottom Fire Initiators
Population Dose Within 50 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4
X21	0.4579		0.7711	0.4965	0.6565
X39	0.1197			0.2616	0.0411
X52	0.0953		0.0725	0.0510	0.0600
X46	0.0305		0.0567		
X200	0.0289	0.0469	0.0138	0.0078	0.0084
X205	0.0176	0.0193	0.0103	0.0062	0.0047
X34	0.0149		0.0075	0.0054	0.0072
X159	0.0145	0.2032			
X207	0.0145	0.0102	0.0088	0.0110	
X23	0.0085	0.0934			
X20		0.2297			
X31		0.0281			
X51		0.0238			
X133		0.0240			
X212		0.0183			
X19		0.0161			
X24		0.0153			
X107		0.0114			
X204		0.0097			
X203			0.0060		0.0072
X47			0.0040		
X32			0.0021		0.0029
X49				0.0391	
X35					0.0927
X36					0.0292
X48					0.0121
X79					0.0027
TOTAL	0.8023	0.7494	0.9528	0.8786	0.9247

* See Table 5.3-2g for a description of the variables.

Table 5.3-2f
Regression Results for Peach Bottom Fire Initiators Population Dose Within Entire Region

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4
X21	0.4589		0.7454	0.4870	0.6468
X39	0.1091			0.2542	0.0406
X52	0.0892		0.0684	0.0490	0.0581
X200	0.0397	0.0503	0.0220	0.0129	0.0118
X46	0.0280		0.0554		
X205	0.0208	0.0237	0.0134	0.0082	0.0051
X207	0.0181	0.0125	0.0130	0.0150	
X159	0.0146	0.2008			
X34	0.0143		0.0078	0.0057	0.0076
X47	0.0086		0.0056		
X20		0.2164			
X23		0.0859			
X31		0.0264			
X133		0.0223			
X51		0.0230			
X212		0.0195			
X19		0.0146			
X24		0.0145			
X203			0.0059		0.0063
X49				0.0369	
X35					0.0940
X36					0.0286
X48					0.0117
X79					0.0032
TOTAL	0.8013	0.7099	0.9369	0.8689	0.9138

* See Table 5.3-2g for a description of the variables.

Table 5.3-2g
Regression Results for Peach Bottom Fire Initiators
Variable Description

VARIABLE	TYPE	DESCRIPTION
X19	FE-FIRE	CABLE SPREADING ROOM FIRE
X20	FE-FIRE	CONTROL ROOM FIRE
X21	FE-FIRE	EMERGENCY SWITCHGEAR ROOM FIRE
X23	FE-FIRE	FAILURE TO RECOVER AT REMOTE SHUTDOWN PANEL
X24	FE-FIRE	CABLE SPREADING ROOM - FAILURE OF CO2 SYSTEM
X31	FE-FIRE	MECHANICAL FAILURE OF RCIC IN FIRE SEQUENCES
X32	FE-FIRE	EMERGENCY SWITCHGEAR ROOM - LARGE FIRE AREA RATIO
X34	FE-FIRE	EMERGENCY SWITCHGEAR ROOM - FAILURE TO SUPPRESS FIRE MANUALLY
X35	FE-FIRE	FAILURE TO SWITCH TO RBCWS W/LOSP
X36	FE-FIRE	FAILURE TO RESTORE DG HARDWARE FAULT IN 30 HOURS
X39	FE-FIRE	DG FAILS TO RUN FOR 16 HOURS
X44	FE-FIRE	RHR CONTROL LOGIC B FAULT
X46	FE-FIRE	CHECK VALVE 515A AND B FAIL
X47	FE-FIRE	CHECK VALVE 514 FAILS
X48	FE-FIRE	FAILURE TO RECOVER PUMP TRAIN B VALVES AFTER MAINTENANCE
X49	FE-FIRE	FAILURE TO RESTORE DG HARDWARE FAULT IN 16 HOURS
X51	FE-FIRE	CONTROL ROOM - FAILURE TO SUPPRESS FIRE MANUALLY
X52	FE-FIRE	ESSENTIAL SWITCHGEAR ROOM - PROBABILITY OF FIRE SPREADING
X79	EVNTRE	Q54C2 AMOUNT OF IN-VESSEL HYDROGEN PRODUCTION
X94	EVNTRE	Q83C3 PROBABILITY OF ALPHA MODE FAILURE
X107	EVNTRE	Q86C2 PROBABILITY OF IN-VESSEL STEAM EXPLOSION RESULTING IN RV FAILURE
X133	EVNTRE	Q94C2P18 PRESSURE RISE AT VB
X159	EVNTRE	Q103C3 PROBABILITY OF DRYWELL MELTTHROUGH
X200	ST	FCOR - FRACTIONAL RELEASE FROM FUEL TO RV BEFORE VB
X202	ST	FREVO - FRACTION REVAPORIZED FROM RV TO CONTAINMENT AFTER VB
X203	ST	FCCI - FRACTIONAL RELEASE FROM CCI
X204	ST	FCONV - FRACTION RELEASED FROM CONTAINMENT OF AMOUNT RELEASED FROM RV
X205	ST	FCONC - FRACTION RELEASED FROM CONTAINMENT OF AMOUNT RELEASED FROM CCI
X206	ST	FLTI - FRACTIONAL LATE IODINE RE-EVOLUTION FROM SP AND DW WATER
X207	ST	RBDF - REACTOR BUILDING DECONTAMINATION FACTOR
X212	ST	FEVSE - RELEASE FRACTION FROM AMOUNT OF CORE PARTICIPATING IN EXVSE

5.3.3 Contributors to Uncertainty in Risk for Seismic Initiators

This section presents the results of using regression-based sensitivity analysis techniques to examine the variability in the consequences of seismically initiated accidents at Peach Bottom. This analysis was only performed for the LLNL hazard curve and all results in this section pertain only to the LLNL seismic analysis. The low and high PGA cases are analyzed separately. The dependent variable is the risk (units: consequences/year) for each consequence measure. For a given observation in the sample, this variable is obtained by multiplying each consequence value by its frequency and then summing these products. This variable can be viewed as the result of reducing each of the seismic curves corresponding to the internal initiator curves shown in Figure D.1 to a single number.

Sensitivity analysis results for the six consequence measures used to express risk are presented in Table 5.3-3. This table contains the results of performing a stepwise regression on the risk as expressed by: early fatalities, latent cancer fatalities, population dose within 50 miles, population dose within the entire region, individual risk of an early fatality within 1 mile, and individual risk of a latent cancer fatality within 10 miles. The statistical package SAS^R was used to perform the regression and a simple linear model was used for the fit. It is clear that a linear model is a great simplification of the actual process used and that better results could have been obtained with more complicated non-linear models. However, as a first approximation, the linear model gives reasonably good results (i.e., it explains on the order of 70% of the variation).

For each consequence measure, Table 5.3-3 lists the variables in the order that they entered the regression analysis for the total internal results and for each PDS and shows the R^2 values that result with the entry of successive variables into the model.

The regression analyses account for > 66% of the observed variability. One can see that variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the seismic analysis is dominated by Level I variables, in particular, the uncertainty in the seismic hazard curve. The source term variable are the next most important (FCONC and RBDF). The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor drywell meltthrough is almost certain to occur, its importance to uncertainty is lower than would be expected just based on its probability of occurrence.

Table 5.3-3a
Regression Results for Peach Bottom Seismic Initiators - Low PGA

Early Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.5205	0.3915	0.4672	0.3857	0.3187	0.2675	0.3919	0.4112
X205	0.0729	0.0354	0.0347		0.1276	0.0425	0.0612	0.0374
X207	0.0440	0.0551	0.0656	0.0535	0.0258	0.0610		0.0159
X203	0.0269				0.0762		0.0277	
X200	0.0153				0.0944	0.0654	0.0389	0.0326
X201	0.0113							
X79			0.0182	0.0240				
X133						0.0374		0.0174
X159						0.0220		0.0323
X62								0.0161
TOTAL	0.6909	0.4820	0.5857	0.4632	0.6427	0.4958	0.5197	0.5629

Early Fatality Risk 0-1 Mile

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.5851	0.4082	0.4954	0.4027	0.3759	0.2956	0.4489	0.4573
X205	0.0438	0.0224	0.0239		0.0895	0.0250	0.0382	0.0196
X207	0.0403	0.0358	0.0476	0.0385	0.0336	0.0527		0.0175
X212		0.0181						
X79			0.0164	0.0224				
X159			0.0155			0.0222		0.0282
X200					0.0691	0.0461	0.0204	0.0174
X203					0.0397			
X133						0.0381		0.0189
X62								0.0161
TOTAL	0.6692	0.4845	0.5988	0.4636	0.6078	0.4797	0.5075	0.5750

* See Table 5.3-3g for a description of the variables.

Table 5.3-3b
Regression Results for Peach Bottom Seismic Initiators - Low PGA

Total Latent Cancer Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7071	0.4780	0.5683	0.4346	0.6161	0.4237	0.5102	0.5367
X205	0.0233				0.0303		0.0167	
X207	0.0158		0.0181		0.0151			
X200	0.0111				0.0138			
X89								0.0192
X62								0.0180
TOTAL	0.7573	0.4780	0.5864	0.4346	0.6753	0.4237	0.5269	0.5739

Total Latent Cancer Risk 0-10 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7457	0.4770	0.5700	0.4416	0.6696	0.4397	0.5376	0.5624
X89		0.0182						0.0186
X108		0.0164						
X159		0.0189	0.0153					
X62								0.0176
TOTAL	0.7457	0.5305	0.5853	0.4416	0.6696	0.4397	0.5376	0.5986

* See Table 5.3-3g for a description of the variables.

Table 5.3-3c
Regression Results for Peach Bottom Seismic Initiators - Low PGA

Population Dose Within 50 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7457	0.4840	0.5742	0.4392	0.6305	0.4307	0.5156	0.5466
X207			0.0145		0.0117			0.0186
X205					0.0271			
X89								0.0185
X62								0.0178
TOTAL	0.7457	0.4840	0.5887	0.4392	0.6693	0.4307	0.5156	0.6015

Population Dose Within Entire Region

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7106	0.4803	0.5712	0.4364	0.6200	0.4257	0.5131	0.5624
X205	0.0223				0.0293			0.0186
X207	0.0150		0.0171		0.0145			
X200	0.0107				0.0128			
X89								0.0194
X62								0.0180
TOTAL	0.7586	0.4803	0.5883	0.4364	0.6766	0.4257	0.5131	0.6184

* See Table 5.3-3g for a description of the variables.

Table 5.3-3d
Regression Results for Peach Bottom Seismic Initiators - High PGA

Early Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.5682	0.3992	0.4727	0.3832	0.3789	0.3223	0.4205	0.4403
X205	0.0586	0.0424	0.0389		0.0999	0.0217	0.0506	0.0252
X207	0.0461	0.0569	0.0659	0.0527	0.0303	0.0525		0.0171
X200	0.0241				0.0718	0.0619	0.0358	0.0318
X203	0.0150				0.0580		0.0192	
X79			0.0163	0.0217				
X133						0.0299		0.0154
X159						0.0209		0.0306
X62								0.0168
TOTAL	0.7120	0.4985	0.5938	0.4576	0.6389	0.5092	0.5261	0.5772

Early Fatality Risk 0-1 Mile

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.6619	0.4439	0.5350	0.4172	0.4345	0.3649	0.4813	0.4926
X205	0.0319	0.0228	0.0228		0.0729		0.0251	
X207	0.0287	0.0243	0.0358	0.0281	0.0326	0.0332		0.0166
X200	0.0153				0.0506	0.0382		
X79				0.0186				
X203					0.0340			
X133						0.0270		0.0157
X159								0.0239
X62								0.0175
TOTAL	0.7378	0.4910	0.5936	0.4639	0.6246	0.4633	0.5064	0.5663

* See Table 5.3-3g for a description of the variables.

Table 5.3-3e
Regression Results for Peach Bottom Seismic Initiators - High PGA

Total Latent Cancer Fatalities

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7308	0.4761	0.5656	0.4329	0.6169	0.4250	0.5088	0.5371
X205	0.0177		0.0141		0.0283		0.0168	
X207	0.0150		0.0190		0.0136			
X200	0.0092				0.0146			
X89								0.0191
X62								0.0189
TOTAL	0.7727	0.4761	0.5987	0.4329	0.6734	0.4250	0.5256	0.5751

Total Latent Cancer Risk 0-10 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.6845	0.4623	0.5440	0.4252	0.5632	0.4131	0.4836	0.5257
X205	0.0286	0.0196	0.0191		0.0474		0.0236	
X207	0.0270	0.0174	0.0301	0.0239	0.0299	0.0202		
X203	0.0096				0.0150			
X79				0.0191				
X200					0.0210			
X62								0.0166
X89								0.0161
TOTAL	0.7497	0.4993	0.5932	0.4682	0.6765	0.4333	0.5072	0.5423

* See Table 5.3-3g for a description of the variables.

Table 5.3-3f
Regression Results for Peach Bottom Seismic Initiators - High PGA

Population Dose Within 50 Miles

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7370	0.4805	0.5688	0.4362	0.6294	0.4303	0.5101	0.5454
X205	0.0156				0.0256			
X207	0.0130		0.0167		0.0116			
X62								0.0188
X89								0.0183
TOTAL	0.7656	0.4805	0.5855	0.4362	0.6666	0.4303	0.5101	0.5642

Population Dose Within Entire Region

VARIABLE*	ALL	PDS1	PDS2	PDS3	PDS4	PDS5	PDS6	PDS7
X55	0.7323	0.4768	0.5665	0.4334	0.6189	0.4258	0.5096	0.5383
X205	0.0175		0.0139		0.0280		0.0165	
X207	0.0147		0.0187		0.0144			
X200	0.0091				0.0130			
X89								0.0191
X62								0.0189
TOTAL	0.7736	0.4768	0.5991	0.4334	0.6743	0.4258	0.5261	0.5763

* See Table 5.3-3g for a description of the variables.

Table 5.3-3g
Regression Results for Peach Bottom Seismic Initiators
Variable Description

VARIABLE	TYPE	DESCRIPTION
X55	FE-SEIS	LLNL SEISMIC HAZARD CURVE
X62	EVNTRE	Q23C1P4 CONTAINMENT FAILURE PRESSURE (LOW OR HIGH TEMP)
X79	EVNTRE	Q54C2 AMOUNT OF IN-VESSEL HYDROGEN PRODUCTION
X89	EVNTRE	Q75C1P9 REACTOR BUILDING PEAK PRESSURE DURING BLOWDOWN
X108	EVNTRE	Q87C2 FRACTION OF CORE DEBRIS MOBILE AT VB
X133	EVNTRE	Q94C2P18 PRESSURE RISE AT VB
X159	EVNTRE	Q103C3 PROBABILITY OF DRYWELL MELTTHROUGH
X200	ST	FCOR - FRACTIONAL RELEASE FROM FUEL TO RV BEFORE VB
X201	ST	FVES - FRACTIONAL RELEASE FROM RV TO CONTAINMENT
X203	ST	FCCI - FRACTIONAL RELEASE FROM CCI
X205	ST	FCONC - FRACTION RELEASED FROM CONTAINMENT OF AMOUNT RELEASED FROM CCI
X207	ST	RBDF - REACTOR BUILDING DECONTAMINATION FACTOR
X209	ST	DFPOOL - SUPPRESSION POOL DECONTAMINATION FACTOR
X212	ST	FEVSE - RELEASE FRACTION FROM AMOUNT OF CORE PARTICIPATING IN EXVSE

5.4 Sensitivity Study Results

5.4.1 Sensitivity Results For LLNL Seismic Analysis With No Early Containment Failure

Tables 5.4-1 and 5.4-2 present the risk results for the sensitivity analysis run on the LLNL hazard curve. For this sensitivity, the probability of containment failure at the start of the accident was set to zero. In the base case for PDSs 1, 2, and 3, the seismic event was assessed to cause a containment failure due to oscillation of the reactor vessel that resulted in the piping penetrations tearing the drywell wall. In 90% of the cases, this was a leak and, in 10% of the cases, it was a rupture.

By examining Table 5.4-1, we see that eliminating immediate containment failure resulted in only a slight drop in the early fatality and latent cancer frequencies. This is because the high PGA cases dominant the risk and, in these cases, the people are not evacuated for 24 hours. This means that, since containment failure is certain at some time in the accident progression for seismic sequences, the people still get caught in the release. The radioactive decay and differences in the containment failure modes, result in a slightly smaller exposure.

Table 5.4-2 shows that the low and high PDSs still contribute roughly the same percentage of the total risk that they did in the base case.

5.4.2 Sensitivity Results For EPRI Seismic Analysis With Normal Evacuation Speed For Low PGA

Tables 5.4-3 and 5.4-4 present the risk results for the sensitivity analysis run on the EPRI hazard curve. For this sensitivity, the evacuation speed was increased back to the non-seismic value; it had been reduced to one-half of the normal speed for the base case seismic analysis. Also, the evacuation delay time was decreased back to the non-seismic delay time; it had been increased by a factor of one and a half to account for the stress and confusion as a result of the seismic event. This sensitivity affected all the PDSs.

By examining Table 5.4-3, we see that using the normal non-seismic evacuation assumptions had hardly any effect on the results. This is because the high PGA cases dominant the risk and, in these cases, the people are not evacuated for 24 hours. This means that the low PGA evacuation assumptions will not have a large impact on the risk. Also, even with the reduced evacuation speed and longer delay time in the base case, the low PGA cases are not that affected. In PDSs 1, 2, and 3, since the containment fails immediately ,the evacuation assumptions do not have that great an effect. In the other PDSs, the people get out before the plume even with the degraded evacuation assumptions.

Table 5.4-4 shows that the low and high PDSs still contribute roughly the same percentage of the total risk that they did in the base case.

Table 5.4-1
Distributions for Annual Risk at Peach Bottom Due to Seismic Initiators
LLNL Hazard Distributions - No CF at T=0
(All values per reactor-year)
(Population Doses in person-rem)

Risk Measure	5th%tile	Median	Mean	95th%tile
Core Damage	4.5E-08	4.3E-06	7.5E-05	3.7E-04
Early Fatalities	2.7E-07	6.6E-05	2.2E-03	5.9E-03
Latent Cancer Fat.	6.5E-05	1.2E-02	2.3E-01	6.4E-01
Population Dose 50 mi.	1.3E-01	2.1E+01	4.1E+02	1.2E+03
Population Dose Entire Region	4.0E-01	7.1E+01	1.4E+03	3.9E+03
Ind. Early Fat. Risk 0-1 mile	3.5E-10	6.5E-08	1.3E-06	4.5E-06
Ind. L. C. Fatality Risk 0-10 mile	6.8E-11	1.2E-08	2.7E-07	7.2E-07

Table 5.4-2
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Seismic Initiators LLNL Hazard Distributions - No CF at T=0

PDS	PGA	Method	% Core Damage	% Early Fatalities	% Latent Cancers
1	Low	FCMR	2.1	0.03	3.4
		MFCR	1.8	0.02	3.2
	High	FCMR	9.6	30.4	11.7
		MFCR	8.1	25.9	11.1
2	Low	FCMR	3.8	0.02	3.9
		MFCR	3.8	0.02	4.7
	High	FCMR	18.7	28.6	14.4
		MFCR	18.6	31.2	17.8
3	Low	FCMR	0.3	0.00	0.3
		MFCR	0.5	0.00	0.6
	High	FCMR	3.7	5.5	2.8
		MFCR	5.9	8.6	5.6
4	Low	FCMR	27.1	0.24	33.9
		MFCR	22.9	0.06	23.5
	High	FCMR	22.1	26.9	21.0
		MFCR	18.7	9.1	14.7
5	Low	FCMR	1.9	0.00	1.6
		MFCR	2.4	0.01	2.4
	High	FCMR	2.3	1.5	1.5
		MFCR	2.9	3.3	2.3
6	Low	FCMR	1.0	0.00	0.9
		MFCR	1.8	0.01	2.3
	High	FCMR	5.2	5.5	3.5
		MFCR	9.7	18.6	9.4
7	Low	FCMR	0.3	0.00	0.2
		MFCR	0.3	0.00	0.4
	High	FCMR	1.9	1.2	1.0
		MFCR	2.5	3.2	2.1

Table 5.4-3
Distributions for Annual Risk at Peach Bottom Due to Seismic Initiators
EPRI Hazard Distributions - Normal Evacuation for Low PGA
(All values per reactor-year)
(Population Doses in person-rem)

Risk Measure	5th%tile	Median	Mean	95th%tile
Core Damage	1.6E-08	6.8E-07	3.2E-06	1.4E-05
Early Fatalities	4.5E-08	6.6E-06	8.8E-05	2.5E-04
Latent Cancer Fat.	2.5E-05	1.6E-03	8.5E-03	2.9E-02
Population Dose 50 mi.	4.9E-02	2.8E+00	1.5E+01	4.7E+01
Population Dose Entire Region	1.5E-01	9.6E+00	5.1E+01	1.7E+02
Ind. Early Fat. Risk 0-1 mile	8.7E-11	8.0E-09	5.3E-08	1.8E-07
Ind. L. C. Fatality Risk 0-10 mile	2.4E-11	1.4E-09	1.1E-08	3.0E-08

Table 5.4-4
Fractional PDS Contributions (in percent) to Annual Risk at Peach Bottom Due to Seismic Initiators
EPRI Hazard Distributions - Normal Evacuation at Low PGA

PDS	PGA	Method	% Core Damage	% Early Fatalities	% Latent Cancers
1	Low	FCMR	2.1	0.01	3.4
		MFCR	1.8	0.01	2.5
	High	FCMR	9.6	27.5	11.6
		MFCR	8.1	14.6	8.2
2	Low	FCMR	3.8	0.01	4.6
		MFCR	3.8	0.02	4.5
	High	FCMR	18.7	38.2	18.6
		MFCR	18.6	33.4	17.7
3	Low	FCMR	0.3	0.00	0.5
		MFCR	0.5	0.00	0.6
	High	FCMR	3.7	7.4	3.8
		MFCR	5.9	8.7	5.3
4	Low	FCMR	27.1	0.04	28.1
		MFCR	22.9	0.02	25.7
	High	FCMR	22.1	18.7	19.2
		MFCR	18.7	14.0	17.1
5	Low	FCMR	1.9	0.00	2.2
		MFCR	2.4	0.00	2.8
	High	FCMR	2.3	1.9	2.0
		MFCR	2.9	4.1	2.6
6	Low	FCMR	1.0	0.00	0.9
		MFCR	1.8	0.00	2.1
	High	FCMR	5.2	4.8	3.7
		MFCR	9.7	21.1	8.6
7	Low	FCMR	0.3	0.00	0.2
		MFCR	0.3	0.00	0.4
	High	FCMR	1.9	1.5	1.3
		MFCR	2.5	4.0	2.1

6. INSIGHTS AND CONCLUSIONS

6.1 Core Damage Arrest

6.1.1 Internal Initiators

For the LOSP collapsed PDS group, the probability of core damage arrest is driven directly by the conditional probability of recovering AC power between the time core damage starts and vessel breach occurs. Because of the many available injection systems, injection into the RPV is possible in most cases immediately after AC is restored. While the probability of recovering AC power is high (0.9) in PDS 4, the probability of recovery in PDS 5 is only 0.37 (for long-term station blackout, the probability of recovering AC power within the time window of core damage is about 1/3 that of the short-term case) and it is the dominant PDS. Since the probability of core damage arrest is about 25% given injection is restored, the average for this collapsed PDS group is only .112. Many factors must be considered in determining if core damage arrest is possible even if injection is restored. In particular, six major factors were considered in the APET. First, the timing of the injection recovery with respect to the time between the start of core damage and vessel breach. Second, the fraction of the core participating in core slump. Third, the probability of in-vessel steam explosions. Fourth, the amount of core debris which is mobile in the lower plenum. Fifth, depending upon the accident scenario, the RPV pressure may also be a factor and, sixth, the probability of the core going recritical during reflood. All of the above factors contribute to our estimate of the fraction of time that injection recovery can result in core damage arrest.

For the LOCA collapsed PDS group, injection is not recoverable in the dominant PDSs. If injection was recoverable core damage would in most cases not even have occurred. The possibility of core damage arrest is, therefore, zero.

In the ATWS collapsed PDS group, injection recovery depends upon the conditions allowing the operator to be able to depressurize and then that he does it. PDS 8 dominates this PDS group. In PDS 8, injection is recovered with a probability of 0.33 and core damage arrest is 0.1. In the other PDSs the probability of core damage arrest is the same or lower, so that the overall probability for this collapsed PDS group is 0.09.

In the transient collapsed PDS group, injection is recoverable in one of the PDSs but the other is like the LOCA PDS and injection can not be recovered. The frequency of the PDS where injection is not recovered dominates and the probability of core damage arrest for transients is only 0.014. Operator error dominates the recovery probability.

It must be remembered that core damage arrest does not necessarily mean that there will be no radionuclide releases during the accident. Both hydrogen and radionuclides are released to the containment during the core damage process through the SRVs to the suppression pool. In the majority of the cases, the release is small because, when injection is restored, containment heat removal is also restored and, if the mass of hydrogen released is small, containment pressure remains low. This implies radionuclides get released only through the nominal containment leakage paths. However, in some cases, either a large amount of non-condensibles are generated and containment venting is required or containment heat removal is not restored and venting or containment failure occurs.

6.1.2 Fire Initiators

For the dominant PDSs in the fire analysis, only PDS 1 has a possibility of recovering injection after core damage has begun. For PDS 2 to 4, the failure of injection in a non-recoverable manner was necessary to get core damage in the first place. The average conditional probability for core damage arrest for all the fire PDSs together is 0.078.

6.1.3 Seismic Initiators

For the dominant PDSs in the seismic analysis, no PDS has a possibility of recovering injection after core damage has begun. Damage from the seism was assessed to be non-recoverable for off-site power within the time frame of interest. Recovery of onsite power from non-seismic failures, in order to prevent core damage, was allowed in the Level I analyses; but no further credit was taken in the accident progression analysis because the failures were either easy to recover and so would have been recovered before core damage took place or so difficult that recovery within the time frame of interest was negligible.

6.2 Early Containment Failure

6.2.1 Internal Initiators

The early fatality risk depends strongly on the probability of early containment failure (CF). Early containment failure includes both failures that occur before vessel breach and those that occur at or shortly after vessel breach. The Peach Bottom containment is a relatively strong containment with the suppression pool being able to absorb large amounts of energy if not released too quickly. The design pressure is 56 psig; but, after evaluation by the experts, an assessed mean failure pressure of 150 psig was determined. Because of its high failure pressure combined with its energy absorbing capabilities in the suppression pool, the containment is unlikely to fail early from overpressure in most accidents. The containment has a significant probability of early overpressure failure only in those sequences where containment heat removal and venting are failed or inadequate (ATWS) and the suppression pool becomes saturated. This can result in a significant base pressure before core damage begins and then the pressure increase from hydrogen generation during core damage or events at vessel breach can result in peak containment pressures in the failure range.

At vessel breach many different mechanisms were considered as contributing to potential containment failure. These mechanisms included: 1) fast pressure rise from steam produced at vessel breach, 2) fast pressure rise from hydrogen generation produced at vessel breach, 3) high pressure melt ejection (fast pressure rises), 4) ex-vessel steam explosions in the reactor cavity (impulsive loads and/or fast pressure rises), 5) drywell meltthrough, 6) pedestal failure from high pressure or impulsive loads from the first four mechanisms resulting in drywell failure, and 7) alpha mode in-vessel steam explosions. In this analysis, the experts could not distinguish between mechanisms 1, 2, 3, and 4. Drywell meltthrough, pedestal-induced failure, and alpha mode failure were considered separately. We can say whether or not an ex-vessel steam explosion or HPME event occurred; but, we can not explicitly separate the effects of the various mechanisms. In addition, in the APET, ruptures in the drywell take precedence over leaks in the drywell and drywell meltthrough over ruptures by any of the other mechanisms. Since multiple failures can occur as the result of the different mechanisms, it is very difficult to determine the importance of any one mechanism individually.

Early containment failure is most likely in non-ATWS sequences (represented by PDS 5, the dominant non-ATWS PDS) to occur at vessel breach from drywell meltthrough. This accounts for roughly 73% of the early containment failure probability. However, roughly one-third of the time, some other containment failure mechanisms have occurred simultaneously with the drywell meltthrough but have been subsumed. In the other 27% of the failures early venting during core damage, pedestal-induced containment failure at vessel breach, and overpressure from the combination of events occurring at vessel breach are all about equally likely.

Early containment failure is most likely in ATWS sequences (represented by PDS 8, the dominant ATWS PDS) to occur from wetwell venting before core damage (about 77% of the time). However, drywell meltthrough still occurs about one-half of the time and subsumes venting in the accident progression bin definition. In the APBs resulting from this analysis, one finds, therefore, that drywell meltthrough occurs in about one-half of the dominant ATWS bins. It almost always occurs with some other failure mechanism such as venting. Because of the early venting, structural failure by overpressure either during core damage or at vessel breach is significantly less likely in ATWS sequences and can only occur if venting has failed (in about 4% of the cases). However, drywell meltthrough is also likely to occur in about half of these cases.

6.2.2 Fire Initiators

For fire initiated events, the probability of early containment failure is high. This is driven by the nature of the dominant PDSs, most of which do not have AC power or injection. This leads to a high probability of drywell meltthrough since the drywell will, at most, only have water in the reactor cavity sump and this is the most favorable condition for drywell meltthrough (i.e., no continuous supply of water on the debris). One fire PDS (PDS 1), does have continuous water in the form of containment sprays and, while containment failure from all modes is substantially less than in the other fire PDSs, drywell meltthrough still overwhelmingly dominates the early failure modes.

6.2.3 Seismic Initiators

For seismically initiated events, the probability of early containment failure is high (70% or greater). This is driven by the nature of the seismic event which does not allow AC power recovery and the characteristics of the dominant PDSs which do not have any continuing injection or containment heat removal. This leads to a high probability of drywell meltthrough since the drywell will, at most, only have the water in the reactor cavity sump or on the drywell floor and this is the most favorable condition for drywell meltthrough (i.e. as opposed to having some continuous supply of covering water). About 28% of the time, the containment fails initially due to the seism; but, this is subsumed by drywell meltthrough in about half the cases.

6.3 Results of Accident Progression Analysis

6.3.1 Internal Initiators

Because the Level I analysis did not resolve some of the ATWS sequences all the way to core damage, the ATWS group has a probability of 2.4% of no core damage. These involve sequences where low pressure injection is being used to cool the core and injection does not fail from severe environments or injection valve cycling. In the Level I analysis, these were conservatively assumed to go to core damage.

The LOSP group is composed of two PDSs representing a short-term station blackout with no DC power (PDS 4) and a long-term station blackout (PDS 5). These two PDSs are 46.7% of the core damage frequency and PDS 5 is 90% of the group frequency so that its characteristics dominate. There is a 0.112 probability of recovering AC power during core degradation and arresting core damage. The high probability of early drywell failure (0.569) is mostly from drywell shell meltthrough. The dominant APBs for this group have no recovery of AC power and the vessel breach occurs at high RPV pressure. The next highest APBs have AC recovery but no core damage arrest and vessel breach occurs at low RPV pressure. In either case, drywell failure by meltthrough is the dominant containment failure mechanism (although the relative probability is lower in the AC recovered cases because the drywell can be flooded by containment sprays). If drywell meltthrough does not occur then there is still some probability of failure by overpressure, venting, or pedestal failure. In 12.1% of the cases, AC power is recovered, vessel breach occurs, and the sprays provide sufficient heat removal and reduced CCI to prevent containment failure altogether.

The LOCA group is composed only of PDS 1 representing 5.8% of the mean core damage frequency. In order to get core damage, all injection had to fail and there is no possibility of recovering injection; therefore, core damage arrest is not possible. There are no high pressure RPV vessel breach scenarios because of the LOCA depressurizing the vessel. Since the drywell is flooded by water from the vessel, drywell meltthrough is less likely in this case (only 0.36). There is some probability of overpressure failure or venting; but, the availability of containment heat removal in this sequence results in a high probability of no containment failure at all (0.536).

The ATWS group is composed of four PDSs (PDSs 6, 7, 8, 9). This group is 43.1% of the mean core damage frequency. PDS 8 is 77% of the group frequency, PDS 6 is 16%, PDS 7 is 6%, and PDS 9 is 2%. Since PDSs 7, 8, and 9 are almost the same, 85% of this group is represented by PDS 8. PDSs 7, 8, and 9 were not resolved all the way to core damage in the Level I analysis and there is a group average of 2.4% of no core damage. All the PDSs have some chance of recovery of injection during core damage and arresting vessel breach. The group average is 9.1%. If vessel breach is not avoided, most accident progression bins (about 75%) will have containment venting before core damage (PDS 7, 8, and 9). Drywell meltthrough can still occur, mainly in cases were the RPV is at high pressure at vessel breach (about 50% of the time usually concurrent with wetwell venting).

The Transient group is composed of two PDSs (PDS 2 and 3). This group is 5% of the mean core damage frequency and PDS 2 is 98% of the group frequency. PDS 2 is very similar to the LOCA group with containment heat removal working but no injection recovery. PDS 3 does not have containment heat removal but does have some possibility of recovering injection. It can be seen that there is a small possibility of core damage arrest (1.4%) for the group. The rest is identical to the LOCA group and for the same reasons.

The frequency weighted average results are about equally weighted between the LOSP and ATWS groups which are dominated by PDS 5 and 8, respectively. For accidents which proceed to core damage and vessel breach, there is still a significant probability that the core debris will be cooled by an overlying pool of water and either no CCI will occur or the CCI releases will be scrubbed through the water.

6.3.2 Fire Initiators

The fire PDSs are dominated by scenarios (66%) that do not allow for the recovery of injection or containment heat removal (CHR) and they look much like short or long-term station blackout sequences. The impossibility of recovering injection or CHR, however, means that the containment failure probability will be very high from overpressure related events since the base pressure in containment can not be reduced before vessel breach and long term containment failure from overpressure can not be mitigated.

For the fire initiated PDSs, only in PDS 1 is there a significant probability of being able to cool the core debris by adding water and thereby preventing CCI.

6.3.3 Seismic Initiators

The seismic PDSs are dominated by scenarios (100%) that do not allow for the recovery of injection or containment heat removal (CHR) and they look much like short or long-term station blackout sequences. The impossibility of recovering injection or CHR, however, means that the containment failure probability will be very high from overpressure related events since the base pressure in containment can not be reduced before vessel breach and long term containment failure from overpressure can not be mitigated.

For the seismically initiated PDSs, no PDS has a significant probability of being able to cool the core debris by adding water and thereby preventing CCI. All have a dry CCI with only a possibility in some cases of an initial layer of water from a LOCA or CRD leakage.

6.3.4 Overall Insights for the Accident Progression Analysis

There are significant differences between the internal events results and the external events results. Both of the external events had a much lower probability (if any at all) for recovering injection during core damage and for having continuous water flow onto the debris in the cavity and drywell. These two differences imply that the external events PDSs will, in general, have a higher probability of early containment failure, a higher probability of drywell meltthrough, that ultimately the containment will almost certainly fail by some mechanism, and that core damage arrest will not be likely. The external events PDSs are mainly like short term station blackout sequences with no recovery of AC power and can have compounding events, such as LOCAs, in addition.

As explained in the next section (6.4), removing the possibility of drywell meltthrough will decrease the probability of early containment failure but not as much as would seem to be possible from its calculated frequency because of the fact that multiple failure modes are possible and if one does not occur than another will. Also the probability of containment failure at some time in the accident is not much affected since the probability of the late failure modes will increase to compensate for eliminating drywell meltthrough. For internal events, the total containment failure probability decreases from 0.82 to 0.70; for fire events, it decreases from 0.84 to 0.78; and, for seismic events, it does not change from 1.0.

6.4 Accident Progression Results for Sensitivity Analyses

6.4.1 Internal Initiators - No Drywell Shell Meltthrough

In this section, we will discuss the implications of a sensitivity calculation run through the APET which investigated the effect of removing completely the possibility of drywell shell meltthrough. This sensitivity analysis was done only on the APET; the results were not propagated through to risk. The internal events PDSs were run through the APET with the question pertaining to drywell meltthrough set so that meltthrough never occurred.

Two factors significantly affect the relative importance of drywell meltthrough in the analysis. First, that multiple containment failure modes can and do occur. This means that the algebraic sum of the conditional probabilities for the individual modes add up to more than the final realized probability for containment failure as a whole. The implication of this is that removing a particular mode of failure does not buy as much reduction as one might think; it depends upon the amount of overlap of that particular mode with the other modes (PDS 8 is an example of this; containment has failed by venting in almost all cases and drywell shell meltthrough occurs in addition so that removing meltthrough hardly changes the early containment failure probability). Second, that removing drywell shell meltthrough from the possible early failure modes does not affect the probabilities of the other early modes but can increase substantially, in some cases, the probability of some late containment failure modes. This means that if one is concerned with containment failure only, not just early containment failure, that removing drywell shell meltthrough may not buy much reduction (PDS 3 is an example of this; removing drywell shell meltthrough results in late failures increasing so much that the final total containment failure probability hardly changes, 0.67 vs 0.63).

The conclusion that can be drawn by looking at the two dominant plant damage states (PDS 5 and 8) is that removing drywell shell meltthrough would not change the early containment failure probability as much as expected (PDS 5, 0.75 to 0.43; PDS 8, 0.85 to 0.81).

6.4.2 Fire Initiators - No Drywell Shell Meltthrough

In this section, we will discuss the implications of a sensitivity calculation run through the APET which investigated the effect of removing completely the possibility of drywell shell meltthrough. This sensitivity analysis was done only on the APET; the results were not propagated through to risk. The fire PDSs were run through the APET with the question pertaining to drywell meltthrough set so that meltthrough never occurred.

Because of the nature of the dominant PDSs in the fire analysis, the effect of removing drywell meltthrough is even less significant then in the case of the internal event analysis. In fact, in three of the four PDSs, the probability of early containment failure is 1.0 with or without drywell meltthrough! Only in the case of PDS 1, where there is successful containment heat removal by the CSS system, does the absence of drywell meltthrough allow for the possibility of no containment failure.

The conclusion that can be drawn is that removing drywell shell meltthrough would not change the early containment failure probability as much as expected and will not affect the probability of early containment failure in three of the four fire PDSs.

6.4.3 Seismic Initiators

6.4.3.1 No Drywell Shell Meltthrough

In this section, we will discuss the implications of a sensitivity calculation run through the APET which investigated the effect of removing completely the possibility of drywell shell meltthrough. This sensitivity analysis was done only on the APET; the results were not propagated through to risk. The seismic PDSs were run through the APET with the question pertaining to drywell meltthrough set so that meltthrough never occurred.

For PDSs 1-3, one must be careful in interpreting the results since the containment has failed initially due to the seismic event. However, in 90% of the cases this is a drywell leak and in only 10% is it a drywell rupture. This affects the final result because the initial leak will prevent overpressure failures later. Also, the severity of the containment failure would be less if the failure was a leak as opposed to a rupture. So removing drywell meltthrough will not change the early containment failure probability for these PDSs, but it will change the source term. In the dominant PDS (PDS 4), drywell meltthrough is very likely (0.73); but, removing it only deceases the early failure probability by a factor of two since the other modes can occur simultaneously with drywell meltthrough. The late failure modes increase significantly in probability and containment failure is certain (1.0) by the late time frame. In fact, for all the PDSs, containment failure occurs some time during the accident whether or not drywell meltthrough can occur.

Because of the nature of the dominant PDSs in the seismic analysis, the effect of removing drywell meltthrough is even less significant then in the case of the internal event or fire analyses. In fact, in all of the seven PDSs, the probability of late containment failure is 1.0 with or without drywell meltthrough. Only in the case of PDS 5, which is a fast station blackout with a dry cavity, does the absence of drywell meltthrough allow for a significant reduction in the early containment failure probability, but it still fails late (the other fast station blackouts all involve LOCAs and have a wet drywell, vessel breach occurs at low pressure, and there is some improved possibility of preventing drywell meltthrough and pedestal failure from CCI early.

The conclusion that can be drawn is that removing drywell shell meltthrough would not change the early containment failure probability as much as expected and will not significantly affect the probability of early containment failure in four of the seven seismic PDSs.

6.4.3.2 No CFs at the Start due to RPV Support Failures

For the seismic initiators, one sensitivity was carried all the way through the analysis. The sensitivity involved the effects of elimination of the possibility of initial containment failure in PDSs 1-3 as a result of the seism inducing a twisting motion to the RPV which results in a tearing of the drywell shell wall at one of the penetrations. Removing the initial containment failure hardly affected the probability of early containment failure because of compensating increases in the other failure modes. Containment failure was ultimately assured in all cases.

By comparing the fifteen most probable bins for each PDS for the base case and sensitivity case, we found that the most obvious difference in the accident progression was the reduction in the number of bins with large reactor building bypass. This is primarily due to the fact that the initial leak allows the hydrogen produced during the in-vessel phase of the accident and after to be released more continuously and that the releases occur at lower pressures. This results in lower hydrogen concentrations, lower peak pressures both with and without burns, and lower bypass levels.

Also the nine out of fifteen bins that had initial containment failure that was not superseded by drywell meltthrough were now replaced by other containment failure modes during core damage or at vessel breach such as: wetwell venting, overpressure failures in the wetwell or drywell, and drywell failures induced by pedestal failure.

6.5 Source Term Analysis Results

The range in the release fractions for similar accidents is large; typically several orders of magnitude. Although the containment is predicted to fail in most of the accidents analyzed, there are several features of Peach Bottom that tend to mitigate the release. First, the in-vessel releases are generally directed to the suppression pool where they are subjected to the pool DF. Although not as effective as the suppression pool, the containment sprays and water in the reactor cavity and on the drywell floor also offer mechanisms for reducing the release of radionuclides from the containment. The reactor building at Peach Bottom also offers a decontamination mechanism since, if not completely bypassed, the radionuclides have a significant chance of being retained in the reactor building after being released from containment. The largest releases tend to occur when the suppression pool is bypassed and the containment sprays are not operating. Furthermore, because many of the dominant accidents are SBOs, it is not uncommon for the containment sprays to be unavailable at the time of vessel breach. In these accidents, releases that occur at vessel breach (e.g., release associated with DCH or an ex-vessel steam explosion) and after vessel breach (e.g., CCI releases) bypass the suppression pool and are not subjected to either a pool DF or a spray DF.

6.6 Risk Results

6.6.1 Absolute Value of Risk

6.6.1.1 Internal Initiators

The early fatality risk at Peach Bottom for internal initiators is relatively low, both with respect to the safety goals and with respect to the PWR plants analyzed in NUREG-1150. There are several factors that lead to these low values for risk. First, the core damage frequency for Peach Bottom is very low. The mean core damage frequency is 4.3E-06/yr. and the risk is roughly proportional to the core damage frequency. Second, although it is likely that the containment will fail given that core damage occurs, there are several features of the Peach Bottom plant and the surrounding area that tend to reduce the consequences, since the early fatality risk depends on the magnitude of the release, the timing of containment failure, and the number of people exposed to the release.

There is a threshold effect associated with early fatalities. That is, to cause an early fatality, the release must be of a certain magnitude (i.e., above a certain threshold). There are several features of the Peach Bottom plant that reduce the magnitude of the source term. First, in the majority of the accidents analyzed, the in-vessel releases are scrubbed by the suppression pool. Second, because one of the dominant PDS groups (Slow SB, PDS 5 = 42% of the mean core damage frequency) is a long-term SBO, there is a significant probability that AC power will be recovered and coolant injection will be restored to the core such that the core damage process is arrested before the vessel fails. Third, given that the vessel does fail, it is likely that either the core debris released from the vessel will be cooled or if CCI is initiated it will occur with water being sprayed upon it.

If the containment fails early in the accident it is more likely that a portion of the population will be exposed to the release than if the containment fails after the nearby population has been evacuated. For the long-term station blackout accidents that are one of the two dominant PDSs, there is a long time to core damage and, therefore, a long time in which to evacuate the nearby population. The containment is most likely to fail at or near vessel breach and a general emergency would have been called long before that time.

Also, the low early fatality risk can, in part, be attributed to the fast evacuation of the population around the plant. Even if the accidents are from the other dominant PDS (ATWS, PDS 8 = 33% of the mean core damage frequency), the population in the vicinity of the plant is fairly sparse and can be evacuated ahead of the plume. This is due to a short evacuation delay and a fast evacuation speed. Thus, in many of the accidents analyzed, most of the population was evacuated in such a way that they were not exposed to the plume from the accident.

For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers. Because the total conditional probability of containment failure is high (i.e., the containment is likely to fail some time during the accident, either early or late), the low values for latent cancer fatalities can be attributed to the low core damage frequency.

6.6.1.2 Fire Initiators

The early fatality risk at Peach Bottom from fire initiators is also relatively low, both with respect to the safety goals and with respect to the PWR plants analyzed in NUREG-1150. The same factors leading to low risk from internal initiators leads to these low values for risk from fire initiators.

The fire core damage frequency for Peach Bottom is relatively low. The mean core damage frequency is 2.0E-05/yr. and the risk is roughly proportional to the core damage frequency. Even though this is a factor of five larger than the internal initiator frequency, it is still very low.

For the threshold effect associated with early fatalities, in the majority of the accidents analyzed for fire, the in-vessel releases are also scrubbed by the suppression pool. Since the dominant PDS group for fire (PDS 1 = 33% of the mean core damage frequency) is a fast transient, there is a significant probability that injection will be recovered and vessel breach avoided. If the vessel does fail for the dominant PDS, it is likely that either the core debris released from the vessel will be cooled or, if CCI is initiated, it will occur with water being sprayed upon it.

For early containment failure, in the long-term station blackout accidents and the long-term containment heat removal PDSs that are three of the four dominant PDSs for fire (PDSs 2-4 = a total of 77% of the mean core damage frequency), there is a long time to core damage and, therefore, a long time in which to evacuate the nearby population. The containment is most likely to fail at or near vessel breach and a general emergency would have been called long before that time.

For early fatality risk, even if the accidents are from PDS 1 which has a relatively short time to vessel breach, the population in the vicinity of the plant is fairly sparse and can be evacuated ahead of the plume.

For latent cancer fatalities, because the total conditional probability of containment failure is high (i.e., the containment is likely to fail some time during the accident, either early or late), the low values for latent cancer fatalities can be attributed to the low core damage frequency.

6.6.1.3 Seismic Initiators - LLNL Hazard Curve

The mean early fatality risk at Peach Bottom from seismic initiators using the LLNL hazard curve is greater than the safety goal and greater than the PWR plant analyzed in NUREG-1150 (Surry). There are several factors that lead to these relatively high values for risk. First, the core damage frequency for Peach Bottom is fairly high from seismic events using the LLNL hazard curve and the distribution tends to favor the high PGA cases because of the long tail on the distribution. The mean core damage frequency is 7.5E-05/yr. and the early fatalities are roughly proportional to the core damage frequency for seismic events because of the evacuation assumptions. Even though this is a factor of seventeen larger than the internal initiator frequency, it is still relatively low as core damage frequencies go (i.e., even adding up the seismic, fire, and internal mean core damage frequencies, the total core damage frequency is about 1.0E-04/yr. which is within the NRC's core damage frequency goal). Second, the evacuation assumptions guarantee that a large part of the nearby population will receive significant exposure given that an event occurs.

The latent cancer fatality risk is less than the safety goal at Peach Bottom but still greater than the corresponding risk at the PWR plant (Surry). For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers (for high PGA cases this is moot because the population does not evacuate). Because the total conditional probability of containment failure is certain for seismic events, the low values for latent cancer fatalities can be attributed to the low core damage frequency.

6.6.1.4 Seismic Initiators - EPRI Hazard curve

The mean early fatality risk at Peach Bottom from seismic initiators using the EPRI hazard curve is less than the safety goal (although the upper bound is close to the goal) and greater than the PWR plant analyzed in NUREG-1150 (Surry). There are several factors that lead to these relatively low values for risk. First, the core damage frequency for Peach Bottom is fairly low from seismic events using the EPRI hazard curve and the distribution tends to favor the low PGA cases more than the LLNL hazard curve because the tail of the distribution drops off faster with the EPRI curve than with the LLNL curve. The mean core damage frequency is 3.2E-06/yr. and the early fatalities are roughly proportional to the core damage frequency for seismic events because of the evacuation assumptions. Second, while the evacuation assumptions guarantee that a large part of the nearby population will receive significant exposure given that an event occurs, in the low PGA cases, which constitute 8% more of the core damage frequency than in the LLNL case, some people can still evacuate before the plume reaches them.

The latent cancer risk is also less than the safety goal using the EPRI curve. For latent cancer fatalities, the risk is generally dominated by that part of the population located over ten miles from the plant. Thus, this risk measure is not particularly sensitive to the timing of containment failure or the evacuation assumptions, but rather whether the containment fails or not. Furthermore, because there is no threshold effect for latent cancer fatalities, this consequence measure is not as sensitive to the magnitude of the release as is the early fatality risk. Thus, latent cancer fatality risk is primarily dependent on the frequency of containment failure. Unlike early fatality risk, late containment failures as well as early failures of the containment are important to the latent cancers (for high PGA cases this is moot because the population does not evacuate). Because the total conditional probability of containment failure is certain for seismic events, the low values for latent cancer fatalities can be attributed to the low core damage frequency.

The EPRI results are generally a factor of ten to one hundred lower than the corresponding LLNL risk measure.

6.6.2 Uncertainty in Risk

For internal initiators, the regression analyses account for > 66% of the observed variability. Variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the internal analysis is dominated by source term variable uncertainty (FCOR, FCONC, and FCCI); but, for fire and seismic initiators, the result is different. The reason for this result in the internal analysis is that the risk is determined by two PDSs. The LOSP PDS does not have large uncertainties in the initiating event frequency or in recovery of LOSP. The ATWS PDS has a large uncertainty in the failure to scram frequency; but, since it only contributes one half the risk, that variable is only the 3rd to 4th most important. The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor drywell meltthrough is almost certain to occur, its importance to uncertainty is lower than would be expected just based on its probability of occurrence.

For fire initiators, the regression analyses account for > 65% of the observed variability. Again, variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the fire analysis is dominated by source term variable uncertainty for early fatalities (FCOR, FCONC, and FCCI); but, for latent cancers, the Level I variables dominate (fire initiating event frequency and diesel generator failure to run). The reason for this result is that the early fatalities depend critically on the magnitude of the source term; but, the latent cancers depend mainly upon whether or not the accident occurs. The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor drywell meltthrough is almost certain to occur, its importance to uncertainty is lower than would be expected just based on its probability of occurrence.

For seismic initiators, the regression analyses account for > 66% of the observed variability. Again, variables from all of the sampled analyses contribute to the uncertainty in risk. Depending upon the PDS characteristics, variables from any of the three sampled analyses can be most important. The overall result for the seismic analysis is dominated by Level I variables, in particular, the uncertainty in the seismic hazard curve. The source term variables are the next most important (FCONC and RBDF). The accident progression variable that is most important to uncertainty is drywell meltthrough. Since in many accidents without water on the drywell floor drywell meltthrough is almost certain to occur, its importance to uncertainty is lower than would be expected just based on its probability of occurrence.

6.7 Sensitivity Study Results

6.7.1 Sensitivity Results For LLNL Seismic Analysis With No Early Containment Failure

Eliminating immediate containment failure resulted in only a slight drop in the early fatality and latent cancer frequencies. This is because the high PGA cases dominant the risk and, in these cases, the people are not evacuated for 24 hours. This means that, since containment failure is certain at some time in the accident progression for seismic sequences, the people still get caught in the release. The radioactive decay and differences in the containment failure modes, result in a slightly smaller exposure.

6.7.2 Sensitivity Results For EPRI Seismic Analysis With Normal Evacuation Speed For Low PGA

Using the normal non-seismic evacuation assumptions had hardly any effect on the results. This is because the high PGA cases dominant the risk and, in these cases, the people are not evacuated for 24 hours. This means that the low PGA evacuation assumptions will not have a large impact on the risk. Also, even with the reduced evacuation speed and longer delay time in the base case, the low PGA cases are not that affected. In PDSs 1, 2, and 3, since the containment fails immediately, the evacuation assumptions do not have that great an effect. In the other PDSs, the people get out before the plume even with the degraded evacuation assumptions.

6.8 Comparison to Safety Goals

For both individual early fatality risk within one mile of the site boundary and individual latent cancer fatality risk within ten miles, the maximum value for risk from the 200 values that make up the risk distribution, the 95th%, and the mean value are all far below the safety goals for internal initiators. For fire initiators, the results are lower than the safety goals but the maximum value is much closer for the individual early fatality risk than for internal events (i.e, within a factor of 15 as opposed to 900 for internal initiators). For the seismic analysis performed using the LLNL hazard curve, the individual early fatality risk exceeds the safety goal for all three values and the individual latent cancer risk exceeds the safety goals for the maximum value but not for the mean or 95th%. The value is within a factor of ten of the early fatality safety goal for the mean value, however. For the seismic analysis performed using the EPRI hazard curve, the individual early fatality risk exceeds the safety goal for the maximum value, is about the same as the safety goal for the 95th%, and is a factor of ten less for the mean value. For the individual latent cancer risk, the maximum is just less than the safety goal and the 95th% and the mean are a factor of 100 less than the safety goal. Table 6.1 summarizes the comparison for all the constituent analyses.

Table 6.1
Comparison with Safety Goals (/yr.)

	Safety Goal	Internal Analysis	Fire Analysis	Seismic Analysis		
				LLNL	EPRI	
Individual Early Fatality Risk 0-1 Mi.	5.0E-07	4.7E-11	4.8E-10	1.6E-06	5.3E-08	Mean
		2.4E-10	1.7E-09	4.3E-06	1.8E-07	95%
		5.8E-10	1.6E-08	1.4E-04	2.9E-06	Maximum
Individual Latent Cancer Fatality Risk 0-10 Mi.	2.0E-06	4.3E-10	2.4E-09	3.4E-07	1.1E-08	Mean
		9.1E-10	8.1E-09	6.4E-07	3.0E-08	95%
		1.9E-08	4.4E-08	3.8E-05	8.2E-07	Maximum