AEB-98-01

Detailed Modeling and Analysis of Phase III of the Revised (NUREG-1465) Source Term Rebaselining for Operating Reactors

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Date: September 23, 1998

DF02

Table of Contents

Table of Contents 2

Introduction 3

DBA LOCA Dose Calculations Using Updated Removal Mechanism Modeling 5
- Surry 5
  - Containment Leak Model 5
  - ECCS Leak Model 9
  - Results 11
- Grand Gulf 12
  - Containment Leak Model 12
  - ECCS Leak Model 16
  - Results 17
- Zion 19
  - Containment Leak Model 19
  - ECCS Leak Model 21
  - Results 22

Dose Calculations Based on MELCOR Environmental Releases for Recovered Large-Break LOCA 23
- Surry 23
- Grand Gulf 27
- Zion 30

REFERENCES 33

APPENDIX A: RADTRAD Input Deck Listings 35
- Surry Containment Leakage Model: PMF file 36
- Surry Containment Leakage Model: SDF file 38
- Surry ECCS Leakage Model: PMF file 42
- Surry ECCS Leakage Model: SDF file 43
- Grand Gulf Containment Leakage Model: PMF file 46
- Grand Gulf Containment Leakage Model: SDF file 50
- Grand Gulf ECCS Leakage Model: PMF file 61
- Grand Gulf ECCS Leakage Model: SDF file 63
- Zion Containment Leakage Model: PMF file 68
- Zion Containment Leakage Model: SDF file 69
- Zion ECCS Leakage Model: PMF file 72
- Zion ECCS Leakage Model: SDF file 73
- Dose Conversion Factors File: FGR60.INP 76
- Release Fractions and Timing File: PWR_DBA.RFT 90
- Nuclide Information File: PWR_DEF.NIF 91
- Release Fractions and Timing File: BWR_DBA.RFT 103
- Nuclide Information File: BWR_DEF.NIF 104

Introduction

In order to more fully evaluate issues associated with implementation of the revised source term (Reference 1) at operating reactors, including assessment of the impact of revised dose acceptance criteria, the staff undertook a systematic evaluation of dose analyses for a range of accidents at representative plants. This evaluation, termed rebaselining, was intended to explore significant trends, evaluate generic implications, and where possible, identify types of plant specific dependencies. The principal technical issues of rebaselining concerned the effect of the revised source term on calculation of individual offsite and control room doses, the effect on the dose calculation used for equipment qualification, and the impact of potential plant changes both on dose analyses and on severe accident risk. In implementing the rebaselining activity, the work was broken down into four phases, which divided the work according to the types of analyses and allowed insights gained to be incorporated into subsequent phases.

The purpose of this Accident Evaluation Branch report is to describe in more detail the modeling and analysis underlying the Phase III results presented in SECY-98-154 of June 30, 1998 (Reference 2). In particular, this Accident Evaluation Branch report describes two parts of the Phase III analysis. First, DBA dose calculations for the LOCA performed with the RADTRAD code and updated modeling are described. Second, dose calculations based on MELCOR environmental releases for a recovered large-break LOCA are described. These calculations were performed for three representative plants, namely, Surry, Grand Gulf, and Zion. A discussion of the elements of the four phases of rebaselining is given below.

In Phase I, analyses were performed to calculate DBA doses using both the TID (Reference 3) and revised source terms to assess the impact of the revised source term (and newer dose conversion factors) on individual dose. Calculations were performed for a spectrum of design based accidents including loss of coolant, fuel handling, main steam line break, and rod drop accidents. Analyses in Phase I were performed using the analytical assumptions employed in the staff's confirmatory analyses and documented in the safety evaluation report. Analyses of the main steam line break accident do not specifically involve the revised source term, however calculations were performed in this case to assess the revised dose acceptance criteria. Also, in the case of the fuel handling accident, the entire TID and NUREG-1465 source terms are not involved but rather the fission product release is limited to gap activity.

Phase II addressed the same types of calculations as Phase I (i.e., DBA dose calculations) but in Phase II the calculations were performed using the analytical models and assumptions employed by the licensees in their analyses described in the FSAR. The intent here was to evaluate the representative impact of the revised source term using industry methods to determine if different impacts would be seen. The staff also included in Phase II equipment qualification dose calculations using both the TID and NUREG-1465 source terms. As noted previously, the staff, as part of implementing the revised source term, will apply revised dose acceptance criteria (TEDE methodology) and a modification to the two hour interval for determining EAB doses. Rebaselining in Phases I and II also explored the impact of those revisions.

In Phase III, the staff addressed the impact of updated models in the RADTRAD code for fission product removal mechanisms by comparison with calculations using equivalent SRP models. (Phase I calculations using SER assumptions employed treatments which in some areas predate the SRP methods). All Phase III analyses utilized the revised source term. Phase III analyses also considered the calculation of doses using the MELCOR severe accident

code (References 4 and 5). MELCOR, which is an integrated code containing models for thermal hydraulic and fission product behavior, was used to assess margins in the DBA dose calculation. As part of Phase III, a study was also undertaken (Reference 8) to examine the long term revolatilization of iodine from the containment sump. As noted, the revised source term prescribes a relatively modest amount of iodine in vapor form. A condition which, in theory, could challenge the validity of this assumption is the long term revolatilization of iodine from water pools which are or have become acidic following an accident. Analyses were performed then to determine the extent of revolatilization of iodine, using the TRENDS code, a containment water chemistry code. These analyses predict both the transient pH of the sump/suppression pool and the amount of iodine revolatilization.

In Phase IV, a study was conducted to assess potential plant changes that may be feasible with the use of the revised source term. Some specific plant modifications have been proposed by pilot plants in conjunction with a generic industry proposal described in EPRI Technical Report, TR-105909, "Generic Framework for Application of Revised Source Term to Operating Plants," November 1995 (Reference 6). In addition to the specific plant modifications described in pilot plant submittals, the staff also evaluated other generic candidates such as containment leak rates. Finally, modification of plant systems, while acceptable from a design basis regulatory standpoint, may have severe accident risk impacts. Therefore, as part of Phase IV, we included the results of a study (Reference 9) to evaluate severe accident risk impacts of potential plant changes which may arise as a result of implementing the revised source term.

As indicated above, this report describes the modeling and analysis underlying two parts of Phase III of the rebaselining study. Results of the remaining parts of Phase III and the other phases described above are reported separately. Phase I work is documented in Reference 4. Phase II work is documented in Reference 4 with the exception of the Zion plant calculations which are documented in Reference 7. The Phase III work not documented in this report is documented in References 4, 5, and 8. The Phase IV work is documented in References 4 and 9.

DBA LOCA Dose Calculations Using Updated Removal Mechanism Modeling

The DBA LOCA dose calculations in Phase III used the NUREG-1465 source term along with the FSAR plant models. However, instead of using the FSAR spray removal rate constants and suppression pool decontamination factors, the values from the SRP models (Reference 10), and the models described in NUREG/CR-5966 (Reference 11) and NUREG/CR-6153 (Reference 12) were used. The following sections describe the DBA dose calculations performed for the Surry, Grand Gulf, and Zion plants.

These calculations were performed using the RADTRAD 2.20 code (Reference 13). The following describes the input parameters and modeling assumptions used in the Phase III analysis performed by the Accident Evaluation Branch (refer to the RADTRAD code manual, Reference 13, for further details on the input file requirements). The iodine chemical form fractions used in all of the RADTRAD calculations is from NUREG-1465 and is:

Form	Fraction
Elemental	0.0485
Organic	0.0015
Aerosol	0.9500

The dose conversion factors (DCF) were specified in file "FGR60.INP", which are the DCFs from EPA Federal Guidance Reports 11 and 12 (References 14 and 15). This file is reproduced in Appendix A of this report.

Surry

In the Surry analysis, the release fractions and timing used in RADTRAD are the NUREG-1465 specified release for a PWR and are contained in the file "PWR_DBA.RFT". RADTRAD options were set to model decay with no daughter products. The nuclide inventory which specifies nuclides considered, decay constants, and the Ci/MW values, are contained in the file "PWR_DEF.NIF". These two files are reproduced in Appendix A of this report.

The Surry DBA LOCA scenario was modeled by two leak paths to the environment: (1) a leak from the containment atmosphere and (2) a leak of containment sump water through the ECCS system in the safeguards building.

Containment Leak Model

For Surry, the RADTRAD nodalization of the containment leakage to the environment is shown in Figure 1. The corresponding input decks (SS3100P5.PMF and SS3100P5.SDF) are in Appendix A. Model details are shown in the following tables.

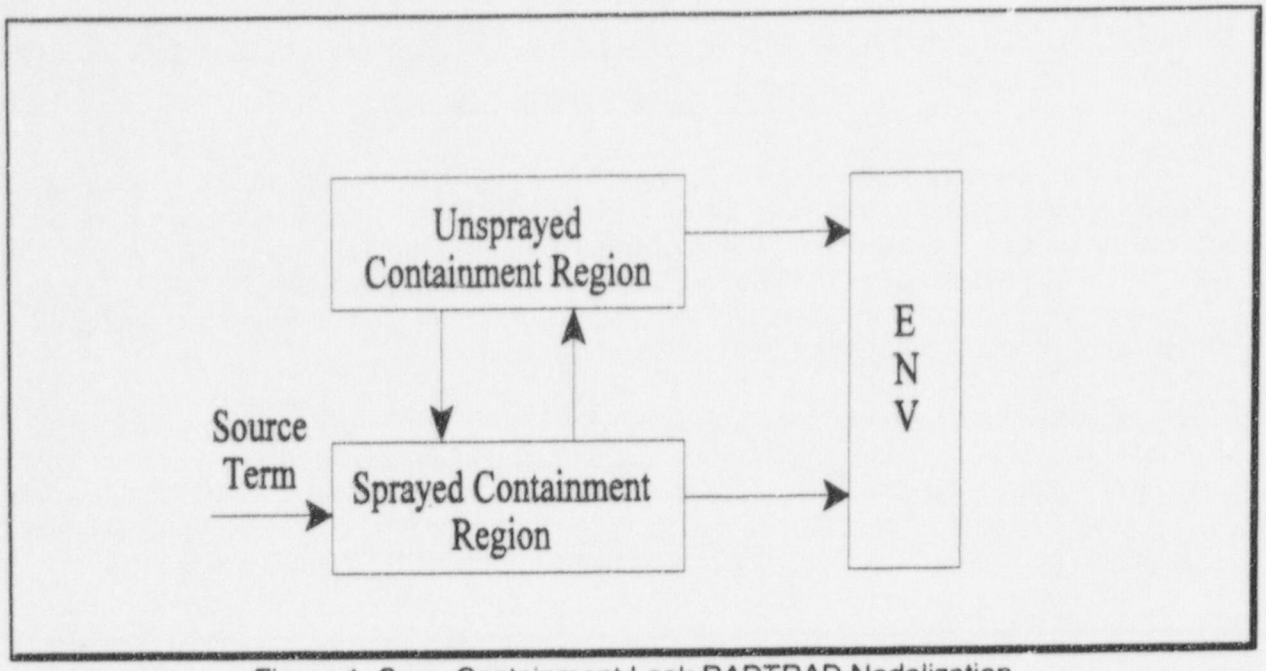

Figure 1: Surry Containment Leak RADTRAD Nodalization

Containment Leak Model Parameters	
Parameter	Value
Plant Power	2605 MWt
Release Fractions and Timing	As specified for PWR in NUREG-1465 (gap and early in-vessel releases only)
Release Location	Directly to sprayed portion of containment
Containment Volume	1.863×10^6 ft^3
Containment Sprayed Volume	1.36×10^6 ft^3
Containment Leak Rate (Both Regions)	0.1%/day for the first hour, 0%/day thereafter

Containment Leak Model Parameters	
Parameter	Value
Containment Spray Removal Rate Constant for Particulates	SRP: 3.48 hr^{-1} (with h=71.6 ft, F=1800 gpm, V=1.36x10^6 ft^3) Note: The SRP specifies that this constant decreases by a factor of 10 after DF=50. However, because the release does not come out all at once, the time it takes to reach this DF is uncertain. Also, we concluded that reducing the spray constant would not significantly impact the results. Powers[1] Model, 90%, initial value: 11.5 hr^{-1} Powers Model, 50%, initial value: 5.4 hr^{-1} Powers Model, 10%, initial value: 2.2 hr^{-1} (with Q=0.012668 cfm/ft^3, H=71.6 ft)
Containment Spray Removal Rate Constant for Elemental Iodine	10.0 hr^{-1} for entire 30 days
Containment Spray Removal Rate Constant for Organic Iodine	0.0
Sprays Initiation Time	Start of Accident
Flow Rate from Sprayed to Unsprayed Volume	Twice the unsprayed volume per hour
Flow Rate from Unsprayed to Sprayed Volume	Twice the unsprayed volume per hour

Control Room Model Parameters	
Control Room Volume	2.23x10^5 ft^3
Control Room Inlet:	Flow Rate: 1000 cfm Filter Efficiency: 90%
Control Room Unfiltered In-leakage	Flow Rate: 10 cfm
Iodine Protection Factor (CR entrance thyroid dose/CR thyroid dose)	1st hour: 31 After 1st hour: 9.18
Murphy-Campe Geometry Factor (CR whole body semi-infinite cloud dose / CR whole body dose)	18.263

[1]The "Powers" model refers to the spray removal model specified in Reference 11.

Meteorology Data	
Exclusion Area Boundary	
Time (hr)	X/Q (s/m^3)
0-720	1.16×10^{-3}
Low Population Zone Distance	
Time (hr)	X/Q (s/m^3)
0-8	5.04×10^{-5}
8-24	3.43×10^{-5}
24-96	1.49×10^{-5}
96-720	4.5×10^{-6}
Control Room (from Containment leak location)	
Time (hr)	X/Q (s/m^3)
0-8	4.03×10^{-3}
8-24	2.52×10^{-3}
24-96	1.43×10^{-3}
96-720	4.03×10^{-4}

Control Room (from ECCS leak location)	
Time (hr)	X/Q (s/m^3)
0-8	4.02×10^{-3}
8-24	2.49×10^{-3}
24-96	1.41×10^{-3}
96-720	4.03×10^{-4}
Breathing Rate for Exclusion Area Boundary	
0-30 days	3.47×10^{-4} m^3/s
Breathing Rate for Low Population Zone Distance	
Time (hr)	Breathing Rate (m^3/s)
0-8	3.47×10^{-4}
8-24	1.75×10^{-4}
24-720	2.32×10^{-4}
Control Room Occupancy and Breathing Rates	
Time (hr)	Occupancy Factor	Effective Breathing Rate (m^3/s)
0-24	1.0	3.47×10^{-4}
24-96	0.6	2.082×10^{-4}
96-720	0.4	1.388×10^{-4}

ECCS Leak Model

The nodalization used for the ECCS leakage is shown in Figure 2. The corresponding input decks (S3300N.PMF, SS3100N.SDF) are in Appendix A. Model details are shown in the following table.

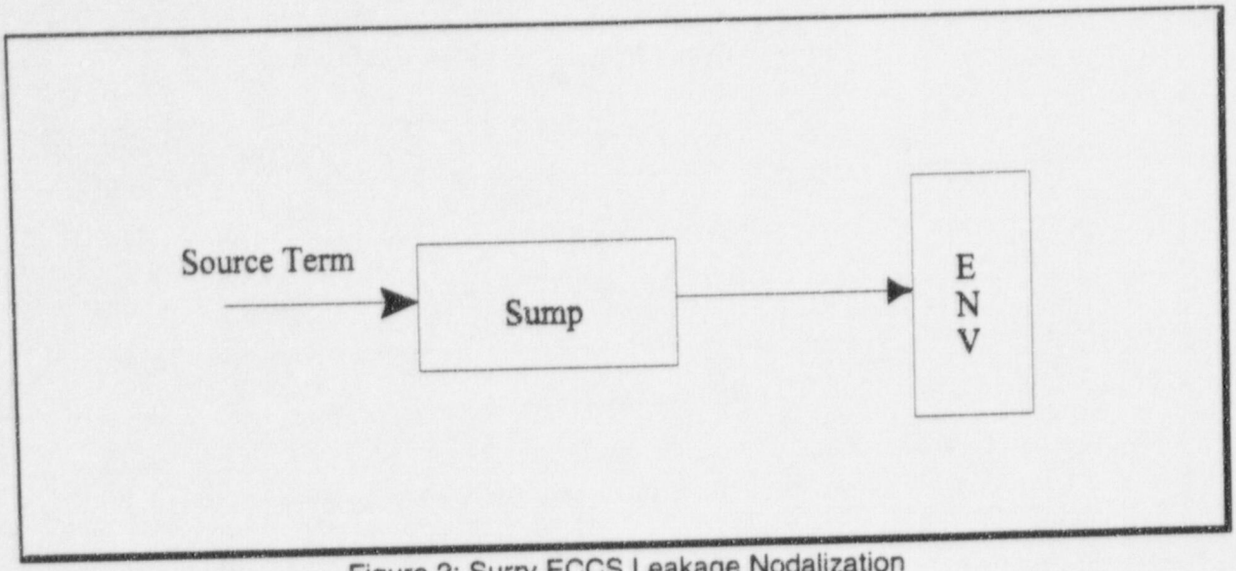

Figure 2: Surry ECCS Leakage Nodalization

ECCS Leak Model Parameters	
Plant Power and Release Fractions and Timing are the same as in the containment leak model discussed previously.	
Release Location	Directly into the containment sump
Sump Water Volume	5.826×10^{4} ft^3
Leak Rate to Environment	
Time (hours)	Leak Rate (cfm)
0.0000-0.4833	1.133×10^{-3}
0.4833-720.00	5.650×10^{-3}
Partition Factor	10% of the iodine in the leaked ECCS water becomes airborne in the safeguards building
Safeguard filters	90% efficiency
Mixing and Hold-up in Safeguards Building	Not modeled

Results

Table 1 shows the results of the Surry DBA LOCA analysis. There are several insights that were obtained from this analysis. For the EAB, the first two hours are the worst two hours, because the subatmospheric containment does not leak after one hour. Also, the TEDE dose is mainly from iodine. With the exception of the EAB thyroid dose for the FSAR λ_p (λ_p = spray removal rate constant) case, EAB and LPZ doses with the NUREG-1465 source term are a small fraction of the 300 rem thyroid and 25 rem whole body and TEDE limits. Also, control room thyroid doses are about one half of the 30 rem thyroid limit. Finally, ECCS leakage is important for LPZ and control room thyroid doses, but it is unimportant for other doses.

Table 1: Results of Surry DBA LOCA Analysis

Total Dose (rem) from Containment Leakage and ECCS Leakage									
Spray Model	EAB			LPZ			Control Room		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
FSAR λ_p	108	0.58	4.93	5.78	0.025	0.25	22.8	0.120	0.940
SRP λ_p	62	0.40	2.95	3.81	0.018	0.16	17.5	0.082	0.690
10% λ_p	76	0.46	3.55	4.41	0.021	0.19	19.2	0.092	0.760
50% λ_p	48	0.35	2.33	3.21	0.016	0.14	16.0	0.071	0.620
90% λ_p	29	0.27	1.47	2.37	0.013	0.10	13.8	0.057	0.510
Dose (rem) from ECCS Leakage Only									
	EAB			LPZ			Control Room		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
NA	1.53	0.01	0.05	1.16	0.001	0.04	10.6	0.005	0.332

Grand Gulf

The RADTRAD calculations for Grand Gulf use the NUREG-1465 specified release fraction and timing for a BWR, which are included in the file "BWR_DBA.RFT". RADTRAD options were set to model decay with no daughter products. The nuclide inventory which specifies nuclides considered, decay constant, and the Ci/MW values, was from file "BWR_DEF.NIF". These two data files are reproduced in Appendix A of this report.

The Grand Gulf DBA LOCA scenario was modeled by two leak paths to the environment: (1) a leak from the containment building atmosphere and (2) a leak of suppression pool water through the ECCS.

Containment Leak Model

The nodalization is shown in Figure 3. The corresponding input decks (GGF5.PMF and GGP5.SDF) are in Appendix A. Model details are shown in the following tables.

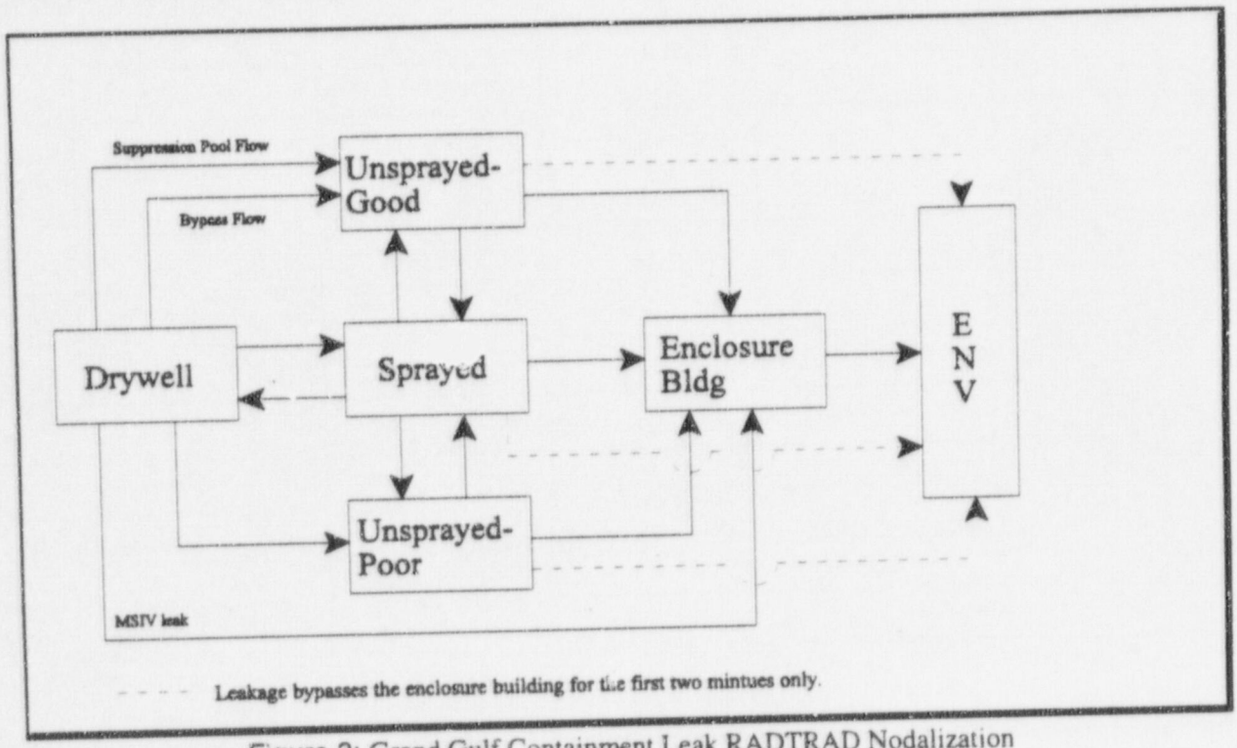

Figure 3: Grand Gulf Containment Leak RADTRAD Nodalization

Containment Leak Model Parameters	
Parameter	Value
Plant Power	3910 MWt
Release Fractions and Timing	As specified for BWR in NUREG-1465 (gap and early in-vessel releases only)

Containment Leak Model Parameters			
Parameter		Value	
Release Location		Directly to Drywell	
Drywell Volume		2.7×10^5 ft^3	
Wetwell (Containment) Volume		1.4×10^6 ft^3	
Volume of sprayed region		9.927×10^5 ft^3	
Volume of unsprayed region with good communication with sprayed region		2.383×10^5 ft^3	
Volume of unsprayed region with poor communication with sprayed region		1.690×10^5 ft^3	
Mixing Rate Between Sprayed Region and Good Unsprayed Region		While sprays are off: 4100 cfm During sprays operation: 66000 cfm	
Mixing Rate Between Sprayed Region and Poor Unsprayed Region		5600 cfm	
Containment Leak Rate		0.35% of each wetwell region/day	
Drywell to wetwell flows that bypass the suppression pool:			
Time (hours)	Sprayed Region (%/day)	Unsprayed Region with Good communication	Unsprayed Region with poor communication
0-0.0014	1.3×10^4	1.3×10^4	1.3×10^4
0.0014-0.0083	1.1×10^4	1.1×10^4	1.1×10^4
0.0083-0.3333	0.8×10^4	0.8×10^4	0.8×10^4
0.3333-720	6222	6222	6222
Flow from drywell to unsprayed-good region through suppression pool			
Time (hours)		Flow Rate (cfm)	
0-0003		0	
.0003-0028		8.83×10^6	
.0028-0055		6.79×10^6	
.0055-0093		2.92×10^6	
.0093-.22		0	
.22-24		1000 (hydrogen purge compressor)	

Containment Leak Model Parameters	
Parameter	Value
24-720	0
Suppression Pool decontamination factor for inorganic iodine: 10	
Flow from Drywell to enclosure building through MSIV leak:	
Time (hours)	Flow rate (scfh)
0-.33	0
.33-2.91	25
2.91-720	100
Containment Spray Removal Rate Constant for Particulates	SRP: 13.4 hr^{-1} for entire 30 days (with h_a= 62.85 ft, h_b=65.64 ft, F=5650 gpm,V= $9.927x10^5 ft^3$) Note: The SRP specifies that this constant decreases by a factor of 10 after DF=50. However, because the release does not come out all at once, the time it takes to reach this DF is uncertain. Also, we concluded that reducing the spray constant would not significantly impact the results. Powers Model, 90%, initial value: 40.0 hr^{-1} Powers Model, 50%, initial value: 20.9 hr^{-1} Powers Model, 10%, initial value: 7.5 hr^{-1} (with Q=0.04888 cfm/ft^3, H=64.245 ft)
Containment Spray Removal Rate Constant for Elemental Iodine	6.9 hr^{-1} for entire 30 days
Containment Spray Removal Rate Constant for Organic Iodine	0.0
Sprays Initiation Time	30 minutes after accident initiation

Meteorology Data	
Exclusion Area Boundary	
Time (hr)	X/Q (s/m^3)
0-720	$1.26x10^{-3}$

Meteorology Data	
Low Population Zone Distance	
Time (hr)	X/Q (s/m^3)
0-2	2.84×10^{-4}
2-8	1.56×10^{-4}
8-24	1.16×10^{-4}
24-96	6.06×10^{-5}
96-720	2.39×10^{-5}
Control Room	
Time (hr)	X/Q (s/m^3)
0-0.333	1.34×10^{-3}
0.333-8	3.29×10^{-4}
8-24	1.96×10^{-4}
24-96	1.08×10^{-4}
96-720	6.98×10^{-6}

Breathing Rates	
Exclusion Area Boundary	
Time (hr)	Breathing Rate (m^3/s)
0-720	3.47×10^{-4}
Low Population Zone Distance	
Time (hr)	Breathing Rate (m^3/s)
0-8	3.47×10^{-4}
8-24	1.75×10^{-4}
24-720	2.32×10^{-4}

Breathing Rates		
Control Room		
Time (hr)	Occupancy Factor	Effective Breathing Rate (m^3/s)
0-24	1.0	$3.47x10^{-4}$
24-96	0.6	$2.082x10^{-4}$
96-720	0.4	$1.388x10^{-4}$

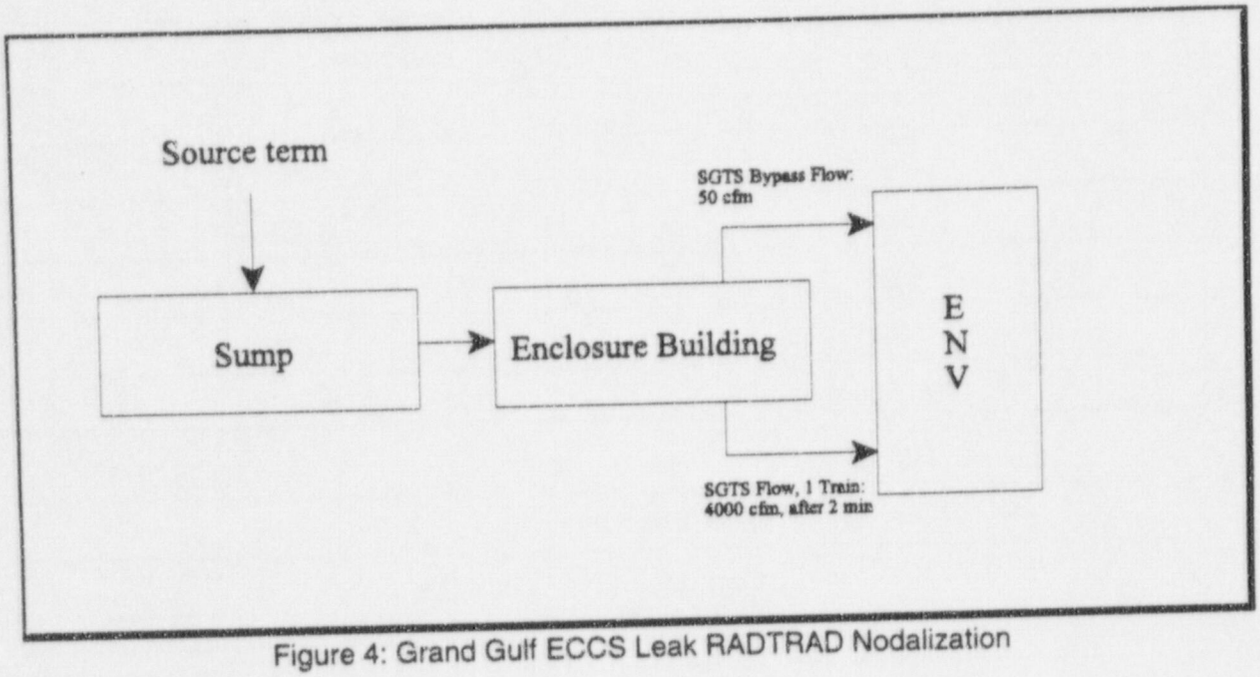

Figure 4: Grand Gulf ECCS Leak RADTRAD Nodalization

ECCS Leak Model

The nodalization is shown in Figure 4. The corresponding input decks (GG21D0N.PMF and GG21D0N.SDF) are in Appendix A. Model details are shown in the following tables.

ECCS Leak model		
Plant Power and Release Fractions and Timing are the same as in the containment leak model discussed previously.		
Sump Water Volume (minimum volume of water in the suppression pool)	$1.22x10^5$ ft^3	
Leak Rate to Enclosure Building	0-58 seconds	0.0 cfm

ECCS Leak model		
	58 seconds-720 hours	0.1366 cfm
Enclosure Building Volume	3.0×10^5 ft^3	
Standby Gas Treatment System (SGTS) flow rate through filter	0-2 minutes	0.0
	2 minutes-720 hours	4000 cfm
SGTS flow rate bypassing filter	0-2 minutes	0
	2 minutes-720 hours	50 cfm
SGTS Filter Efficiency	99% for all forms of iodine	
Partition Factor	10% of the iodine in the leaked ECCS water becomes airborne.	

Results

Table 2 shows the results of the Grand Gulf DBA LOCA analysis. All rows in the table use the Standard Review Plan suppression pool decontamination factor (DF), except for the row labeled 50% DF, which uses the 50th percentile DF from NUREG/CR-6153. For the NUREG-1465 source term, the first two minutes are unimportant for overall dose, because the source term has only begun to appear in containment. Most of the TEDE dose is from noble gas, because of the containment sprays and the SGTS that filters releases from the secondary containment. However, sensitivity studies revealed that the most of the dose reduction is due to the SGTS. Suppression pool scrubbing is less important with the NUREG-1465 source term, because most of the flow from the drywell to the containment bypasses the suppression pool. Finally, ECCS leakage is important for LPZ and control room thyroid doses and unimportant for other doses.

Table 2: Results from Grand Gulf DBA LOCA Analysis

Total Dose (rem) from Containment Leakage and ECCS Leakage									
Spray or Suppression Pool Model	EAB			LPZ			Control Room		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
FSAR λ_p	22.6(1.5h)	5.89(2.3h)	6.78(2.2h)	19.5	4.05	4.73	3.94	.39	.53
SRP λ_p	21.2(1.6)	5.89(2.3h)	6.72(2.2h)	19.1	4.05	4.72	3.85	.39	.528
10% λ_p	24.4(1.6h)	5.90(2.3h)	6.89(2.2h)	19.9	4.06	4.76	4.06	.39	.538
50% λ_p	20.0(1.6h)	5.86(2.3h)	6.65(2.2h)	18.7	4.05	4.69	3.77	.39	.524
90% λ_p	19.8(1.6h)	5.86(2.3h)	6.63(2.2h)	18.7	4.05	4.69	3.75	.39	.523
50% DF and 50 % λ_p	22.0(1.6h)	5.89(2.3h)	6.78(2.2h)	19.2	4.05	4.72	3.91	.39	.531
Dose (rem) from ECCS Leakage Only									
	EAB			LPZ			Control Room		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
NA	5.36(5.1h)	0.02(8.0h)	0.20(5.2h)	14.13	0.030	0.46	2.6973	0.003	0.086

Zion

In the Zion analysis, the release fractions and timings used in RADTRAD are the NUREG-1465 specified release for a PWR and are contained in the file "PWR_DBA.RFT". RADTRAD options were set to model decay but no daughter products. The nuclide inventory which specifies nuclides considered, decay constant, and the Ci/MW values, was from file "PWR_DEF.NIF". These two data files are reproduced in Appendix A of this report.

This scenario was modeled by two leak paths to the environment: (1) a leak from the containment building atmosphere and (2) a leak of sump water through the ECCS.

Containment Leak Model

The nodalization is shown in Figure 5. The corresponding input decks (ZIONP5.PMF and ZIONP5.SDF) are in Appendix A. Model details are shown in the following tables.

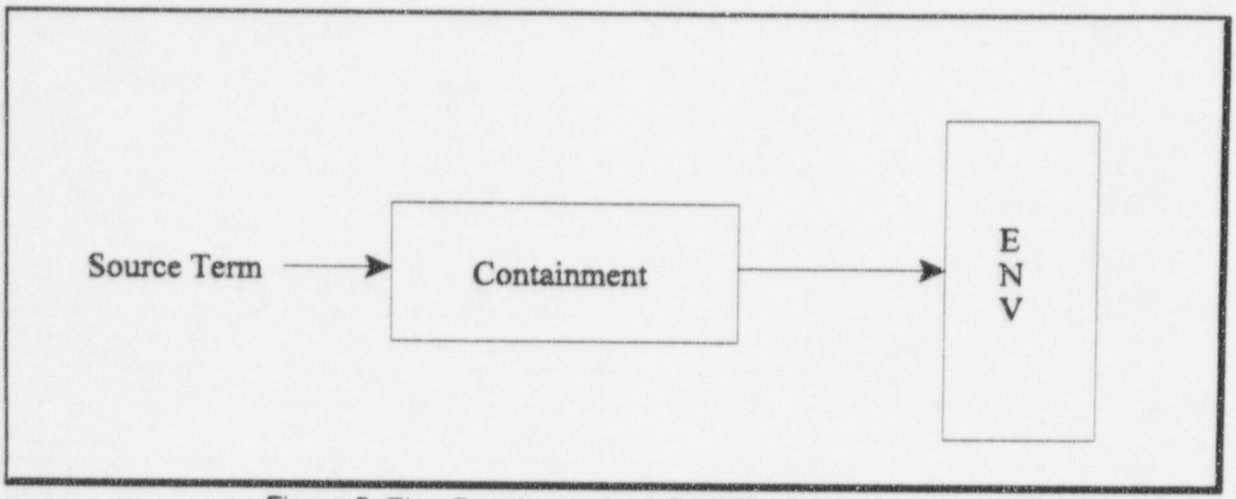

Figure 5: Zion Containment Leak RADTRAD Nodalization

Containment Leak Model Parameters		
Parameter	Value	
Plant Power	3391 MWt	
Release Fractions and timing	As specified for PWR in NUREG-1465 (gap and early in-vessel releases only).	
Release Location	Directly to Containment	
Containment Volume	2.86×10^6 ft^3	
Containment Leak Rate	0-24 hours	0.1 %/day
	24-720 hours	0.045 %/day

Containment Leak Model Parameters	
Parameter	Value
Containment Spray Removal Rate Constant for Particulates	SRP: 9.862 hr^{-1} (with h=147 ft, F=5230 gpm, V=2.86x10^6 ft^3) Note: The SRP specifies that this constant decreases by a factor of 10 after DF=50. However, because the release does not come out all at once, the time it takes to reach this DF is uncertain. Also, we concluded that reducing the spray constant would not significantly impact the results. Powers Model, 90%, initial value: 30.1 hr^{-1} Powers Model, 50%, initial value: 14.9 hr^{-1} Powers Model, 10%, initial value: 4.7 hr^{-1} (with Q=0.035935 cfm/ft^3, H=147 ft)
Containment Spray Removal Rate Constant for Elemental Iodine	54 hr^{-1} for entire 30 days
Containment Spray Removal Rate Constant for Organic Iodine	0.0
Sprays Initiation Time	Start of Accident

Meteorology Data	
Exclusion Area Boundary	
Time (hr)	X/Q (s/m^3)
0-720	9.2x10^{-4}
Low Population Zone Distance	
Time (hr)	X/Q (s/m^3)
0-8	5.04x10^{-5}
8-24	3.43x10^{-5}
24-96	1.49x10^{-5}
96-720	4.5x10^{-6}

Breathing Rate	
Exclusion Area Boundary	
Time (hr)	Breathing Rate (m^3/s)
0-720	$3.47x10^{-4}$
Low Population Zone Distance	
Time (hr)	Breathing Rate (m^3/s)
0-8	$3.47x10^{-4}$
8-24	$1.75x10^{-4}$
24-720	$2.32x10^{-4}$

ECCS Leak Model

The nodalization is shown in Figure 6. The corresponding input decks (ZL.PMF and ZL.SDF) are in Appendix A. Model details are shown in the following tables.

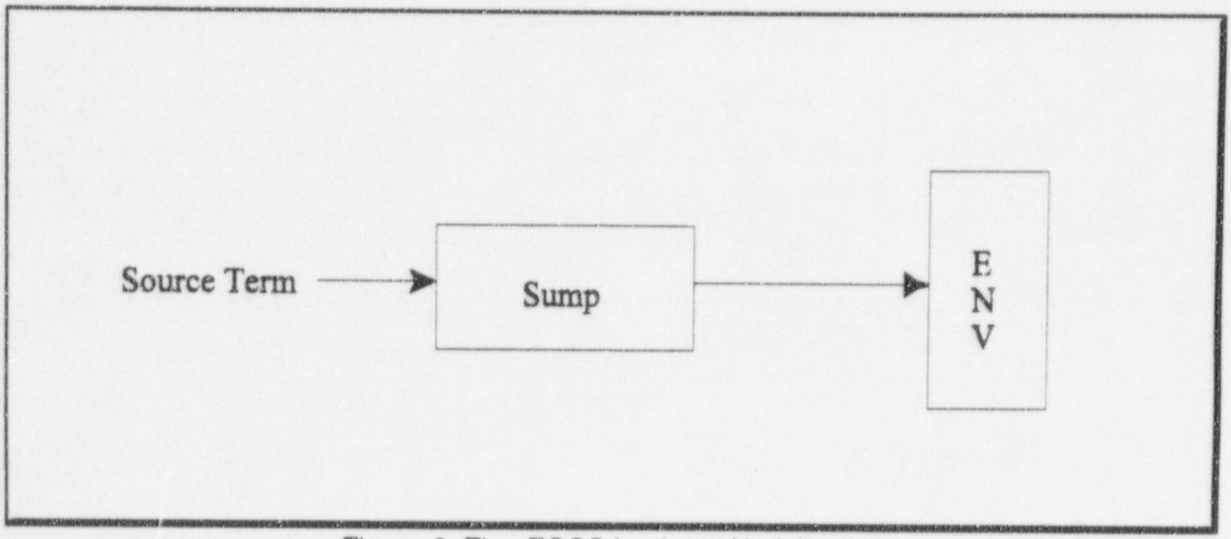

Figure 6: Zion ECCS Leakage Nodalization

ECCS Leak model		
Plant Power and Release Fractions and Timing are the same as in the containment leak model discussed previously.		
Sump Water Volume	$4.59x10^4$ ft^3	
Leak Rate to Environment	0-1 hours	$8.122x10^{-4}$ cfm
	1-720 hours	0 cfm

ECCS Leak model	
Iodine release	10% of the iodine in the leaked ECCS water becomes airborne.
Filter Efficiency for ECCS leakage	90% for all forms of iodine
Mixing and Hold-up for ECCS leakage	Not modeled

Results

Results from the Zion DBA LOCA analysis are shown in Table 3. Because of the large FSAR λ_p (54/hr), doses with the NUREG-1465 source term are very small and the TEDE doses are mainly from noble gases. Also, doses with the NUREG-1465 source term are a small fraction of the 300 rem thyroid and 25 rem whole body and TEDE limits.

Table 3: Results of Zion DBA LOCA Analysis

Spray Model	EAB			LPZ		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
FSAR λ_p	14.5(0h)	1.65(1.2h)	2.03(.8h)	6.02	.91	1.14
SRP λ_p	72.8(0h)	1.75(1.1h)	4.45(.5h)	23.2	.97	1.93
10% λ_p	145(.3h)	1.94(.9h)	8.02(.5h)	47.6	1.04	3.06
50% λ_p	48.1(0h)	1.69(1.1h)	3.40(.5h)	15.9	.943	1.60
90% λ_p	24.9(0h)	1.66(1.2h)	2.41(.6h)	9.08	.919	1.28

Dose Calculations Based on MELCOR Environmental Releases for Recovered Large-Break LOCA

As part of Phase III, calculations were performed with the MELCOR code, the NRC's integral severe accident code, to evaluate the margin in the licensing dose methodology's estimation of releases to the environment for the Surry, Grand Gulf, and Zion LOCAs. This was done by calculating EAB and LPZ doses from the MELCOR release to the environment for a recovered core-melt accident which involved a fission product release from the fuel similar to the NUREG-1465 release. Because use of the traditional design basis accident with ECCS operational would not result in core damage with any significant release of fission products, a core damage accident with delayed recovery of ECCS was used to approximate the relative magnitude of the NUREG-1465 source term. In one set of calculations, the NUREG-1465 release was coupled to MELCOR thermal-hydraulics and fission product removal.

The MELCOR analysis consisted of integral calculations of plant thermal-hydraulics and fission product release and deposition. This analysis was also used to assess consistency of the thermal-hydraulic treatment in the licensing dose calculations. This analysis was also intended as an overall examination of a best-estimate dose calculation. MELCOR calculations were performed using both the MELCOR-generated source term and the NUREG-1465 source term. In the case of the MELCOR-generated source term, water was injected into the vessel at a time which resulted in approximately 40% of the iodine (for PWRs) released into the containment; 40% iodine release was chosen because that quantity is specified by NUREG-1465 as the iodine release into containment for PWRs (30% for BWRs). For the NUREG-1465 source term case, water was injected at the same time as for the MELCOR-generated source term case. MELCOR containment releases were coupled with the licensing dose code HABIT 1.1 (TACT5 module) to produce offsite doses for comparison with results from the Phase III licensing dose calculations.

The MELCOR analyses are documented in Reference 4 for Surry and Zion and in Reference 5 for Grand Gulf. The MELCOR-predicted containment releases and dose calculations based on the releases are described below.

Surry

The MELCOR containment nodalization for Surry consisted of four volumes: an upper dome, a lower dome, a pressurizer cubicle, and a steam generator compartment. All of these regions are sprayed. The total volume of the containment is equal to 1.863×10^6 ft^3 which matches the UFSAR value and the value used in the licensing calculations, however, the licensing calculation only sprays 73% of the total containment volume. The leak to the environment occurs from the lower dome volume. The leak area was set so that at design pressure a leak rate of 0.1 %/day is achieved. The actual leak rate varies as a function of containment pressure in the MELCOR calculations. The spray rate is initially 3200 gpm which is higher than the licensing calculations value of 1800 gpm. In the MELCOR case the containment building attains a sub-atmospheric pressure after only about 20 minutes as opposed to the one hour assumed in the licensing calculation. Also, the spray height of 157 ft is higher than the licensing calculation value of 71.6 ft, although this difference is not expected to influence the results significantly. A more detailed description of the MELCOR model along with nodalization diagrams is given in Reference 4.

Results for the Surry Large Break LOCA are shown in Table 4. Dose results for ECCS leakage for Surry are from the DBA LOCA dose analysis documented earlier in this report. The MELCOR predicted release to the environment using a MELCOR predicted source term is shown in Figures 7 and 8. The MELCOR predicted release to the environment using the NUREG-1465 source term is shown in Figures 9 and 10.

Table 4: Surry Dose Results Predicted by MELCOR

Assumptions	EAB			LPZ		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
Dose (rem) from containment leakage only						
MELCOR (NUREG-1465)	0.024	0.001	0.002	0.003	0.00008	0.00020
MELCOR (MELCOR)	0.070	0.005	0.008	0.003	0.00020	0.00030
Dose (rem) from combined containment and ECCS leakage						
MELCOR (NUREG-1465)	1.550	0.006	0.055	1.160	0.001	0.037
MELCOR (MELCOR)	1.600	0.010	0.061	1.160	0.001	0.037

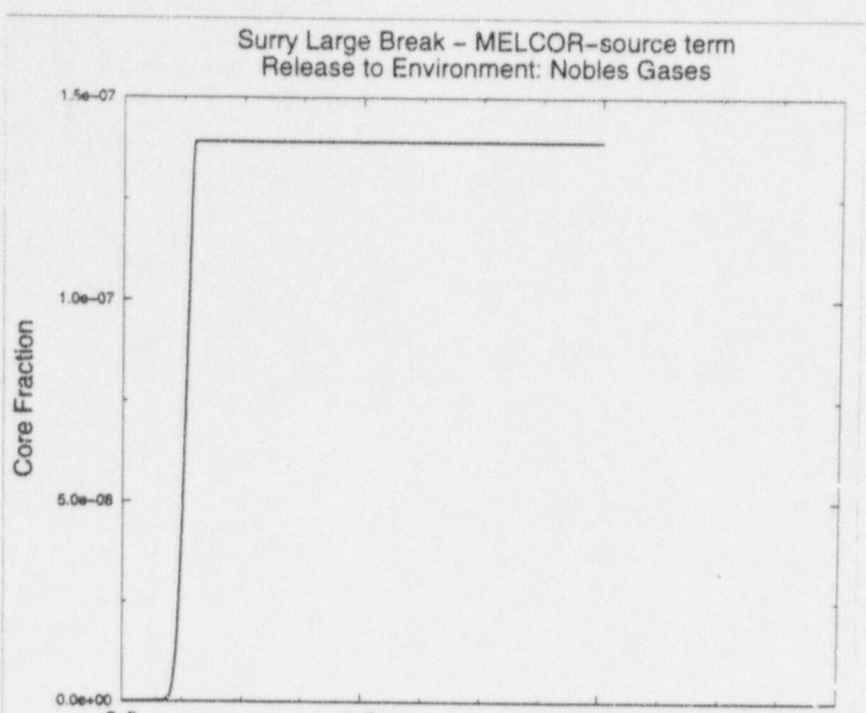

Figure 7: Surry Large Break LOCA - MELCOR predicted release of Noble Gases to the Environment

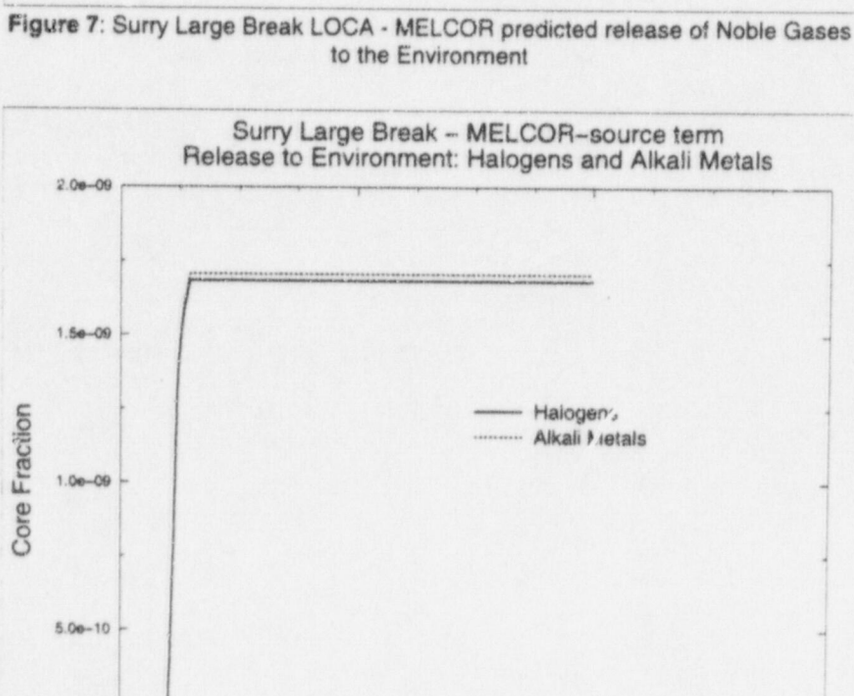

Figure 8: Surry Large Break LOCA - MELCOR predicted release of Halogens and Alkali Metals to the Environment

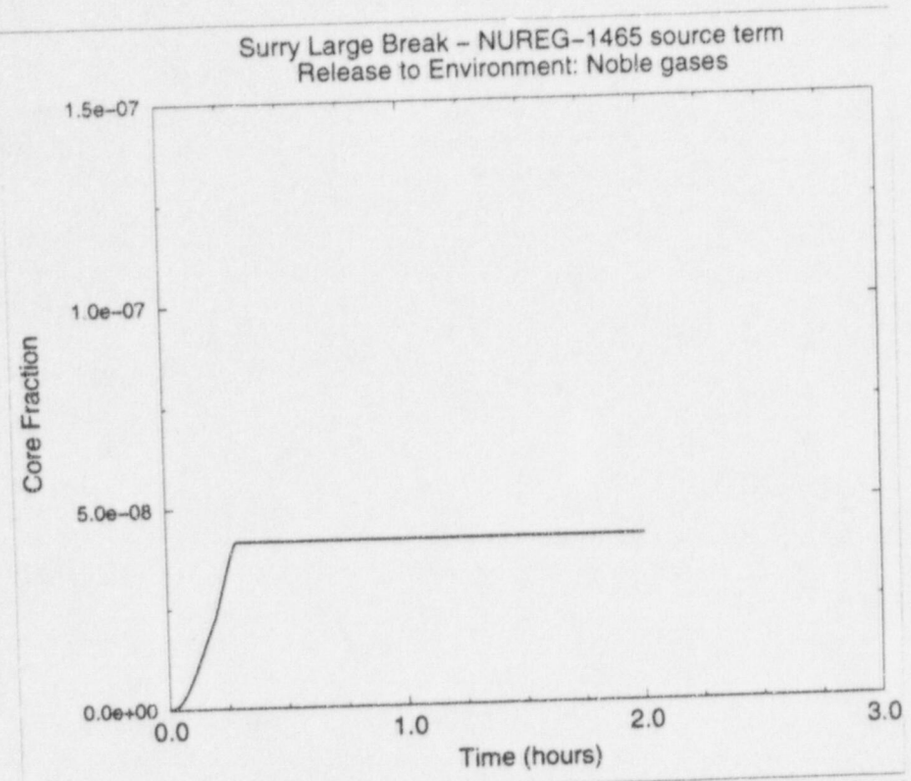

Figure 9: Surry Large Break LOCA - NUREG-1465 source term- MELCOR predicted release of Noble Gases to the Environment

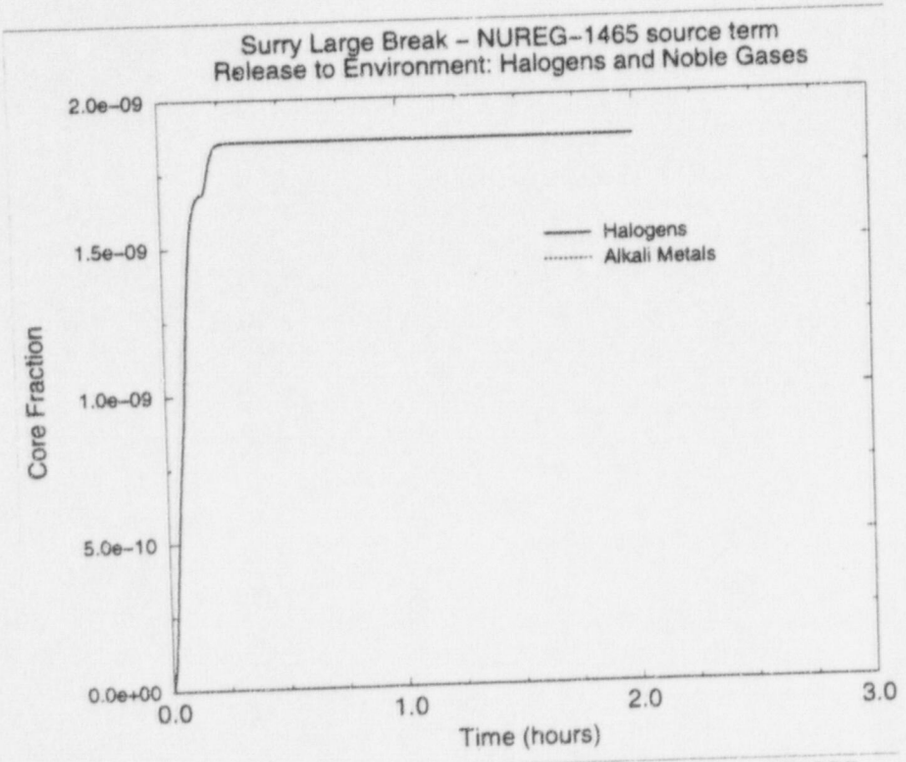

Figure 10: Surry Large Break LOCA - NUREG-1465 source term - MELCOR predicted release of Halogens and Alkali Metals to the Environment

Grand Gulf

The MELCOR containment nodalization consisted of a sprayed and an unsprayed region. The sprayed region has eight control volumes with a total combined volume of 9.860×10^5 ft^3. The unsprayed region is modeled by four control volumes with a total combined volume of 3.201×10^5 ft^3. The total volume of the containment is equal to 1.306×10^6 ft^3 which is slightly lower than the UFSAR value and the value used in the licensing calculations (1.400×10^6 ft^3). The leak area from the containment to the enclosure building was set to achieve a 0.35 %/day leak rate at design pressure. The actual leak rate is a function of the containment pressure in the MELCOR calculations. The spray rate is 5650 gpm which is the same as the value used in the licensing calculations. The sprays are actuated after 62 minutes as opposed to 30 minutes used in the licensing calculations. A more detailed description of the MELCOR model along with nodalization diagrams is given in Reference 5.

Results for the Grand Gulf Large Break LOCA are shown in Table 5. Dose results for ECCS leakage for Grand Gulf are from the DBA LOCA dose analysis documented earlier in this report. The MELCOR predicted release to the environment using a MELCOR predicted source term is shown in Figures 11 and 12. The MELCOR predicted release to the environment using the NUREG-1465 source term is shown in Figures 13 and 14.

Table 5: Grand Gulf Dose Results Predicted by MELCOR

Assumptions	EAB			LPZ		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
Dose (rem) from containment leakage only						
MELCOR (NUREG-1465)	5.95 (3.8h)	4.74 (2.4h)	4.87 (2.5h)	1.95	3.24	3.31
MELCOR (MELCOR)	5.98 (.6h)	2.00 (1.4h)	2.15 (1.1h)	1.54	1.30	1.30
Dose (rem) from combined containment and ECCS leakage						
MELCOR (NUREG-1465)	11.70 (3.8h)	4.76 (2.4h)	5.05 (2.5h)	16.10	3.27	3.77
MELCOR (MELCOR)	8.21 (.7h)	2.01 (1.4h)	2.27 (1.2h)	15.70	1.33	1.82

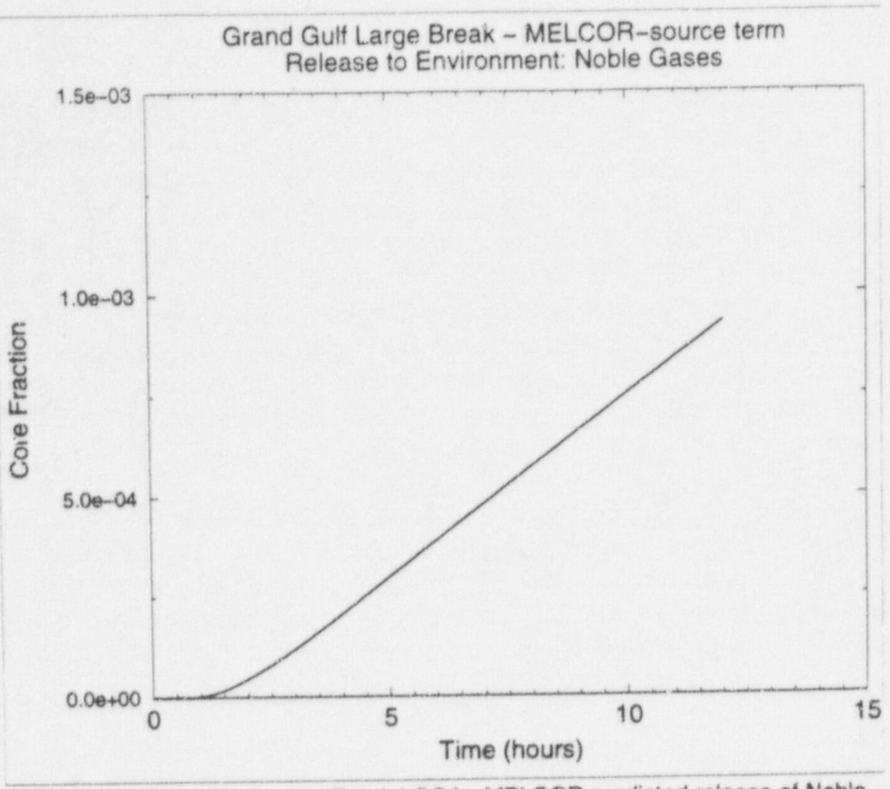

Figure 11: Grand Gulf Large Break LOCA - MELCOR predicted release of Noble Gases to the Environment

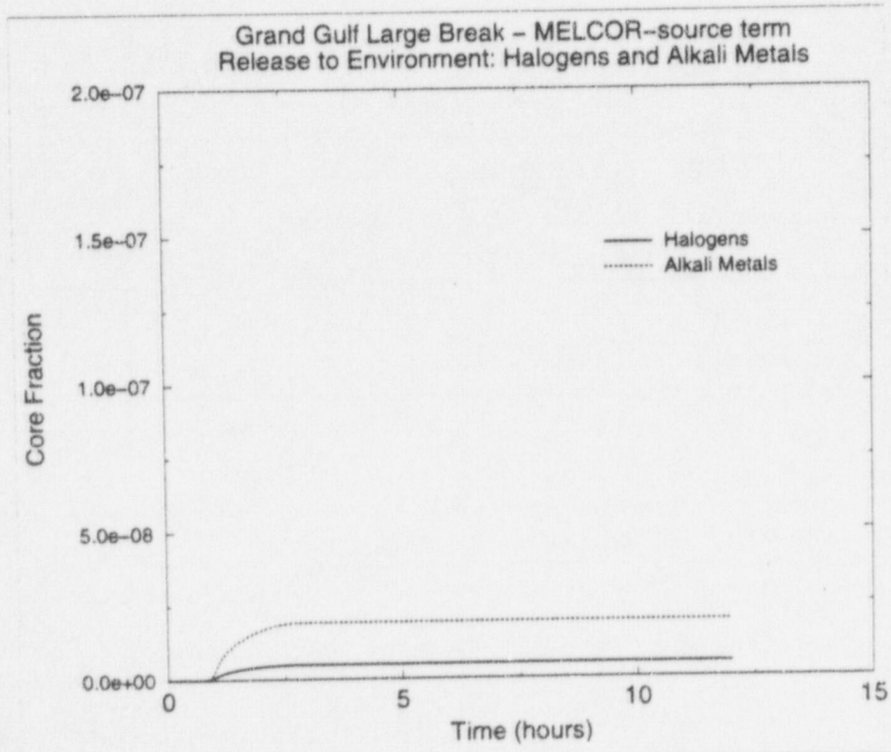

Figure 12: Grand Gulf Large Break LOCA - MELCOR predicted release of Halogens and Alkali Metals to the Environment

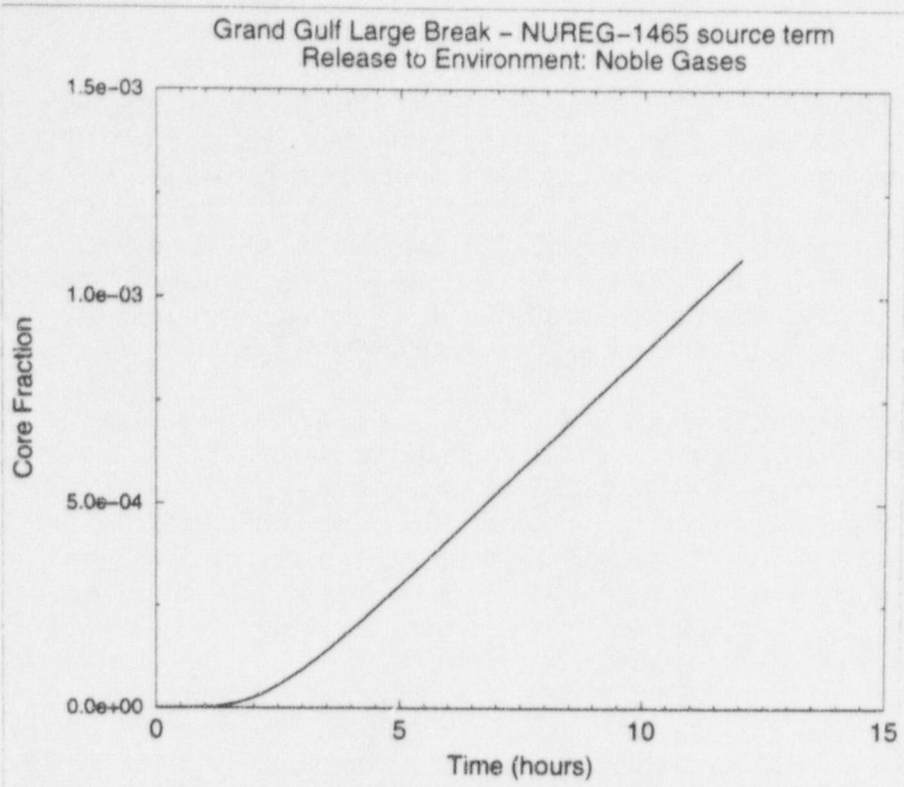

Figure 13: Grand Gulf Large Break LOCA - NUREG-1465 source term - MELCOR predicted release of Noble Gases to the Environment

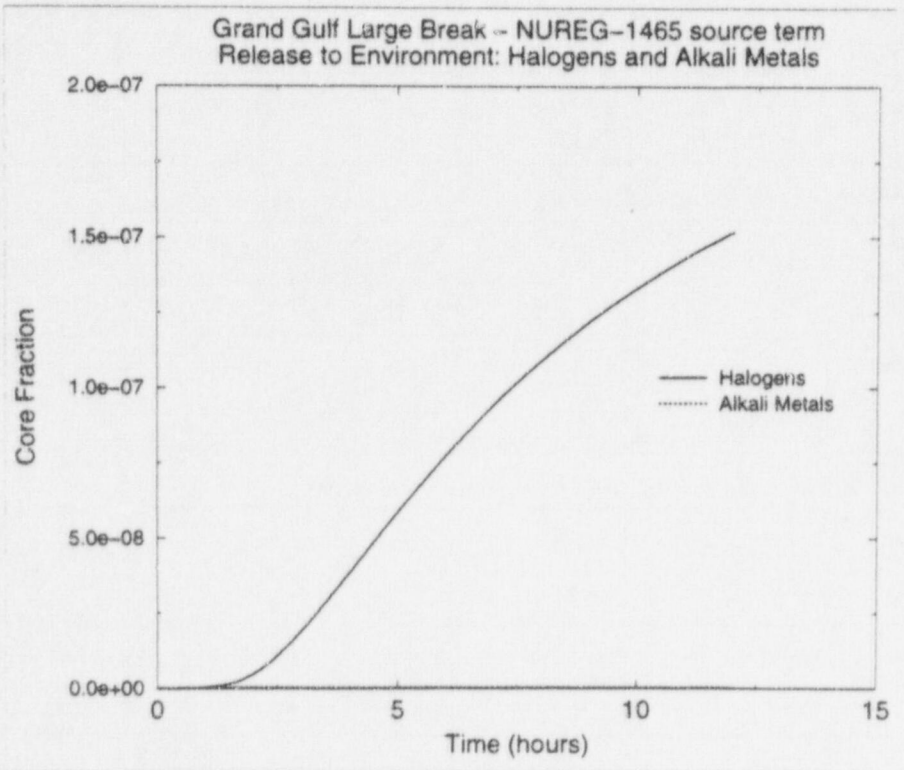

Figure 14: Grand Gulf Large Break LOCA - NUREG-1465 source term - MELCOR predicted release of Halogens and Alkali Metals to the Environment

Zion

The MELCOR containment nodalization consisted of three control volumes all of which are sprayed. The combined total volume of the containment is 2.850×10^6 ft^3 and is approximately the same as the UFSAR value used in the licensing calculation (2.860×10^6 ft^3). The leak area was set to achieve a 0.1 %/day leak rate at design pressure. The actual leak rate is a function of the containment pressure in the MELCOR calculations. The spray rate is 3012 gpm which is lower than 5230 gpm which was used in the licensing calculations. The sprays are actuated based on the pressure setpoint and latched on. A more detailed description of the MELCOR model along with nodalization diagrams is given in Reference 4.

Results for the MELCOR Large Break LOCA for Zion are shown in Table 6. The MELCOR containment leakage doses in Table 6 are based on earlier MELCOR runs designated as 'zionlb5' and 'zionlbr5.' The MELCOR runs documented in Reference 4 are updated runs entitled 'zionlbx' and 'zionlbrx.' The earlier runs are different in two ways. First, in the earlier runs the switch over to recirculation for containment sprays and ECCS injection is not modeled. Instead, the refueling water storage inventory is assumed to be available over the course of the calculation. In the updated runs, the switch over to recirculation is modeled. Second, in the earlier runs, only one spray pump and one fan cooler were modeled. In the updated runs, two spray pumps (out of three) and three fan coolers (out of five) were modeled. Dose results for ECCS leakage for Zion are from the DBA LOCA dose analysis documented earlier in this report. The MELCOR predicted release to the environment using a MELCOR predicted source term is shown in Figures 15 and 16. The MELCOR predicted release to the environment using the NUREG-1465 source term is shown in Figures 17 and 18.

Table 6: Zion Dose Results Predicted by MELCOR

Assumptions	EAB			LPZ		
	Thyroid	Whole Body	TEDE	Thyroid	Whole Body	TEDE
Dose from containment leakage only						
MELCOR (NUREG-1465)	0.48 (.2h)	1.03 (1.2h)	1.03 (1.1h)	0.14	0.51	0.52
MELCOR (MELCOR)	0.29 (.2h)	1.41 (.4h)	1.43 (.4h)	0.09	0.67	0.67
Dose from combined containment and ECCS leakage						
MELCOR (NUREG-1465)	0.79 (.1h)	1.03 (1.2h)	1.03 (1.1h)	0.23	0.51	0.52
MELCOR (MELCOR)	0.61 (0h)	1.42 (.4h)	1.40 (.4h)	0.18	0.67	0.68

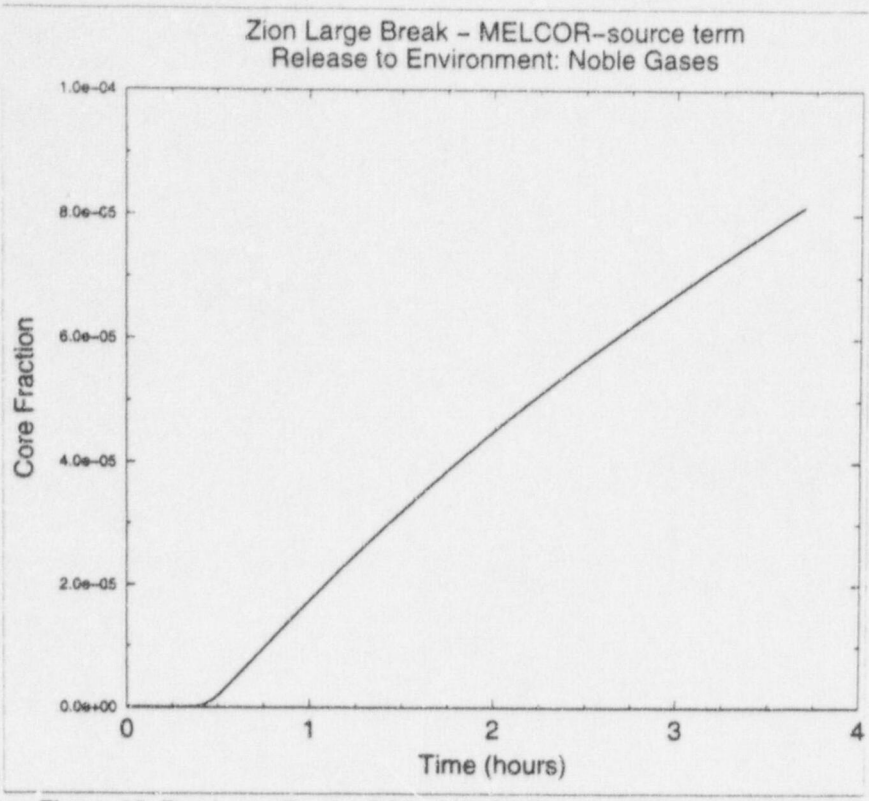

Figure 15: Zion Large Break LOCA - MELCOR predicted release of Noble Gases to the Environment

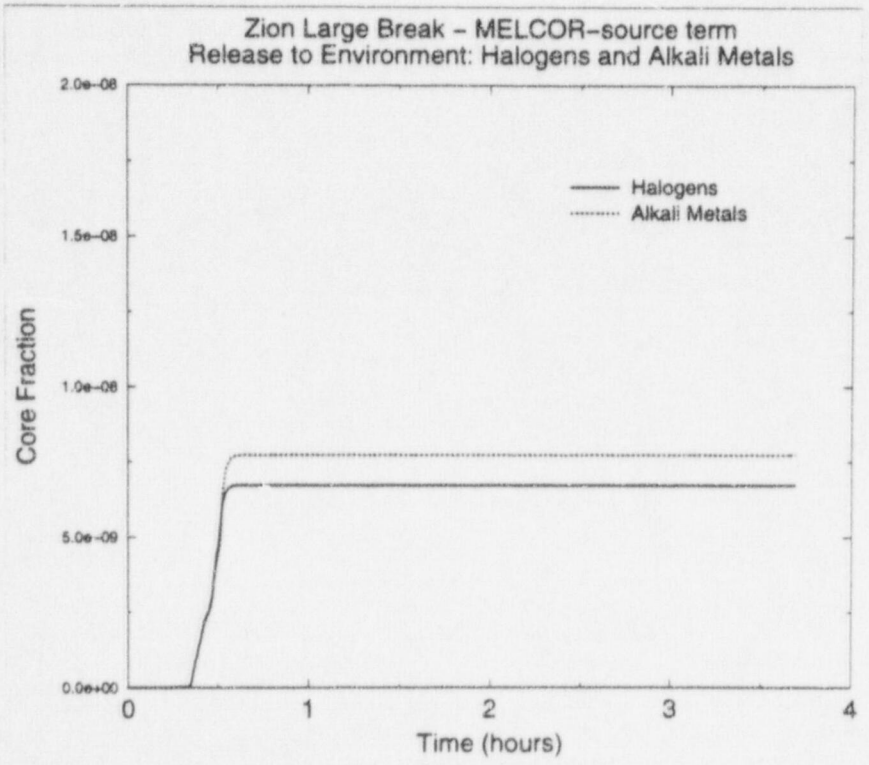

Figure 16: Zion Large Break LOCA - MELCOR predicted release of Halogens and Alkali Metals to the Environment

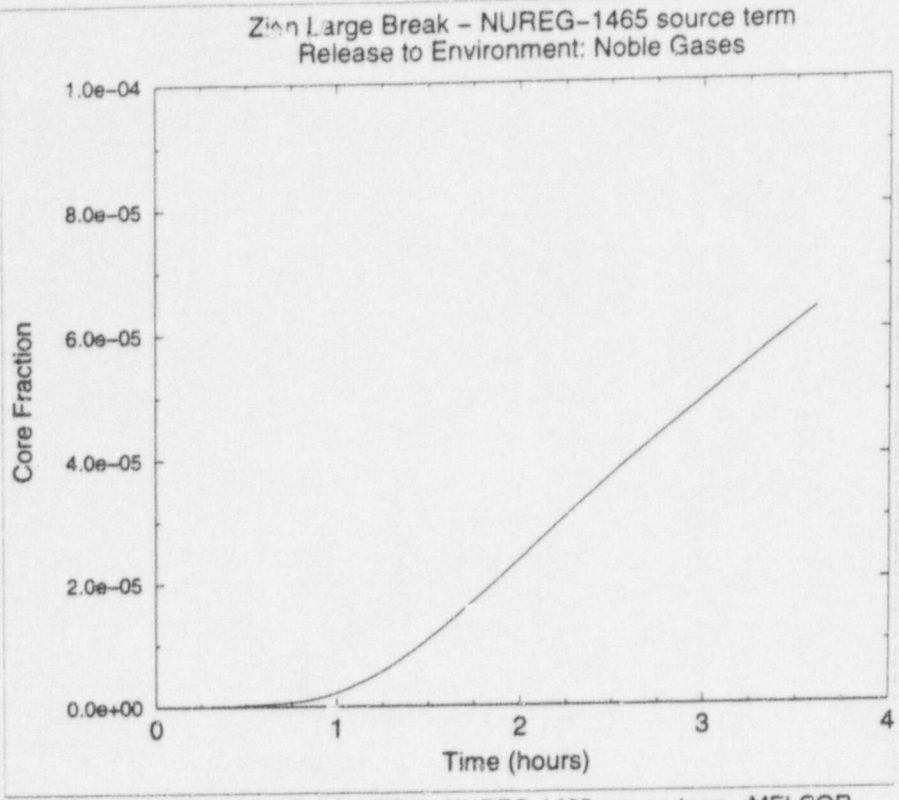

Figure 17: Zion Large Break LOCA - NUREG-1465 source term - MELCOR predicted release of Noble Gases to the Environment

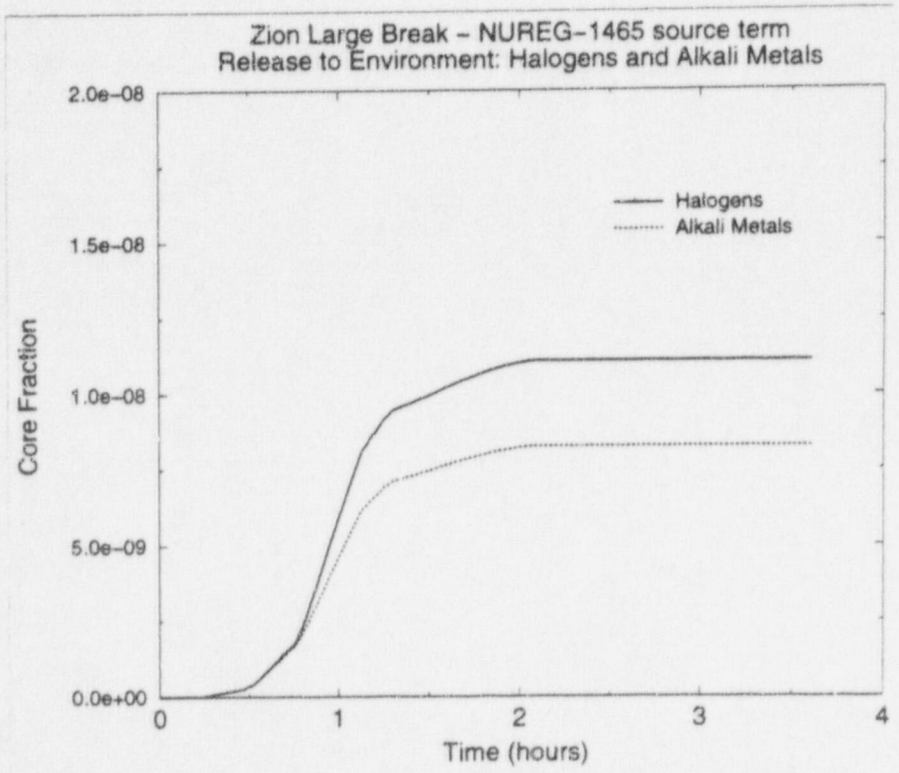

Figure 18: Zion Large Break LOCA - NUREG-1465 source term - MELCOR predicted release of Halogens and Alkali Metals to the Environment

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1. L. Soffer et al., "Accident Source Terms for Light-Water Nuclear Power Plants," NUREG-1465, February 1995

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3. J.J. DiNunno et al., "Calculation of Distance Factors for Power and Test Reactor Sites," Technical Information Document (TID)-14844, U.S. Atomic Energy Commission, 1962

4. M.M. Pilch et al., "Evaluation of Radiological Consequences of Design Basis Accidents at Operating Reactors Using the Revised Source Term," Letter Report, Sandia National Laboratories, September 1998

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7. C.G. Gingrich, "Detailed Modeling and Analysis of the Zion Plant for Phase II of the Revised (NUREG-1465) Source Term Rebaselining for Operating Reactors," AEB-98-02 (draft), October 1998

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11. D. A. Powers and S. B. Burson, "A Simplified Model of Aerosol Removal by Containment Sprays," NUREG/CR-5966, SAND92-2689, Sandia National Laboratories, Albuquerque, NM, 1993

12. D. A. Powers, "A Simplified Model of Decontamination by BWR Steam Suppression Pools," NUREG/CR-6153, SAND93-2588, Sandia National Laboratories, Albuquerque, NM, 1997

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14. Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," EPA 520/1-88-020, Environmental Protection Agency, Washington, DC, 1988

15. Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water and Soil," EPA 420-r-93-081, Environmental Protection Agency, Washington, DC, 1993

APPENDIX A: RADTRAD Input Deck Listings

Surry Containment Leakage Model: PMF file

FILENAME: S3100P5.PMF

```
Plant Model Name:
Surry  SER
Nuclide Inventory File:
DEFAULTS\PWR_DEF.NIF
Plant Power Level:
 0.2605E+04
Compartments:
 3
Compartment  1:
Containment
 3
 0.1360E+07
 1
 0
 0
 0
 0
Compartment  2:
Environment
 2
 0.9146E+21
 0
 0
 0
 0
 0
Compartment  3:
Unsprayed
 3
 0.5030E+06
 0
 0
 0
 0
 0
Pathways:
 4
Pathway   1:
Leak to Environment
 1
 2
 4
Pathway   2:
Unsprayed-Sprayed
 3
```

1
4
Pathway 3:
Sprayed-Unsprayed
1
3
4
Pathway 4:
Unsprayed to Env
3
2
4
End of Plant Model File

Surry Containment Leakage Model: SDF file

FILENAME: S3100P5.SDF

```
Scenario Description Name:
Surry 1972 SRP
Plant Model Filename:
REBASE\S3100P5.SDF
Source Term:
 1
DEFAULTS\FGR60.INP
DEFAULTS\PWR_DBA.RFT
 0.0000E+00
 0
 0.9500E+00  0.4850E-01  0.1500E-02  0.1000E+01
Overlying Pool:
 0
 0.0000E+00
 0
 0
 0
 0
Compartments:
 3
Compartment 1:
 0
 1
 2
 0.0000E+00
 0.0000E+00
 0.5000E+02
 2
 0.0000E+00  0.1267E-01  0.7160E+02
 0.7200E+03  0.0000E+00  0.0000E+00
 1
 0.0000E+00
 2
 0.0000E+00  0.1000E+02
 0.7200E+03  0.0000E+00
 0
 0
 0
 0
 0
Compartment 2:
 0
 1
 0
 0
```

```
 0
 0
 0
 0
 0
Compartment 3:
 0
 1
 0
 0
 0
 0
 0
 1
 0
 0
Pathways:
 4
Pathway 1:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 4
 0.0000E+00  0.1000E+00
 0.2500E+00  0.1000E+00
 0.7500E+00  0.1000E+00
 0.1000E+01  0.0000E+00
 0
Pathway 2:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00  0.4800E+07
```

```
 0.2000E-02  0.4800E+04
 0
Pathway  3:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00  0.1765E+07
 0.2000E-02  0.1765E+04
 0
Pathway  4:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00  0.1000E+00
 0.1000E+01  0.0000E+00
 0
Dose Locations:
 3
Location  1:
Exclusion Area Bndry (x/q, br)
 2
 1
 3
 0.0000E+00  0.1160E-02
 0.5000E+00  0.1160E-02
 0.1000E+01  0.0000E+00
 1
 2
 0.0000E+00  0.3470E-03
 0.1000E+01  0.0000E+00
 0
Location  2:
```

```
Low Population Zone (x/q, br)
 2
 1
 2
 0.0000E+00   0.5040E-04
 0.1000E+01   0.0000E+00
 1
 2
 0.0000E+00   0.3470E-03
 0.1000E+01   0.0000E+00
 0
Location  3:
Control Room
 2
 1
 2
 0.0000E+00   0.4070E-02
 0.1000E+01   0.0000E+00
 1
 2
 0.0000E+00   0.3470E-03
 0.1000E+01   0.0000E+00
 0
Effective Volume Location:
 0
Simulation Parameters:
 4
 0.0000E+00   0.2000E-02
 0.1000E+01   0.1000E+01
 0.2400E+02   0.4000E+01
 0.7200E+03   0.0000E+00
Output Filename:
REBASE\S3100P5.TXT
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 1
 1
 1
 1
End of Scenario File
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Surry ECCS Leakage Model: PMF file

FILENAME: S3300N.PMF

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Surry  SER
Nuclide Inventory File:
DEFAULTS\PWR_DEF.NIF
Plant Power Level:
 0.2605E+04
Compartments:
  2
Compartment  1:
Sump
  3
 0.5826E+05
  0
  0
  0
  0
  0
Compartment  2:
Environment
  2
 0.9146E+21
  0
  0
  0
  0
  0
Pathways:
  1
Pathway   1:
Leak to Environment
  1
  2
  4
End of Plant Model File
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Surry ECCS Leakage Model: SDF file

FILENAME: S3300N.SDF

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Surry 1972 SRP
Plant Model Filename:
REBASE\S3300N.SDF
Source Term:
 1
DEFAULTS\FGR60.INP
DEFAULTS\S2300N.RFT
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 0
 0.0000E+00  0.7500E+00  0.2500E+00  0.1000E+01
Overlying Pool:
 0
 0.0000E+00
 0
 0
 0
 0
Compartments:
 2
Compartment  1:
 0
 1
 0
 0
 0
 0
 0
 0
 0
Compartment  2:
 0
 1
 0
 0
 0
 0
 0
 0
 0
Pathways:
 1
Pathway   1:
 0
 0
```

```
 0
 0
 0
 0
 0
 0
 0
 0
 1
 4
 0.0000E+00  0.2860E-04
 0.3333E+00  0.2860E-04
 0.4833E+00  0.1400E-03
 0.7200E+03  0.0000E+00
 0
Dose Locations:
 3
Location  1:
Exclusion Area Bndry (x/q, br)
 2
 1
 4
 0.0000E+00  0.1160E-02
 0.1000E+01  0.1160E-02
 0.2000E+01  0.1160E-02
 0.1200E+02  0.0000E+00
 1
 3
 0.0000E+00  0.3470E-03
 0.8000E+01  0.1750E-03
 0.2400E+02  0.2320E-03
 0
Location  2:
Low Population Zone (x/q, br)
 2
 1
 4
 0.0000E+00  0.5040E-04
 0.8000E+01  0.3430E-04
 0.2400E+02  0.1490E-04
 0.9600E+02  0.4500E-05
 1
 3
 0.0000E+00  0.3470E-03
 0.8000E+01  0.1750E-03
 0.2400E+02  0.2320E-03
 0
Location  3:
Control Room
 2
```

```
 1
 4
 0.0000E+00   0.4020E-02
 0.8000E+01   0.2490E-02
 0.2400E+02   0.1410E-02
 0.9600E+02   0.4030E-03
 1
 3
 0.0000E+00   0.3470E-03
 0.2400E+02   0.2082E-03
 0.9600E+02   0.1388E-03
 0
Effective Volume Location:
 0
Simulation Parameters:
 4
 0.0000E+00   0.5000E-01
 0.8000E+01   0.1000E+01
 0.2400E+02   0.4000E+01
 0.7200E+03   0.0000E+00
Output Filename:
REBASE\S3300N.TXT
 1
 1
 1
 0
 0
End of Scenario File
```

Grand Gulf Containment Leakage Model: PMF file

FILENAME: GGP5.PMF

Plant Model Name:

Nuclide Inventory File:
DEFAULTS\BWR_DEF.NIF
Plant Power Level:
0.3910E+04
Compartments:
6
Compartment 1:
sprayed
3
0.9927E+06
1
0
0
0
0
Compartment 2:
drywell
3
0.2700E+06
0
0
0
0
0
Compartment 3:
uns-good
3
0.2383E+06
0
0
0
0
0
Compartment 4:
uns-poor
3
0.1690E+06
0
0
0
0
0
Compartment 5:

```
aux
 3
0.3000E+06
 0
 0
 0
 0
 0
Compartment 6:
env
 2
0.0000E+00
 0
 0
 0
 0
 0
Pathways:
 19
Pathway 1:
dry-spray
 2
 1
 4
Pathway 2:
dry-unsbad
 2
 4
 4
Pathway 3:
spray-unsgood
 1
 3
 4
Pathway 4:
spray-unsbad
 1
 4
 4
Pathway 5:
unsgd-spray
 3
 1
 4
Pathway 6:
unsgd-env
 3
 6
 4
Pathway 7:
```

unsbad-env
4
6
4
Pathway 8:
unsbad-spray
4
1
4
Pathway 9:
spray-encl
1
5
4
Pathway 10:
spray-env
1
6
4
Pathway 11:
dry-encl
2
5
4
Pathway 12:
unsgd-encl
3
5
4
Pathway 13:
unsbad-encl
4
5
4
Pathway 14:
encl-env
5
6
4
Pathway 15:
dry-unsgd-spool
2
3
1
Pathway 16:
dry-unsgood
2
3
4
Pathway 17:

encl-env filtered
5
6
2
Pathway 18:
sprayed to dryweli
1
2
4
Pathway 19:
dry-unsgd-spool 2
2
3
1
End of Plant Model File

Grand Gulf Containment Leakage Model: SDF file

FILENAME: GGP5.SDF

Scenario Description Name:

Plant Model Filename:
REBASE\GGP5.SDF
Source Term:
2
DEFAULTS\FGR60.INP
DEFAULTS\BWR_DBA.RFT
0.0000E+00
0
0.9500E+00 0.4850E-01 0.1500E-02 0.1000E+01
Overlying Pool:
0
0.0000E+00
0
0
0
0
Compartments:
6
Compartment 1:
1
1
2
0.0000E+00
0.0000E+00
0.5000E+02
2
0.0000E+00 0.4888E-01 0.6424E+02
0.7200E+03 0.4888E-01 0.6424E+02
1
0.0000E+00
2
0.5000E+00 0.6900E+01
0.1000E+02 0.0000E+00
0
0
0
0
0
Compartment 2:
0
1
0
0

0
0
0
0
0
Compartment 3:
0
1
0
0
0
0
0
0
0
Compartment 4:
0
1
0
0
0
0
0
0
0
Compartment 5:
0
1
0
0
0
0
0
0
0
Compartment 6:
0
1
0
0
0
0
0
0
0
Pathways:
19
Pathway 1:
0
0

```
 0
 0
 0
 0
 0
 0
 0
 0
 1
 4
 0.0000E+00  0.1300E+05
 0.1400E-02  0.1100E+05
 0.8300E-02  0.8000E+04
 0.3333E+00  0.6222E+04
 0
Pathway  2:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 4
 0.0000E+00  0.1300E+05
 0.1400E-02  0.1100E+05
 0.8300E-02  0.8000E+04
 0.3333E+00  0.6222E+04
 0
Pathway  3:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00  0.5950E+03
 0.5000E+00  0.9574E+04
 0
Pathway  4:
```

```
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00   0.8123E+03
 0.2400E+02   0.8123E+03
 0
Pathway  5:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00   0.4364E+04
 0.5000E+00   0.7024E+05
 0
Pathway  6:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00   0.3500E+00
 0.3330E-01   0.0000E+00
 0
Pathway  7:
 0
 0
```

```
0
0
0
0
0
0
0
0
0
1
2
0.0000E+00  0.3500E+00
0.3330E-01  0.0000E+00
0
Pathway  8:
0
0
0
0
0
0
0
0
0
0
1
2
0.0000E+00  0.2965E+04
0.7200E+03  0.2965E+04
0
Pathway  9:
0
0
0
0
0
0
0
0
0
0
1
2
0.0000E+00  0.0000E+00
0.3330E-01  0.3500E+00
0
Pathway 10:
0
0
0
0
```

```
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00   0.3500E+00
 0.3330E-01   0.0000E+00
 0
Pathway  11:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 3
 0.0000E+00   0.0000E+00
 0.3330E+00   0.2222E+00
 0.2910E+01   0.8890E+00
 0
Pathway  12:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00   0.0000E+00
 0.3330E-01   0.3500E+00
 0
Pathway  13:
 0
 0
 0
 0
 0
```

```
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00  0.0000E+00
 0.3330E-01  0.3500E+00
 0
Pathway 14:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00  0.0000E+00
 0.3330E-01  0.2400E+02
 0
Pathway 15:
 0
 0
 1
 5
 0.0000E+00  0.1000E+02  0.0000E+00
 0.3000E-03  0.1000E+02  0.8830E+07
 0.2800E-02  0.1000E+02  0.6790E+07
 0.5500E-02  0.1000E+02  0.2920E+07
 0.9300E-02  0.1000E+02  0.0000E+00
 1
 5
 0.0000E+00  0.1000E+02  0.0000E+00
 0.3000E-03  0.1000E+02  0.8830E+07
 0.2800E-02  0.1000E+02  0.6790E+07
 0.5500E-02  0.1000E+02  0.2920E+07
 0.9300E-02  0.1000E+02  0.0000E+00
 1
 5
 0.0000E+00  0.0000E+00  0.0000E+00
 0.3000E-03  0.0000E+00  0.8830E+07
 0.2800E-02  0.0000E+00  0.6790E+07
 0.5500E-02  0.0000E+00  0.2920E+07
 0.9300E-02  0.0000E+00  0.0000E+00
```

```
0
1
0.0000E+00
1
0.0000E+00  0.1000E+02  0.1000E+04
1
0.0000E+00
1
0.0000E+00  0.1000E+02  0.1000E+04
1
0.0000E+00
1
0.0000E+00  0.1000E+02  0.1000E+04
0
0
0
Pathway 16:
0
0
0
0
0
0
0
0
0
0
1
4
0.0000E+00  0.1300E+05
0.1400E-02  0.1100E+05
0.8300E-02  0.8000E+04
0.3333E+00  0.6222E+04
0
Pathway 17:
0
0
0
0
0
1
0.4300E+04
3
0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
0.3330E-01  0.9900E+02  0.9900E+02  0.9900E+02
0.7200E+03  0.9900E+02  0.9900E+02  0.9900E+02
0
0
0
0
```

```
 0
 0
Pathway  18:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 2
 0.2160E+00  0.1450E+03
 0.7200E+03  0.1450E+03
 0
Pathway  19:
 0
 0
 1
 2
 0.2167E+00  0.1000E+02  0.1000E+04
 0.2400E+02  0.1000E+02  0.0000E+00
 1
 2
 0.2167E+00  0.1000E+02  0.1000E+04
 0.2400E+02  0.1000E+02  0.0000E+00
 1
 2
 0.2167E+00  0.0000E+00  0.1000E+04
 0.2400E+02  0.0000E+00  0.0000E+00
 0
 0
 0
 0
 0
 0
 0
Dose Locations:
 3
Location  1:
EAB
 6
 1
 2
 0.0000E+00  0.1260E-02
 0.2000E+01  0.1260E-02
 1
```

```
 2
 0.0000E+00   0.3470E-03
 0.2000E+01   0.3470E-03
 0
Location 2:
LPZ
 6
 1
 5
 0.0000E+00   0.2840E-03
 0.2000E+01   0.1560E-03
 0.8000E+01   0.1160E-03
 0.2400E+02   0.6060E-04
 0.9600E+02   0.2390E-04
 1
 3
 0.0000E+00   0.3470E-03
 0.8000E+01   0.1750E-03
 0.2400E+02   0.2320E-03
 0
Location 3:
Control Room
 6
 1
 5
 0.0000E+00   0.1340E-02
 0.3330E-01   0.3290E-03
 0.8000E+01   0.1960E-03
 0.2400E+02   0.1080E-03
 0.9600E+02   0.6980E-05
 1
 3
 0.0000E+00   0.3470E-03
 0.2400E+02   0.2080E-03
 0.9600E+02   0.1388E-03
 0
Effective Volume Location:
 0
Simulation Parameters:
 5
 0.0000E+00   0.2000E-02
 0.5000E-01   0.5000E-01
 0.4000E+01   0.1000E+00
 0.8000E+01   0.1000E+01
 0.2400E+02   0.4000E+01
Output Filename:
REBASE\GGP5.TXT
 1
 1
 1
```

1
1
End of Scenario File

Grand Gulf ECCS Leakage Model: PMF file

FILENAME: GG21D0N.PMF

Plant Model Name:

Nuclide Inventory File:
DEFAULTS\BWR_DEF.NIF
Plant Power Level:
0.3993E+04
Compartments:
3
Compartment 1:
Dry Well Sump
3
0.1222E+06
0
0
0
0
0
Compartment 2:
Environment
2
0.0000E+00
0
0
0
0
0
Compartment 3:
Enclosure Building
3
0.3000E+06
0
0
1
0
0
Pathways:
5
Pathway 1:
Standby Gas Treatment
3
2
2
Pathway 2:
Liquid to Secondary
1

3
2
Pathway 3:
Liquid to Secondary Fuel Pool
1
3
2
Pathway 4:
Environment to Enclosure
2
3
2
Pathway 5:
Enclosure Bypass
3
2
2
End of Plant Model File

Grand Gulf ECCS Leakage Model: SDF file

FILENAME: GG21D0N.SDF

Scenario Description Name:

Plant Model Filename:
REBASE\GG21D0N.SDF
Source Term:
1
DEFAULTS\FGR60.INP
DEFAULTS\GG21D0N.RFT
0.0000E+00
1
0.9500E+00 0.4850E-01 0.1500E-02 0.1000E+01
Overlying Pool:
0
0.0000E+00
0
0
0
0
Compartments:
3
Compartment 1:
0
1
0
0
0
0
0
0
0
Compartment 2:
0
1
0
0
0
0
0
0
0
Compartment 3:
0
1
0
0

```
 0
 0
 1
 0.1274E+05
 2
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 0.7200E+03  0.0000E+00  0.0000E+00  0.0000E+00
 0
 0
Pathways:
 5
Pathway  1:
 0
 0
 0
 0
 0
 1
 0.4300E+04
 5
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 0.3330E-01  0.9900E+02  0.9900E+02  0.9900E+02
 0.1000E+01  0.9900E+02  0.9900E+02  0.9900E+02
 0.1500E+01  0.9900E+02  0.9900E+02  0.9900E+02
 0.2500E+01  0.9900E+02  0.9900E+02  0.9900E+02
 0
 0
 0
 0
 0
 0
Pathway  2:
 0
 0
 0
 0
 0
 1
 0.1364E-01
 5
 0.0000E+00  0.1000E+03  0.0000E+00  0.1000E+03
 0.1610E-01  0.0000E+00  0.0000E+00  0.0000E+00
 0.3500E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0.4000E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0.4500E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0
 0
 0
 0
 1
```

```
 2
 0.0000E+00  0.2187E+00
 0.3330E-01  0.0000E+00
 0
Pathway  3:
 0
 0
 0
 0
 0
 1
 0.1334E-02
 5
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 0.1750E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0.2250E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0.2750E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0.3250E+01  0.0000E+00  0.0000E+00  0.0000E+00
 0
 0
 0
 0
 1
 4
 0.0000E+00  0.0000E+00
 0.3330E-01  0.2187E+00
 0.1000E+01  0.2187E+00
 0.2000E+01  0.8907E+00
 0
Pathway  4:
 0
 0
 0
 0
 0
 1
 0.5000E+02
 4
 0.0000E+00  0.9900E+02  0.9900E+02  0.9900E+02
 0.3000E+01  0.9900E+02  0.9900E+02  0.9900E+02
 0.3750E+01  0.9900E+02  0.9900E+02  0.9900E+02
 0.4250E+01  0.9900E+02  0.9900E+02  0.9900E+02
 0
 0
 0
 0
 0
 0
Pathway  5:
 0
```

```
 0
 0
 0
 0
 1
 0.5000E+02
 2
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
 0.7200E+03  0.0000E+00  0.0000E+00  0.0000E+00
 0
 0
 0
 0
 0
 0
Dose Locations:
 3
Location  1:
Exclusion Area
 2
 1
 2
 0.0000E+00  0.1260E-02
 0.1000E+02  0.1260E-02
 1
 2
 0.0000E+00  0.3470E-03
 0.2000E+01  0.3470E-03
 0
Location  2:
Low Population Zone
 2
 1
 5
 0.0000E+00  0.2840E-03
 0.2000E+01  0.1560E-03
 0.8000E+01  0.1160E-03
 0.2400E+02  0.6060E-04
 0.9600E+02  0.2390E-04
 1
 3
 0.0000E+00  0.3470E-03
 0.8000E+01  0.1750E-03
 0.2400E+02  0.2320E-03
 0
Location  3:
Control Room Inlet
 2
 1
 5
```

```
 0.0000E+00   0.1340E-02
 0.3330E-01   0.3290E-03
 0.8000E+01   0.1960E-03
 0.2400E+02   0.1080E-03
 0.9600E+02   0.6980E-05
 1
 3
 0.0000E+00   0.3470E-03
 0.2400E+02   0.2082E-03
 0.9600E+02   0.1388E-03
 0
Effective Volume Location:
 1
 1
 0.0000E+00   0.2000E-05
Simulation Parameters:
 4
 0.0000E+00   0.5000E-01
 0.2000E+01   0.1000E+00
 0.8000E+01   0.4000E+01
 0.7200E+03   0.0000E+00
Output Filename:
REBASE\GG21D0N.TXT
 1
 1
 1
 1
 1
End of Scenario File
```

Zion Containment Leakage Model: PMF file

FILENAME: ZIONP5.PMF

```
Plant Model Name:

Nuclide Inventory File:
DEFAULTS\PWR_DEF.NIF
Plant Power Level:
 0.3391E+04
Compartments:
 2
Compartment  1:
containment
 3
 0.2715E+07
 1
 0
 0
 0
 0
Compartment  2:
Environment
 2
 0.0000E+00
 0
 0
 0
 0
 0
Pathways:
 1
Pathway   1:
Containment to env
 1
 2
 4
End of Plant Model File
```

Zion Containment Leakage Model: SDF file

```
FILENAME: ZIONP5.SDF

Scenario Description Name:

Plant Model Filename:
REBASE\ZIONP5.SDF
Source Term:
 1
DEFAULTS\FGR60.INP
DEFAULTS\PWR_DBA.RFT
 0.0000E+00
 0
 0.9500E+00  0.4850E-01  0.1500E-02  0.1000E+01
Overlying Pool:
 0
 0.0000E+00
 0
 0
 0
 0
Compartments:
 2
Compartment  1:
 1
 1
 2
 0.0000E+00
 0.0000E+00
 0.5000E+02
 2
 0.0000E+00  0.3594E-01  0.1470E+03
 0.7200E+03  0.3594E-01  0.1470E+03
 1
 0.0000E+00
 2
 0.0000E+00  0.5400E+02
 0.7200E+03  0.5400E+02
 0
 0
 0
 0
 0
Compartment  2:
 0
 1
 0
 0
```

```
 0
 0
 0
 0
 0
Pathways:
 1
Pathway  1:
 0
 0
 0
 0
 0
 0
 0
 0
 0
 0
 1
 3
 0.0000E+00  0.1000E+00
 0.2400E+02  0.4500E-01
 0.7200E+03  0.4500E-01
 0
Dose Locations:
 2
Location  1:
EAB
 2
 1
 2
 0.0000E+00  0.9200E-03
 0.7200E+03  0.9200E-03
 1
 2
 0.0000E+00  0.3470E-03
 0.2000E+01  0.3470E-03
 0
Location  2:
LPZ
 2
 1
 4
 0.0000E+00  0.2700E-03
 0.2000E+01  0.1400E-03
 0.1200E+02  0.1900E-04
 0.9600E+02  0.4200E-05
 1
 3
 0.0000E+00  0.3470E-03
```

0.8000E+01 0.1750E-03
0.2400E+02 0.2320E-03
0
Effective Volume Location:
0
Simulation Parameters:
5
0.0000E+00 0.2000E-02
0.1000E+01 0.5000E-01
0.1800E+01 0.2000E-02
0.3000E+01 0.1000E+01
0.2400E+02 0.4000E+01
Output Filename:
REBASE\ZIONP5.TXT
1
1
1
1
1
End of Scenario File

Zion ECCS Leakage Model: PMF file

FILENAME: ZL.PMF

```
Plant Model Name:

Nuclide Inventory File:
DEFAULTS\PWR_DEF.NIF
Plant Power Level:
 0.3391E+04
Compartments:
 2
Compartment  1:
sump
 3
 0.4590E+05
 0
 0
 0
 0
 0
Compartment  2:
Environment
 2
 0.0000E+00
 0
 0
 0
 0
 0
Pathways:
 1
Pathway   1:
sump to env
 1
 2
 2
End of Plant Model File
```

Zion ECCS Leakage Model: SDF file

FILENAME: ZL.SDF

```
 Scenario Description Name:

 Plant Model Filename:
ZL.SDF
Source Term:
 1
DEFAULTS\FGR60.INP
DEFAULTS\ZL.RFT
 0.0000E+00
 0
 0.9500E+00  0.4850E-01  0.1500E-02  0.1000E+01
Overlying Pool:
 0
 0.0000E+00
 0
 0
 0
 0
Compartments:
 2
Compartment  1:
 1
 1
 1
 0.0000E+00
 2
 0.0000E+00  0.5400E+02
 0.7200E+03  0.5400E+02
 1
 0.0000E+00
 2
 0.0000E+00  0.5400E+02
 0.7200E+03  0.5400E+02
 0
 0
 0
 0
 0
Compartment  2:
 0
 1
 0
 0
 0
 0
```

```
 0
 0
 0
Pathways:
 1
Pathway  1:
 0
 0
 0
 0
 0
 1
 0.8122E-03
 3
 0.0000E+00  0.9000E+02  0.9000E+02  0.9000E+02
 0.1000E+01  0.1000E+03  0.1000E+03  0.1000E+03
 0.7200E+03  0.1000E+03  0.1000E+03  0.1000E+03
 0
 0
 0
 0
 1
 3
 0.0000E+00  0.1000E+00
 0.2400E+02  0.4500E-01
 0.7200E+03  0.4500E-01
 0
Dose Locations:
 2
Location  1:
EAB
 2
 1
 2
 0.0000E+00  0.9200E-03
 0.7200E+03  0.9200E-03
 1
 2
 0.0000E+00  0.3470E-03
 0.2000E+01  0.3470E-03
 0
Location  2:
LPZ
 2
 1
 4
 0.0000E+00  0.2700E-03
 0.2000E+01  0.1400E-03
 0.1200E+02  0.1900E-04
 0.9600E+02  0.4200E-05
```

```
 1
 3
 0.0000E+00   0.3470E-03
 0.8000E+01   0.1750E-03
 0.2400E+02   0.2320E-03
 0
Effective Volume Location:
 0
Simulation Parameters:
 5
 0.0000E+00   0.2000E-02
 0.5000E-01   0.5000E-01
 0.1000E+01   0.1000E+00
 0.8000E+01   0.1000E+01
 0.2400E+02   0.4000E+01
Output Filename:
ZL.TXT
 1
 1
 1
 1
 1
End of Scenario File
```

Dose Conversion Factors File: FGR60.INP

FGRDCF 10/24/95 03:24:50 beta-test version 1.10, minor FORTRAN fixes 5/4/95
Implicit daughter halflives (m) less than 90 and less than 0.100 of parent
9 ORGANS DEFINED IN THIS FILE:
GONADS
BREAST
LUNGS
RED MARR
BONE SUR
THYROID
REMAINDER
EFFECTIVE
SKIN(FGR)
60 NUCLIDES DEFINED IN THIS FILE:

Co-58	Y	
Co-60	Y	
Kr-85		
Kr-85m		
Kr-87		
Kr-88		
Rb-86	D	
Sr-89	Y	
Sr-90	Y	
Sr-91	Y	Including:Y-91m
Sr-92	Y	
Y-90	Y	
Y-91	Y	
Y-92	Y	
Y-93	Y	
Zr-95	D	
Zr-97	Y	Including:Nb-97m , Including:Nb-97
Nb-95	Y	
Mo-99	Y	
Tc-99m	D	
Ru-103	Y	Including:Rh-103m
Ru-105	Y	
Ru-106	Y	Including:Rh-106
Rh-105	Y	
Sb-127	W	
Sb-129	W	
Te-127	W	
Te-127m	W	
Te-129	W	
Te-129m	W	Including:Te-129
Te-131m	W	Including:Te-131
Te-132	W	
I-131	D	
I-132	D	

I-133 D
I-134 D
I-135 D Including:Xe-135m
Xe-133
Xe-135
Cs-134 D
Cs-136 D
Cs-137 D Including:Ba-137m
Ba-139 D
Ba-140 D
La-140 W
La-141 D
La-142 D
Ce-141 Y
Ce-143 Y
Ce-144 Y Including:Pr-144m, Including:Pr-144
Pr-143 Y
Nd-147 Y
Np-239 W
Pu-238 Y
Pu-239 Y
Pu-240 Y
Pu-241 Y
Am-241 W
Cm-242 W
Cm-244 W

	CLOUDSHINE	GROUND SHINE 8HR	GROUND SHINE 7DAY	GROUND SHINE RATE	INHALED ACUTE	INHALED CHRONIC	INGESTION
Co-58							
GONADS	4.660E-14	2.867E-11	5.828E-10	9.970E-16-1.000E+00	6.170E-10	1.040E-09	
BREAST	5.300E-14	2.737E-11	5.565E-10	9.520E-16-1.000E+00	9.370E-10	1.790E-10	
LUNGS	4.640E-14	2.617E-11	5.319E-10	9.100E-16-1.000E+00	1.600E-08	8.530E-11	
RED MARR	4.530E-14	2.671E-11	5.430E-10	9.290E-16-1.000E+00	9.230E-10	2.600E-10	
BONE SUR	7.410E-14	3.795E-11	7.716E-10	1.320E-15-1.000E+00	6.930E-10	1.250E-10	
THYROID	4.770E-14	2.720E-11	5.530E-10	9.460E-16-1.000E+00	8.720E-10	6.310E-11	
REMAINDER	4.440E-14	2.585E-11	5.255E-10	8.990E-16-1.000E+00	1.890E-09	1.580E-09	
EFFECTIVE	4.760E-14	2.732E-11	5.553E-10	9.500E-16-1.000E+00	2.940E-09	8.090E-10	
SKIN(FGR)	5.580E-14	3.278E-11	6.664E-10	1.140E-15-1.000E+00	0.000E+00	0.000E+00	
Co-60							
GONADS	1.230E-13	7.056E-11	1.480E-09	2.450E-15-1.000E+00	4.760E-09	3.190E-09	
BREAST	1.390E-13	6.739E-11	1.413E-09	2.340E-15-1.000E+00	1.840E-08	1.100E-09	
LUNGS	1.240E-13	6.537E-11	1.371E-09	2.270E-15-1.000E+00	3.450E-07	8.770E-10	
RED MARR	1.230E-13	6.710E-11	1.407E-09	2.330E-15-1.000E+00	1.720E-08	1.320E-09	
BONE SUR	1.780E-13	8.956E-11	1.879E-09	3.110E-15-1.000E+00	1.350E-08	9.390E-10	
THYROID	1.270E-13	6.480E-11	1.359E-09	2.250E-15-1.000E+00	1.620E-08	7.880E 10	
REMAINDER	1.200E-13	6.508E-11	1.365E-09	2.260E-15-1.000E+00	3.600E-08	4.970E-09	
EFFECTIVE	1.260E-13	6.768E-11	1.419E-09	2.350E-15-1.000E+00	5.910E-08	2.770E-09	
SKIN(FGR)	1.450E-13	7.948E-11	1.667E-09	2.760E-15-1.000E+00	0.000E+00	0.000E+00	
Kr-85							
GONADS	1.170E-16	8.121E-14	1.704E-12	2.820E-18-1.000E+00	0.000E+00	0.000E+00	

BREAST 1.340E-16 7.891E-14 1.656E-12 2.740E-18-1.000E+00 0.000E+00 0.000E+00
LUNGS 1.140E-16 7.056E-14 1.481E-12 2.450E-18-1.000E+00 0.000E+00 0.000E+00
RED MARR 1.090E-16 6.998E-14 1.469E-12 2.430E-18-1.000E+00 0.000E+00 0.000E+00
BONE SUR 2.200E-16 1.287E-13 2.702E-12 4.470E-18-1.000E+00 0.000E+00 0.000E+00
THYROID 1.180E-16 7.459E-14 1.565E-12 2.590E-18-1.000E+00 0.000E+00 0.000E+00
REMAINDER 1.090E-16 6.941E-14 1.457E-12 2.410E-18-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE 1.190E-16 7.603E-14 1.596E-12 2.640E-18-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR) 1.320E-14 2.304E-11 4.835E-10 8.000E-16-1.000E+00 0.000E+00 0.000E+00
Kr-85m
GONADS 7.310E-15 2.594E-12 3.653E-12 1.570E-16-1.000E+00 0.000E+00 0.000E+00
BREAST 8.410E-15 2.527E-12 3.560E-12 1.530E-16-1.000E+00 0.000E+00 0.000E+00
LUNGS 7.040E-15 2.379E-12 3.351E-12 1.440E-16-1.000E+00 0.000E+00 0.000E+00
RED MARR 6.430E-15 2.346E-12 3.304E-12 1.420E-16-1.000E+00 0.000E+00 0.000E+00
BONE SUR 1.880E-14 5.286E-12 7.446E-12 3.200E-16-1.000E+00 0.000E+00 0.000E+00
THYROID 7.330E-15 2.395E-12 3.374E-12 1.450E-16-1.000E+00 0.000E+00 0.000E+00
REMAINDER 6.640E-15 2.313E-12 3.257E-12 1.400E-16-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE 7.480E-15 2.511E-12 3.537E-12 1.520E-16-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR) 2.240E-14 2.247E-11 3.164E-11 1.360E-15-1.000E+00 0.000E+00 0.000E+00
Kr-87
GONADS 4.000E-14 4.962E-12 5.026E-12 7.610E-16-1.000E+00 0.000E+00 0.000E+00
BREAST 4.500E-14 4.740E-12 4.802E-12 7.270E-16-1.000E+00 0.000E+00 0.000E+00
LUNGS 4.040E-14 4.603E-12 4.663E-12 7.060E-16-1.000E+00 0.000E+00 0.000E+00
RED MARR 4.000E-14 4.708E-12 4.769E-12 7.220E-16-1.000E+00 0.000E+00 0.000E+00
BONE SUR 6.020E-14 6.514E-12 6.598E-12 9.990E-16-1.000E+00 0.000E+00 0.000E+00
THYROID 4.130E-14 4.473E-12 4.531E-12 6.860E-16-1.000E+00 0.000E+00 0.000E+00
REMAINDER 3.910E-14 4.590E-12 4.650E-12 7.040E-16-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE 4.120E-14 4.773E-12 4.835E-12 7.320E-16-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR) 1.370E-13 8.802E-11 8.916E-11 1.350E-14-1.000E+00 0.000E+00 0.000E+00
Kr-88
GONADS 9.900E-14 2.278E-11 2.655E-11 1.800E-15-1.000E+00 0.000E+00 0.000E+00
BREAST 1.110E-13 2.177E-11 2.537E-11 1.720E-15-1.000E+00 0.000E+00 0.000E+00
LUNGS 1.010E-13 2.139E-11 2.493E-11 1.690E-15-1.000E+00 0.000E+00 0.000E+00
RED MARR 1.000E-13 2.190E-11 2.552E-11 1.730E-15-1.000E+00 0.000E+00 0.000E+00
BONE SUR 1.390E-13 2.886E-11 3.363E-11 2.280E-15-1.000E+00 0.000E+00 0.000E+00
THYROID 1.030E-13 2.012E-11 2.345E-11 1.590E-15-1.000E+00 0.000E+00 0.000E+00
REMAINDER 9.790E-14 2.139E-11 2.493E-11 1.690E-15-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE 1.020E-13 2.202E-11 2.567E-11 1.740E-15-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR) 1.350E-13 5.607E-11 6.534E-11 4.430E-15-1.000E+00 0.000E+00 0.000E+00
Rb-86
GONADS 4.710E-15 2.788E-12 5.187E-11 9.740E-17-1.000E+00 1.340E-09 2.150E-09
BREAST 5.340E-15 2.662E-12 4.953E-11 9.300E-17-1.000E+00 1.330E-09 2.140E-09
LUNGS 4.710E-15 2.553E-12 4.750E-11 8.920E-17-1.000E+00 3.300E-09 2.140E-09
RED MARR 4.640E-15 2.619E-12 4.873E-11 9.150E-17-1.000E+00 2.320E-09 3.720E-09
BONE SUR 7.050E-15 3.635E-12 6.764E-11 1.270E-16-1.000E+00 4.270E-09 6.860E-09
THYROID 4.840E-15 2.599E-12 4.836E-11 9.080E-17-1.000E+00 1.330E-09 2.140E-09
REMAINDER 4.520E-15 2.542E-12 4.729E-11 8.880E-17-1.000E+00 1.380E-09 2.330E-09
EFFECTIVE 4.810E-15 2.665E-12 4.958E-11 9.310E-17-1.000E+00 1.790E-09 2.530E-09
SKIN(FGR) 4.850E-14 2.210E-10 4.111E-09 7.720E-15-1.000E+00 0.000E+00 0.000E+00
Sr-89
GONADS 7.730E-17 7.155E-14 1.436E-12 2.490E-18-1.000E+00 7.950E-12 8.050E-12

BREAST 9.080E-17 7.212E-14 1.447E-12 2.510E-18-1.000E+00 7.960E-12 7.980E-12
LUNGS 7.080E-17 5.689E-14 1.142E-12 1.980E-18-1.000E+00 8.350E-08 7.970E-12
RED MARR 6.390E-17 5.345E-14 1.073E-12 1.860E-18-1.000E+00 1.070E-10 1.080E-10
BONE SUR 1.940E-16 1.560E-13 3.131E-12 5.430E-18-1.000E+00 1.590E-10 1.610E-10
THYROID 7.600E-17 6.063E-14 1.217E-12 2.110E-18-1.000E+00 7.960E-12 7.970E-12
REMAINDER 6.710E-17 5.603E-14 1.124E-12 1.950E-18-1.000E+00 3.970E-09 8.250E-09
EFFECTIVE 7.730E-17 6.523E-14 1.309E-12 2.270E-18-1.000E+00 1.120E-08 2.500E-09
SKIN(FGR) 3.690E-14 1.914E-10 3.841E-09 6.660E-15-1.000E+00 0.000E+00 0.000E+00
Sr-90
GONADS 7.780E-18 9.590E-15 2.014E-13 3.330E-19-1.000E+00 2.690E-10 5.040E-11
BREAST 9.490E-18 1.008E-14 2.116E-13 3.500E-19-1.000E+00 2.690E-10 5.040E-11
LUNGS 6.440E-18 6.307E-15 1.324E-13 2.190E-19-1.000E+00 2.860E-06 5.040E-11
RED MARR 5.440E-18 5.558E-15 1.167E-13 1.930E-19-1.000E+00 3.280E-08 6.450E-09
BONE SUR 2.280E-17 2.393E-14 5.025E-13 8.310E-19-1.000E+00 7.090E-08 1.390E-08
THYROID 7.330E-18 7.171E-15 1.506E-13 2.490E-19-1.000E+00 2.690E-10 5.040E-11
REMAINDER 6.110E-18 6.422E-15 1.348E-13 2.230E-19-1.000E+00 5.730E-09 6.700E-09
EFFECTIVE 7.530E-18 8.179E-15 1.717E-13 2.840E-19-1.000E+00 3.510E-07 3.230E-09
SKIN(FGR) 9.200E-15 4.032E-12 8.465E-11 1.400E-16-1.000E+00 0.000E+00 0.000E+00
Sr-91
GONADS 4.819E-14 2.155E-11 5.062E-11 1.026E-15-1.000E+00 5.669E-11 2.520E-10
BREAST 5.477E-14 2.059E-11 4.838E-11 9.806E-16-1.000E+00 1.775E-11 3.676E-11
LUNGS 4.803E-14 1.970E-11 4.626E-11 9.376E-16-1.000E+00 2.170E-09 1.055E-11
RED MARR 4.691E-14 2.011E-11 4.722E-11 9.570E-16-1.000E+00 2.275E-11 5.659E-11
BONE SUR 7.674E-14 2.852E-11 6.709E-11 1.360E-15-1.000E+00 1.306E-11 2.070E-11
THYROID 4.938E-14 2.035E-11 4.782E-11 9.693E-16-1.000E+00 9.930E-12 1.968E-12
REMAINDER 4.610E-14 1.948E-11 4.573E-11 9.269E-16-1.000E+00 5.802E-10 2.557E-09
EFFECTIVE 4.924E-14 2.057E-11 4.832E-11 9.793E-16-1.000E+00 4.547E-10 8.455E-10
SKIN(FGR) 9.938E-14 1.748E-10 3.987E-10 8.080E-15-1.000E+00 0.000E+00 0.000E+00
Sr-92
GONADS 6.610E-14 1.593E-11 1.830E-11 1.300E-15-1.000E+00 1.020E-11 8.180E-11
BREAST 7.480E-14 1.520E-11 1.745E-11 1.240E-15-1.000E+00 6.490E-12 1.700E-11
LUNGS 6.670E-14 1.483E-11 1.703E-11 1.210E-15-1.000E+00 1.050E-09 7.220E-12
RED MARR 6.620E-14 1.520E-11 1.745E-11 1.240E-15-1.000E+00 6.980E-12 2.290E-11
BONE SUR 9.490E-14 2.010E-11 2.308E-11 1.640E-15-1.000E+00 4.360E-12 8.490E-12
THYROID 6.820E-14 1.446E-11 1.661E-11 1.180E-15-1.000E+00 3.920E-12 1.300E-12
REMAINDER 6.450E-14 1.471E-11 1.689E-11 1.200E-15-1.000E+00 2.900E-10 1.720E-09
EFFECTIVE 6.790E-14 1.532E-11 1.759E-11 1.250E-15-1.000E+00 2.180E-10 5.430E-10
SKIN(FGR) 8.560E-14 2.280E-11 2.618E-11 1.860E-15-1.000E+00 0.000E+00 0.000E+00
Y-90
GONADS 1.890E-16 1.586E-13 1.601E-12 5.750E-18-1.000E+00 5.170E-13 1.430E-14
BREAST 2.200E-16 1.578E-13 1.593E-12 5.720E-18-1.000E+00 5.170E-13 1.270E-14
LUNGS 1.770E-16 1.313E-13 1.326E-12 4.760E-18-1.000E+00 9.310E-09 1.260E-14
RED MARR 1.620E-16 1.261E-13 1.273E-12 4.570E-18-1.000E+00 1.520E-11 3.700E-13
BONE SUR 4.440E-16 3.228E-13 3.259E-12 1.170E-17-1.000E+00 1.510E-11 3.670E-13
THYROID 1.870E-16 1.385E-13 1.398E-12 5.020E-18-1.000E+00 5.170E-13 1.260E-14
REMAINDER 1.680E-16 1.291E-13 1.303E-12 4.680E-18-1.000E+00 3.870E-09 9.680E-09
EFFECTIVE 1.900E-16 1.468E-13 1.482E-12 5.320E-18-1.000E+00 2.280E-09 2.910E-09
SKIN(FGR) 6.240E-14 2.897E-10 2.924E-09 1.050E-14-1.000E+00 0.000E+00 0.000E+00
Y-91
GONADS 2.560E-16 1.756E-13 3.546E-12 6.110E-18-1.000E+00 8.200E-12 3.540E-12

BREAST 2.930E-16 1.713E-13 3.459E-12 5.960E-18-1.000E+00 8.920E-12 5.540E-13
LUNGS 2.500E-16 1.526E-13 3.082E-12 5.310E-18-1.000E+00 9.870E-08 2.020E-13
RED MARR 2.410E-16 1.521E-13 3.070E-12 5.290E-18-1.000E+00 3.190E-10 6.590E-12
BONE SUR 4.560E-16 2.903E-13 5.862E-12 1.010E-17-1.000E+00 3.180E-10 6.130E-12
THYROID 2.600E-16 1.564E-13 3.157E-12 5.440E-18-1.000E+00 8.500E-12 1.290E-13
REMAINDER 2.390E-16 1.509E-13 3.047E-12 5.250E-18-1.000E+00 4.200E-09 8.570E-09
EFFECTIVE 2.600E-16 1.650E-13 3.332E-12 5.740E-18-1.000E+00 1.320E-08 2.570E-09
SKIN(FGR) 3.850E-14 1.989E-10 4.016E-09 6.920E-15-1.000E+00 0.000E+00 0.000E+00
Y-92
GONADS 1.270E-14 3.855E-12 4.872E-12 2.650E-16-1.000E+00 2.610E-12 1.960E-11
BREAST 1.440E-14 3.680E-12 4.652E-12 2.530E-16-1.000E+00 1.500E-12 3.550E-12
LUNGS 1.270E-14 3.535E-12 4.468E-12 2.430E-16-1.000E+00 1.240E-09 1.390E-12
RED MARR 1.250E-14 3.608E-12 4.560E-12 2.480E-16-1.000E+00 2.070E-12 4.910E-12
BONE SUR 1.950E-14 5.091E-12 6.435E-12 3.500E-16-1.000E+00 1.510E-12 1.750E-12
THYROID 1.300E-14 3.579E-12 4.523E-12 2.460E-16-1.000E+00 1.050E-12 1.770E-13
REMAINDER 1.220E-14 3.506E-12 4.431E-12 2.410E-16-1.000E+00 2.030E-10 1.700E-09
EFFECTIVE 1.300E-14 3.680E-12 4.652E-12 2.530E-16-1.000E+00 2.110E-10 5.150E-10
SKIN(FGR) 1.140E-13 2.022E-10 2.556E-10 1.390E-14-1.000E+00 0.000E+00 0.000E+00
Y-93
GONADS 4.670E-15 2.108E-12 4.989E-12 9.510E-17-1.000E+00 5.310E-12 2.200E-11
BREAST 5.300E-15 2.026E-12 4.794E-12 9.140E-17-1.000E+00 1.740E-12 3.130E-12
LUNGS 4.680E-15 1.937E-12 4.585E-12 8.740E-17-1.000E+00 2.520E-09 8.670E-13
RED MARR 4.580E-15 1.972E-12 4.669E-12 8.900E-17-1.000E+00 4.040E-12 4.930E-12
BONE SUR 7.580E-15 2.948E-12 6.977E-12 1.330E-16-1.000E+00 3.140E-12 1.730E-12
THYROID 4.790E-15 1.908E-12 4.516E-12 8.610E-17-1.000E+00 9.260E-13 1.260E-13
REMAINDER 4.510E-15 1.919E-12 4.543E-12 8.660E-17-1.000E+00 9.250E-10 4.090E-09
EFFECTIVE 4.800E-15 2.021E-12 4.784E-12 9.120E-17-1.000E+00 5.820E-10 1.230E-09
SKIN(FGR) 8.500E-14 2.726E-10 6.452E-10 1.230E-14-1.000E+00 0.000E+00 0.000E+00
Zr-95
GONADS 3.530E-14 2.182E-11 4.421E-10 7.590E-16-1.000E+00 1.880E-09 8.160E-10
BREAST 4.010E-14 2.084E-11 4.223E-10 7.250E-16-1.000E+00 1.910E-09 1.050E-10
LUNGS 3.510E-14 1.989E-11 4.030E-10 6.920E-16-1.000E+00 2.170E-09 2.340E-11
RED MARR 3.430E-14 2.030E-11 4.112E-10 7.060E-16-1.000E+00 1.300E-08 2.140E-10
BONE SUR 5.620E-14 2.875E-11 5.824E-10 1.000E-15-1.000E+00 1.030E-07 4.860E-10
THYROID 3.610E-14 2.076E-11 4.205E-10 7.220E-16-1.000E+00 1.440E-09 8.270E-12
REMAINDER 3.360E-14 1.963E-11 3.978E-10 6.830E-16-1.000E+00 2.280E-09 2.530E-09
EFFECTIVE 3.600E-14 2.078E-11 4.211E-10 7.230E-16-1.000E+00 6.390E-09 1.020E-09
SKIN(FGR) 4.500E-14 2.561E-11 5.190E-10 8.910E-16-1.000E+00 0.000E+00 0.000E+00
Zr-97
GONADS 4.331E-14 2.179E-11 7.799E-11 9.253E-16-1.000E+00 1.840E-10 6.228E-10
BREAST 4.928E-14 2.083E-11 7.455E-11 8.846E-16-1.000E+00 4.706E-11 8.137E-11
LUNGS 4.322E-14 1.992E-11 7.127E-11 8.456E-16-1.000E+00 4.108E-09 1.770E-11
RED MARR 4.224E-14 2.034E-11 7.279E-11 8.634E-16-1.000E+00 6.376E-11 1.302E-10
BONE SUR 6.897E-14 2.881E-11 1.031E-10 1.224E-15-1.000E+00 3.504E-11 4.558E-11
THYROID 4.443E-14 2.061E-11 7.377E-11 8.755E-16-1.000E+00 2.315E-11 2.671E-12
REMAINDER 4.139E-14 1.966E-11 7.035E-11 8.345E-16-1.000E+00 2.041E-09 6.990E-09
EFFECTIVE 4.432E-14 2.078E-11 7.438E-11 8.824E-16-1.000E+00 1.171E-09 2.283E-09
SKIN(FGR) 9.835E-14 2.281E-10 8.148E-10 9.587E-15-1.000E+00 0.000E+00 0.000E+00
Nb-95
GONADS 3.660E-14 2.253E-11 4.435E-10 7.850E-16-1.000E+00 4.320E-10 8.050E-10

BREAST 4.160E-14 2.150E-11 4.231E-10 7.490E-16-1.000E+00 4.070E-10 1.070E-10
LUNGS 3.650E-14 2.055E-11 4.045E-10 7.160E-16-1.000E+00 8.320E-09 2.740E-11
RED MARR 3.560E-14 2.101E-11 4.135E-10 7.320E-16-1.000E+00 4.420E-10 1.990E-10
BONE SUR 5.790E-14 2.957E-11 5.819E-10 1.030E-15-1.000E+00 5.130E-10 2.940E-10
THYROID 3.750E-14 2.144E-11 4.220E-10 7.470E-16-1.000E+00 3.580E-10 1.180E-11
REMAINDER 3.490E-14 2.032E-11 4.000E-10 7.080E-16-1.000E+00 1.070E-09 1.470E-09
EFFECTIVE 3.740E-14 2.147E-11 4.226E-10 7.480E-16-1.000E+00 1.570E-09 6.950E-10
SKIN(FGR) 4.300E-14 2.598E-11 5.112E-10 9.050E-16-1.000E+00 0.000E+00 0.000E+00
Mo-99
GONADS 7.130E-15 4.282E-12 4.403E-11 1.550E-16-1.000E+00 9.510E-11 2.180E-10
BREAST 8.130E-15 4.116E-12 4.233E-11 1.490E-16-1.000E+00 2.750E-11 3.430E-11
LUNGS 7.060E-15 3.867E-12 3.977E-11 1.400E-16-1.000E+00 4.290E-09 1.510E-11
RED MARR 6.820E-15 3.923E-12 4.034E-11 1.420E-16-1.000E+00 5.240E-11 8.320E-11
BONE SUR 1.240E-14 6.105E-12 6.278E-11 2.210E-16-1.000E+00 4.130E-11 6.320E-11
THYROID 7.270E-15 4.033E-12 4.147E-11 1.460E-16-1.000E+00 1.520E-11 1.030E-11
REMAINDER 6.740E-15 3.812E-12 3.920E-11 1.380E-16-1.000E+00 1.740E-09 4.280E-09
EFFECTIVE 7.280E-15 4.061E-12 4.176E-11 1.470E-16-1.000E+00 1.070E-09 1.360E-09
SKIN(FGR) 3.140E-14 1.039E-10 1.068E-09 3.760E-15-1.000E+00 0.000E+00 0.000E+00
Tc-99m
GONADS 5.750E-15 2.334E-12 3.877E-12 1.240E-16-1.000E+00 2.770E-12 9.750E-12
BREAST 6.650E-15 2.258E-12 3.752E-12 1.200E-16-1.000E+00 2.150E-12 3.570E-12
LUNGS 5.490E-15 2.127E-12 3.533E-12 1.130E-16-1.000E+00 2.280E-11 3.140E-12
RED MARR 4.910E-15 2.070E-12 3.439E-12 1.100E-16-1.000E+00 3.360E-12 6.290E-12
BONE SUR 1.630E-14 5.383E-12 8.942E-12 2.860E-16-1.000E+00 2.620E-12 4.060E-12
THYROID 5.750E-15 2.145E-12 3.564E-12 1.140E-16-1.000E+00 5.010E-11 8.460E-11
REMAINDER 5.150E-15 2.070E-12 3.439E-12 1.100E-16-1.000E+00 1.020E-11 3.340E-11
EFFECTIVE 5.890E-15 2.277E-12 3.783E-12 1.210E-16-1.000E+00 8.800E-12 1.680E-11
SKIN(FGR) 7.140E-15 2.710E-12 4.502E-12 1.440E-16-1.000E+00 0.000E+00 0.000E+00
Ru-103
GONADS 2.191E-14 1.404E-11 2.783E-10 4.892E-16-1.000E+00 3.070E-10 5.720E-10
BREAST 2.512E-14 1.350E-11 2.677E-10 4.705E-16-1.000E+00 3.110E-10 1.200E-10
LUNGS 2.180E-14 1.273E-11 2.522E-10 4.432E-16-1.000E+00 1.561E-08 7.310E-11
RED MARR 2.100E-14 1.287E-11 2.551E-10 4.483E-16-1.000E+00 3.190E-10 1.660E-10
BONE SUR 3.892E-14 1.958E-11 3.882E-10 6.823E-16-1.000E+00 2.370E-10 9.631E-11
THYROID 2.241E-14 1.331E-11 2.639E-10 4.638E-16-1.000E+00 2.570E-10 6.250E-11
REMAINDER 2.080E-14 1.248E-11 2.472E-10 4.346E-16-1.000E+00 1.250E-09 2.110E-09
EFFECTIVE 2.251E-14 1.332E-11 2.641E-10 4.642E-16-1.000E+00 2.421E-09 8.271E-10
SKIN(FGR) 2.774E-14 1.785E-11 3.543E-10 6.229E-16-1.000E+00 0.000E+00 0.000E+00
Ru-105
GONADS 3.720E-14 1.327E-11 1.861E-11 8.070E-16-1.000E+00 1.590E-11 9.670E-11
BREAST 4.240E-14 1.271E-11 1.783E-11 7.730E-16-1.000E+00 6.610E-12 1.590E-11
LUNGS 3.700E-14 1.210E-11 1.697E-11 7.360E-16-1.000E+00 5.730E-10 6.210E-12
RED MARR 3.590E-14 1.230E-11 1.725E-11 7.480E-16-1.000E+00 7.700E-12 2.350E-11
BONE SUR 6.280E-14 1.809E-11 2.537E-11 1.100E-15-1.000E+00 4.620E-12 8.390E-12
THYROID 3.800E-14 1.260E-11 1.766E-11 7.660E-16-1.000E+00 4.150E-12 1.820E-12
REMAINDER 3.540E-14 1.189E-11 1.667E-11 7.230E-16-1.000E+00 1.610E-10 8.540E-10
EFFECTIVE 3.810E-14 1.265E-11 1.773E-11 7.690E-16-1.000E+00 1.230E-10 2.870E-10
SKIN(FGR) 6.730E-14 7.368E-11 1.033E-10 4.480E-15-1.000E+00 0.000E+00 0.000E+00
Ru-106
GONADS 1.010E-14 6.411E-12 1.340E-10 2.230E-16-1.000E+00 1.300E-09 1.640E-09

BREAST 1.160E-14 6.152E-12 1.286E-10 2.140E-16-1.000E+00 1.780E-09 1.440E-09
LUNGS 1.010E-14 5.836E-12 1.220E-10 2.030E-16-1.000E+00 1.040E-06 1.420E-09
RED MARR 9.750E-15 5.893E-12 1.232E-10 2.050E-16-1.000E+00 1.760E-09 1.460E-09
BONE SUR 1.720E-14 8.883E-12 1.856E-10 3.090E-16-1.000E+00 1.610E-09 1.430E-09
THYROID 1.030E-14 6.066E-12 1.268E-10 2.110E-16-1.000E+00 1.720E-09 1.410E-09
REMAINDER 9.630E-15 5.721E-12 1.196E-10 1.990E-16-1.000E+00 1.200E-08 2.110E-08
EFFECTIVE 1.040E-14 6.095E-12 1.274E-10 2.120E-16-1.000E+00 1.290E-07 7.400E-09
SKIN(FGR) 1.090E-13 4.082E-10 8.531E-09 1.420E-14-1.000E+00 0.000E+00 0.000E+00
Rh-105
GONADS 3.640E-15 2.127E-12 1.411E-11 7.980E-17-1.000E+00 2.110E-11 5.800E-11
BREAST 4.160E-15 2.063E-12 1.369E-11 7.740E-17-1.000E+00 5.610E-12 8.970E-12
LUNGS 3.570E-15 1.935E-12 1.284E-11 7.260E-17-1.000E+00 9.580E-10 3.860E-12
RED MARR 3.380E-15 1.946E-12 1.291E-11 7.300E-17-1.000E+00 7.770E-12 1.470E-11
BONE SUR 7.530E-15 3.332E-12 2.210E-11 1.250E-16-1.000E+00 4.460E-12 6.750E-12
THYROID 3.680E-15 1.983E-12 1.316E-11 7.440E-17-1.000E+00 2.880E-12 2.910E-12
REMAINDER 3.390E-15 1.885E-12 1.250E-11 7.070E-17-1.000E+00 4.530E-10 1.270E-09
EFFECTIVE 3.720E-15 2.031E-12 1.347E-11 7.620E-17-1.000E+00 2.580E-10 3.990E-10
SKIN(FGR) 1.070E-14 4.691E-12 3.112E-11 1.760E-16-1.000E+00 0.000E+00 0.000E+00
Sb-127
GONADS 3.260E-14 1.985E-11 2.441E-10 7.100E-16-1.000E+00 2.520E-10 6.140E-10
BREAST 3.720E-14 1.904E-11 2.341E-10 6.810E-16-1.000E+00 9.120E-11 7.600E-11
LUNGS 3.240E-14 1.809E-11 2.224E-10 6.470E-16-1.000E+00 6.940E-09 1.570E-11
RED MARR 3.140E-14 1.834E-11 2.255E-10 6.560E-16-1.000E+00 1.610E-10 1.330E-10
BONE SUR 5.520E-14 2.720E-11 3.345E-10 9.730E-16-1.000E+00 1.340E-10 5.240E-11
THYROID 3.330E-14 1.884E-11 2.317E-10 6.740E-16-1.000E+00 6.150E-11 4.640E-12
REMAINDER 3.090E-14 1.775E-11 2.183E-10 6.350E-16-1.000E+00 2.330E-09 5.870E-09
EFFECTIVE 3.330E-14 1.890E-11 2.324E-10 6.760E-16-1.000E+00 1.630E-09 1.950E-09
SKIN(FGR) 5.580E-14 7.967E-11 9.799E-10 2.850E-15-1.000E+00 0.000E+00 0.000E+00
Sb-129
GONADS 6.970E-14 2.336E-11 3.231E-11 1.440E-15-1.000E+00 2.150E-11 1.510E-10
BREAST 7.910E-14 2.222E-11 3.074E-11 1.370E-15-1.000E+00 1.280E-11 2.560E-11
LUNGS 6.980E-14 2.141E-11 2.962E-11 1.320E-15-1.000E+00 8.980E-10 9.390E-12
RED MARR 6.860E-14 2.190E-11 3.029E-11 1.350E-15-1.000E+00 1.700E-11 3.670E-11
BONE SUR 1.070E-13 3.033E-11 4.196E-11 1.870E-15-1.000E+00 1.460E-11 1.340E-11
THYROID 7.160E-14 2.174E-11 3.007E-11 1.340E-15-1.000E+00 9.720E-12 1.470E-12
REMAINDER 6.710E-14 2.125E-11 2.939E-11 1.310E-15-1.000E+00 1.870E-10 1.450E-09
EFFECTIVE 7.140E-14 2.238E-11 3.096E-11 1.380E-15-1.000E+00 1.740E-10 4.840E-10
SKIN(FGR) 1.050E-13 8.273E-11 1.144E-10 5.100E-15-1.000E+00 0.000E+00 0.000E+00
Te-127
GONADS 2.370E-16 1.191E-13 2.661E-13 5.480E-18-1.000E+00 2.020E-12 4.020E-12
BREAST 2.730E-16 1.158E-13 2.588E-13 5.330E-18-1.000E+00 1.880E-12 3.000E-12
LUNGS 2.320E-16 1.060E-13 2.370E-13 4.880E-18-1.000E+00 4.270E-10 2.890E-12
RED MARR 2.210E-16 1.058E-13 2.365E-13 4.870E-18-1.000E+00 4.090E-12 6.570E-12
BONE SUR 4.650E-16 1.862E-13 4.162E-13 8.570E-18-1.000E+00 4.090E-12 6.460E-12
THYROID 2.400E-16 1.106E-13 2.472E-13 5.090E-18-1.000E+00 1.840E-12 2.860E-12
REMAINDER 2.210E-16 1.036E-13 2.316E-13 4.770E-18-1.000E+00 1.110E-10 6.130E-10
EFFECTIVE 2.420E-16 1.125E-13 2.515E-13 5.180E-18-1.000E+00 8.600E-11 1.870E-10
SKIN(FGR) 1.140E-14 1.173E-11 2.622E-11 5.400E-16-1.000E+00 0.000E+00 0.000E+00
Te-127m
GONADS 1.900E-16 4.689E-13 9.642E-12 1.630E-17-1.000E+00 1.100E-10 1.250E-10

BREAST 2.690E-16 5.150E-13 1.059E-11 1.790E-17-1.000E+00 1.100E-10 9.740E-11
LUNGS 7.620E-17 1.602E-13 3.295E-12 5.570E-18-1.000E+00 3.340E-08 9.620E-11
RED MARR 6.430E-17 1.249E-13 2.567E-12 4.340E-18-1.000E+00 5.360E-09 5.430E-09
BONE SUR 3.940E-16 9.005E-13 1.852E-11 3.130E-17-1.000E+00 2.040E-08 2.070E-08
THYROID 1.500E-16 2.779E-13 5.714E-12 9.660E-18-1.000E+00 9.660E-11 9.430E-11
REMAINDER 8.640E-17 1.999E-13 4.111E-12 6.950E-18-1.000E+00 1.660E-09 2.980E-09
EFFECTIVE 1.470E-16 3.251E-13 6.684E-12 1.130E-17-1.000E+00 5.810E-09 2.230E-09
SKIN(FGR) 8.490E-16 1.496E-12 3.076E-11 5.200E-17-1.000E+00 0.000E+00 0.000E+00
Te-129
GONADS 2.710E-15 3.889E-13 3.922E-13 6.510E-17-1.000E+00 5.050E-13 1.590E-12
BREAST 3.120E-15 3.800E-13 3.832E-13 6.360E-17-1.000E+00 5.390E-13 6.050E-13
LUNGS 2.640E-15 3.298E-13 3.326E-13 5.520E-17-1.000E+00 1.530E-10 4.910E-13
RED MARR 2.540E-15 3.298E-13 3.326E-13 5.520E-17-1.000E+00 6.190E-13 7.640E-13
BONE SUR 4.880E-15 5.753E-13 5.802E-13 9.630E-17-1.000E+00 6.220E-13 5.400E-13
THYROID 2.740E-15 3.525E-13 3.555E-13 5.900E-17-1.000E+00 5.090E-13 3.360E-13
REMAINDER 2.520E-15 3.262E-13 3.289E-13 5.460E-17-1.000E+00 7.280E-12 1.790E-10
EFFECTIVE 2.750E-15 3.590E-13 3.621E-13 6.010E-17-1.000E+00 2.090E-11 5.450E-11
SKIN(FGR) 3.570E-14 3.429E-11 3.458E-11 5.740E-15-1.000E+00 0.000E+00 0.000E+00
Te-129m
GONADS 3.321E-15 2.206E-12 4.799E-11 8.561E-17-1.000E+00 1.783E-10 2.420E-10
BREAST 3.838E-15 2.181E-12 4.739E-11 8.454E-17-1.000E+00 1.694E-10 1.664E-10
LUNGS 3.176E-15 1.741E-12 3.815E-11 6.808E-17-1.000E+00 4.040E-08 1.593E-10
RED MARR 3.071E-15 1.729E-12 3.793E-11 6.768E-17-1.000E+00 3.100E-09 3.500E-09
BONE SUR 5.772E-15 3.287E-12 7.147E-11 1.275E-16-1.000E+00 7.050E-09 7.990E-09
THYROID 3.341E-15 1.923E-12 4.201E-11 7.495E-17-1.000E+00 1.563E-10 1.572E-10
REMAINDER 3.048E-15 1.746E-12 3.822E-11 6.819E-17-1.000E+00 3.275E-09 7.196E-09
EFFECTIVE 3.337E-15 1.974E-12 4.308E-11 7.686E-17-1.000E+00 6.484E-09 2.925E-09
SKIN(FGR) 3.811E-14 1.501E-10 3.360E-09 6.001E-15-1.000E+00 0.000E+00 0.000E+00
Te-131m
GONADS 7.292E-14 4.020E-11 2.343E-10 1.535E-15-1.000E+00 2.345E-10 7.415E-10
BREAST 8.286E-14 3.853E-11 2.246E-10 1.472E-15-1.000E+00 9.309E-11 1.361E-10
LUNGS 7.265E-14 3.657E-11 2.131E-10 1.397E-15-1.000E+00 2.296E-09 6.335E-11
RED MARR 7.097E-14 3.736E-11 2.178E-10 1.427E-15-1.000E+00 1.417E-10 2.435E-10
BONE SUR 1.174E-13 5.467E-11 3.189E-10 2.090E-15-1.000E+00 2.276E-10 3.248E-10
THYROID 7.471E-14 3.741E-11 2.181E-10 1.429E-15-1.000E+00 3.669E-08 4.383E-08
REMAINDER 6.965E-14 3.626E-11 2.113E-10 1.385E-15-1.000E+00 9.509E-10 3.153E-09
EFFECTIVE 7.463E-14 3.825E-11 2.229E-10 1.461E-15-1.000E+00 1.758E-09 2.514E-09
SKIN(FGR) 1.038E-13 1.033E-10 6.188E-10 4.056E-15-1.000E+00 0.000E+00 0.000E+00
Te-132
GONADS 1.020E-14 6.812E-12 7.706E-11 2.450E-16-1.000E+00 4.150E-10 5.410E-10
BREAST 1.180E-14 6.756E-12 7.643E-11 2.430E-16-1.000E+00 3.630E-10 3.500E-10
LUNGS 9.650E-15 5.727E-12 6.479E-11 2.060E-16-1.000E+00 1.670E-09 3.300E-10
RED MARR 8.950E-15 5.588E-12 6.322E-11 2.010E-16-1.000E+00 4.270E-10 4.440E-10
BONE SUR 2.420E-14 1.273E-11 1.441E-10 4.580E-16-1.000E+00 7.120E-10 8.300E-10
THYROID 1.020E-14 5.978E-12 6.762E-11 2.150E-16-1.000E+00 6.280E-08 5.950E-08
REMAINDER 9.160E-15 5.644E-12 6.385E-11 2.030E-16-1.000E+00 7.890E-10 1.490E-09
EFFECTIVE 1.030E-14 6.339E-12 7.171E-11 2.280E-16-1.000E+00 2.550E-09 2.540E-09
SKIN(FGR) 1.390E-14 8.313E-12 9.405E-11 2.990E-16-1.000E+00 0.000E+00 0.000E+00
I-131
GONADS 1.780E-14 1.119E-11 1.789E-10 3.940E-16-1.000E+00 2.530E-11 4.070E-11

BREAST 2.040E-14 1.082E-11 1.730E-10 3.810E-16-1.000E+00 7.880E-11 1.210E-10
LUNGS 1.760E-14 1.016E-11 1.626E-10 3.580E-16-1.000E+00 6.570E-10 1.020E-10
RED MARR 1.680E-14 1.022E-11 1.635E-10 3.600E-16-1.000E+00 6.260E-11 9.440E-11
BONE SUR 3.450E-14 1.675E-11 2.679E-10 5.900E-16-1.000E+00 5.730E-11 8.720E-11
THYROID 1.810E-14 1.053E-11 1.685E-10 3.710E-16-1.000E+00 2.920E-07 4.760E-07
REMAINDER 1.670E-14 9.908E-12 1.585E-10 3.490E-16-1.000E+00 8.030E-11 1.570E-10
EFFECTIVE 1.820E-14 1.067E-11 1.707E-10 3.760E-16-1.000E+00 8.890E-09 1.440E-08
SKIN(FGR) 2.980E-14 1.825E-11 2.920E-10 6.430E-16-1.000E+00 0.000E+00 0.000E+00
I-132
GONADS 1.090E-13 2.523E-11 2.771E-11 2.320E-15-1.000E+00 9.950E-12 2.330E-11
BREAST 1.240E-13 2.414E-11 2.652E-11 2.220E-15-1.000E+00 1.410E-11 2.520E-11
LUNGS 1.090F-13 2.305E-11 2.532E-11 2.120E-15-1.000E+00 2.710E-10 2.640E-11
RED MARR 1.070E-13 2.360E-11 2.592E-11 2.170E-15-1.000E+00 1.400E-11 2.460E-11
BONE SUR 1.730E-13 3.327E-11 3.655E-11 3.060E-15-1.000E+00 1.240E-11 2.190E-11
THYROID 1.120E-13 2.381E-11 2.616E-11 2.190E-15-1.000E+00 1.740E-09 3.870E-09
REMAINDER 1.050E-13 2.283E-11 2.509E-11 2.100E-15-1.000E+00 3.780E-11 1.650E-10
EFFECTIVE 1.120E-13 2.403E-11 2.640E-11 2.210E-15-1.000E+00 1.030E-10 1.820E-10
SKIN(FGR) 1.580E-13 8.199E-11 9.007E-11 7.540E-15-1.000E+00 0.000E+00 0.000E+00
I-133
GONADS 2.870E-14 1.585E-11 6.748E-11 6.270E-16-1.000E+00 1.950E-11 3.630E-11
BREAST 3.280E-14 1.519E-11 6.468E-11 6.010E-16-1.000E+00 2.940E-11 4.680E-11
LUNGS 2.860E-14 1.446E-11 6.156E-11 5.720E-16-1.000E+00 8.200E-10 4.530E-11
RED MARR 2.770E-14 1.466E-11 6.242E-11 5.800E-16-1.000E+00 2.720E-11 4.300E-11
BONE SUR 4.870E-14 2.161E-11 9.202E-11 8.550E-16-1.000E+00 2.520E-11 4.070E-11
THYROID 2.930E-14 1.502E-11 6.393E-11 5.940E-16-1.000E+00 4.860E-08 9.100E-08
REMAINDER 2.730E-14 1.418E-11 6.038E-11 5.610E-16-1.000E+00 5.000E-11 1.550E-10
EFFECTIVE 2.940E-14 1.509E-11 6.425E-11 5.970E-16-1.000E+00 1.580E-09 2.800E-09
SKIN(FGR) 5.830E-14 1.150E-10 4.897E-10 4.550E-15-1.000E+00 0.000E+00 0.000E+00
I-134
GONADS 1.270E-13 1.200E-11 1.202E-11 2.640E-15-1.000E+00 4.250E-12 1.100E-11
BREAST 1.440E-13 1.145E-11 1.147E-11 2.520E-15-1.000E+00 6.170E-12 1.170E-11
LUNGS 1.270E-13 1.100E-11 1.102E-11 2.420E-15-1.000E+00 1.430E-10 1.260E-11
RED MARR 1.250E-13 1.127E-11 1.129E-11 2.480E-15-1.000E+00 6.080E-12 1.090E-11
BONE SUR 1.960E-13 1.568E-11 1.571E-11 3.450E-15-1.000E+00 5.310E-12 9.320E-12
THYROID 1.300E-13 1.127E-11 1.129E-11 2.480E-15-1.000E+00 2.880E-10 6.210E-10
REMAINDER 1.220E-13 1.091E-11 1.093E-11 2.400E-15-1.000E+00 2.270E-11 1.340E-10
EFFECTIVE 1.300E-13 1.150E-11 1.152E-11 2.530E-15-1.000E+00 3.550E-11 6.660E-11
SKIN(FGR) 1.870E-13 4.477E-11 4.485E-11 9.850E-15-1.000E+00 0.000E+00 0.000E+00
I-135
GONADS 8.078E-14 3.113E-11 5.489E-11 1.599E-15-1.000E+00 1.700E-11 3.610E-11
BREAST 9.143E-14 2.971E-11 5.240E-11 1.526E-15-1.000E+00 2.340E-11 3.850E-11
LUNGS 8.145E-14 2.886E-11 5.089E-11 1.482E-15-1.000E+00 4.410E-10 3.750E-11
RED MARR 8.054E-14 2.965E-11 5.228E-11 1.523E-15-1.000E+00 2.240E-11 3.650E-11
BONE SUR 1.184E-13 3.983E-11 7.024E-11 2.046E-15-1.000E+00 2.010E-11 3.360E-11
THYROID 8.324E-14 2.852E-11 5.030E-11 1.465E-15-1.000E+00 8.460E-09 1.790E-08
REMAINDER 7.861E-14 2.883E-11 5.084E-11 1.481E-15-1.000E+00 4.700E-11 1.540E-10
EFFECTIVE 8.294E-14 2.989E-11 5.271E-11 1.535E-15-1.000E+00 3.320E-10 6.080E-10
SKIN(FGR) 1.156E-13 9.826E-11 1.733E-10 5.047E-15-1.000E+00 0.000E+00 0.000E+00
Xe-133
GONADS 1.610E-15 1.465E-12 2.052E-11 5.200E-17-1.000E+00 0.000E+00 0.000E+00

BREAST 1.960E-15 1.505E-12 2.107E-11 5.340E-17-1.000E+00 0.000E+00 0.000E+00
LUNGS 1.320E-15 1.045E-12 1.464E-11 3.710E-17-1.000E+00 0.000E+00 0.000E+00
RED MARR 1.070E-15 8.791E-13 1.231E-11 3.120E-17-1.000E+00 0.000E+00 0.000E+00
BONE SUR 5.130E-15 4.254E-12 5.958E-11 1.510E-16-1.000E+00 0.000E+00 0.000E+00
THYROID 1.510E-15 1.181E-12 1.653E-11 4.190E-17-1.000E+00 0.000E+00 0.000E+00
REMAINDER 1.240E-15 1.042E-12 1.460E-11 3.700E-17-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE 1.560E-15 1.299E-12 1.819E-11 4.610E-17-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR) 4.970E-15 1.953E-12 2.734E-11 6.930E-17-1.000E+00 0.000E+00 0.000E+00
Xe-135
GONADS 1.170E-14 5.455E-12 1.194E-11 2.530E-16-1.000E+00 0.000E+00 0.000E+00
BREAST 1.330E-14 5.325E-12 1.166E-11 2.470E-16-1.000E+00 0.000E+00 0.000E+00
LUNGS 1.130E-14 4.959E-12 1.086E-11 2.300E-16-1.000E+00 0.000E+00 0.000E+00
RED MARR 1.070E-14 4.959E-12 1.086E-11 2.300E-16-1.000E+00 0.000E+00 0.000E+00
BONE SUR 2.570E-14 9.120E-12 1.997E-11 4.230E-16-1.000E+00 0.000E+00 0.000E+00
THYROID 1.180E-14 5.023E-12 1.100E-11 2.330E-16-1.000E+00 0.000E+00 0.000E+00
REMAINDER 1.080E-14 4.829E-12 1.058E-11 2.240E-16-1.000E+00 0.000E+00 0.000E+00
EFFECTIVE 1.190E-14 5.217E-12 1.142E-11 2.420E-16-1.000E+00 0.000E+00 0.000E+00
SKIN(FGR) 3.120E-14 4.506E-11 9.867E-11 2.090E-15-1.000E+00 0.000E+00 0.000E+00
Cs-134
GONADS 7.400E-14 4.607E-11 9.646E-10 1.600E-15-1.000E+00 1.300E-08 2.060E-08
BREAST 8.430E-14 4.406E-11 9.224E-10 1.530E-15-1.000E+00 1.080E-08 1.720E-08
LUNGS 7.370E-14 4.204E-11 8.802E-10 1.460E-15-1.000E+00 1.180E-08 1.760E-08
RED MARR 7.190E-14 4.262E-11 8.922E-10 1.480E-15-1.000E+00 1.180E-08 1.870E-08
BONE SUR 1.200E-13 6.105E-11 1.278E-09 2.120E-15-1.000E+00 1.100E-08 1.740E-08
THYROID 7.570E-14 4.377E-11 9.163E-10 1.520E-15-1.000E+00 1.110E-08 1.760E-08
REMAINDER 7.060E-14 4.147E-11 8.681E-10 1.440E-15-1.000E+00 1.390E-08 2.210E-08
EFFECTIVE 7.570E-14 4.377E-11 9.163E-10 1.520E-15-1.000E+00 1.250E-08 1.980E-08
SKIN(FGR) 9.450E-14 6.249E-11 1.308E-09 2.170E-15-1.000E+00 0.000E+00 0.000E+00
Cs-136
GONADS 1.040E-13 6.223E-11 1.102E-09 2.180E-15-1.000E+00 1.880E-09 3.040E-09
BREAST 1.180E-13 5.966E-11 1.056E-09 2.090E-15-1.000E+00 1.670E-09 2.650E-09
LUNGS 1.040E-13 5.710E-11 1.011E-09 2.000E-15-1.000E+00 2.320E-09 2.620E-09
RED MARR 1.010E-13 5.824E-11 1.031E-09 2.040E-15-1.000E+00 1.860E-09 2.950E-09
BONE SUR 1.660E-13 8.422E-11 1.491E-09 2.950E-15-1.000E+00 1.700E-09 2.710E-09
THYROID 1.070E-13 5.852E-11 1.036E-09 2.050E-15-1.000E+00 1.730E-09 2.740E-09
REMAINDER 9.950E-14 5.652E-11 1.001E-09 1.980E-15-1.000E+00 2.190E-09 3.520E-09
EFFECTIVE 1.060E-13 5.966E-11 1.056E-09 2.090E-15-1.000E+00 1.980E-09 3.040E-09
SKIN(FGR) 1.250E-13 7.251E-11 1.284E-09 2.540E-15-1.000E+00 0.000E+00 0.000E+00
Cs-137
GONADS 2.669E-14 1.669E-11 3.530E-10 5.840E-16-1.000E+00 8.760E-09 1.390E-08
BREAST 3.047E-14 1.596E-11 3.376E-10 5.585E-16-1.000E+00 7.840E-09 1.240E-08
LUNGS 2.649E-14 1.517E-11 3.209E-10 5.309E-16-1.000E+00 8.820E-09 1.270E-08
RED MARR 2.583E-14 1.542E-11 3.260E-10 5.394E-16-1.000E+00 8.300E-09 1.320E-08
BONE SUR 4.382E-14 2.238E-11 4.734E-10 7.832E-16-1.000E+00 7.940E-09 1.260E-08
THYROID 2.725E-14 1.589E-11 3.358E-10 5.556E-16-1.000E+00 7.930E-09 1.260E-08
REMAINDER 2.536E-14 1.490E-11 3.152E-10 5.215E-16-1.000E+00 9.120E-09 1.450E-08
EFFECTIVE 2.725E-14 1.585E-11 3.353E-10 5.546E-16-1.000E+00 8.630E-09 1.350E-08
SKIN(FGR) 4.392E-14 5.253E-11 1.110E-09 1.836E-15-1.000E+00 0.000E+00 0.000E+00
Ba-139
GONADS 2.130E-15 3.368E-13 3.429E-13 4.790E-17-1.000E+00 2.560E-12 1.560E-12

BREAST 2.450E-15 3.297E-13 3.357E-13 4.690E-17-1.000E+00 2.460E-12 5.170E-13
LUNGS 2.030E-15 3.002E-13 3.057E-13 4.270E-17-1.000E+00 2.530E-10 3.890E-13
RED MARR 1.870E-15 2.932E-13 2.985E-13 4.170E-17-1.000E+00 3.410E-12 8.590E-13
BONE SUR 5.290E-15 6.841E-13 6.965E-13 9.730E-17-1.000E+00 2.490E-12 4.380E-13
THYROID 2.130E-15 3.044E-13 3.100E-13 4.330E-17-1.000E+00 2.400E-12 2.660E-13
REMAINDER 1.920E-15 2.932E-13 2.985E-13 4.170E-17-1.000E+00 4.820E-11 3.570E-10
EFFECTIVE 2.170E-15 3.227E-13 3.286E-13 4.590E-17-1.000E+00 4.640E-11 1.080E-10
SKIN(FGR) 6.160E-14 7.241E-11 7.373E-11 1.030E-14-1.000E+00 0.000E+00 0.000E+00
Ba-140
GONADS 8.410E-15 5.451E-12 9.607E-11 1.910E-16-1.000E+00 4.300E-10 9.960E-10
BREAST 9.640E-15 5.280E-12 9.305E-11 1.850E-16-1.000E+00 2.870E-10 1.590E-10
LUNGS 8.270E-15 4.852E-12 8.550E-11 1.700E-16-1.000E+00 1.660E-09 6.630E-11
RED MARR 7.930E-15 4.880E-12 8.601E-11 1.710E-16-1.000E+00 1.290E-09 4.390E-10
BONE SUR 1.550E-14 8.020E-12 1.413E-10 2.810E-16-1.000E+00 2.410E-09 5.530E-10
THYROID 8.530E-15 5.109E-12 9.003E-11 1.790E-16-1.000E+00 2.560E-10 5.250E-11
REMAINDER 7.890E-15 4.766E-12 8.399E-11 1.670E-16-1.000E+00 1.410E-09 7.370E-09
EFFECTIVE 8.580E-15 5.137E-12 9.053E-11 1.800E-16-1.000E+00 1.010E-09 2.560E-09
SKIN(FGR) 2.520E-14 5.565E-11 9.808E-10 1.950E-15-1.000E+00 0.000E+00 0.000E+00
La-140
GONADS 1.140E-13 6.027E-11 4.425E-10 2.240E-15-1.000E+00 4.540E-10 1.340E-09
BREAST 1.290E-13 5.758E-11 4.228E-10 2.140E-15-1.000E+00 1.450E-10 1.800E-10
LUNGS 1.150E-13 5.596E-11 4.109E-10 2.080E-15-1.000E+00 4.210E-09 4.010E-11
RED MARR 1.140E-13 5.731E-11 4.208E-10 2.130E-15-1.000E+00 2.140E-10 2.810E-10
BONE SUR 1.690E-13 7.776E-11 5.709E-10 2.890E-15-1.000E+00 1.410E-10 9.770E-11
THYROID 1.180E-13 5.462E-11 4.010E-10 2.030E-15-1.000E+00 6.870E-11 6.400E-12
REMAINDER 1.110E-13 5.569E-11 4.089E-10 2.070E-15-1.000E+00 2.120E-09 6.260E-09
EFFECTIVE 1.170E-13 5.812E-11 4.267E-10 2.160E-15-1.000E+00 1.310E-09 2.280E-09
SKIN(FGR) 1.660E-13 2.217E-10 1.628E-09 8.240E-15-1.000E+00 0.000E+00 0.000E+00
La-141
GONADS 2.330E-15 7.315E-13 9.675E-13 4.740E-17-1.000E+00 1.010E-11 3.770E-12
BREAST 2.640E-15 7.007E-13 9.267E-13 4.540E-17-1.000E+00 9.840E-12 7.070E-13
LUNGS 2.340E-15 6.713E-13 8.879E-13 4.350E-17-1.000E+00 6.460E-10 2.720E-13
RED MARR 2.310E-15 6.852E-13 9.063E-13 4.440E-17-1.000E+00 2.930E-11 1.070E-12
BONE SUR 3.490E-15 9.923E-13 1.312E-12 6.430E-17-1.000E+00 1.200E-10 6.060E-13
THYROID 2.390E-15 6.590E-13 8.716E-13 4.270E-17-1.000E+00 9.400E-12 5.290E-14
REMAINDER 2.260E-15 6.682E-13 8.838E-13 4.330E-17-1.000E+00 2.280E-10 1.240E-09
EFFECTIVE 2.390E-15 7.007E-13 9.267E-13 4.540E-17-1.000E+00 1.570E-10 3.740E-10
SKIN(FGR) 6.580E-14 1.667E-10 2.204E-10 1.080E-14-1.000E+00 0.000E+00 0.000E+00
La-142
GONADS 1.400E-13 1.978E-11 2.034E-11 2.540E-15-1.000E+00 1.660E-11 6.990E-11
BREAST 1.570E-13 1.885E-11 1.938E-11 2.420E-15-1.000E+00 1.130E-11 1.540E-11
LUNGS 1.420E-13 1.846E-11 1.898E-11 2.370E-15-1.000E+00 3.010E-10 8.400E-12
RED MARR 1.420E-13 1.900E-11 1.954E-11 2.440E-15-1.000E+00 1.360E-11 1.930E-11
BONE SUR 1.950E-13 2.484E-11 2.554E-11 3.190E-15-1.000E+00 1.110E-11 7.400E-12
THYROID 1.450E-13 1.768E-11 1.818E-11 2.270E-15-1.000E+00 8.740E-12 1.160E-12
REMAINDER 1.380E-13 1.853E-11 1.906E-11 2.380E-15-1.000E+00 8.070E-11 5.200E-10
EFFECTIVE 1.440E-13 1.916E-11 1.970E-11 2.460E-15-1.000E+00 6.840E-11 1.790E-10
SKIN(FGR) 2.160E-13 9.111E-11 9.368E-11 1.170E-14-1.000E+00 0.000E+00 0.000E+00
Ce-141
GONADS 3.380E-15 2.213E-12 4.332E-11 7.710E-17-1.000E+00 5.540E-11 1.080E-10

BREAST 3.930E-15 2.170E-12 4.247E-11 7.560E-17-1.000E+00 4.460E-11 1.110E-11
LUNGS 3.170E-15 1.951E-12 3.820E-11 6.800E-17-1.000E+00 1.670E-08 1.430E-12
RED MARR 2.830E-15 1.860E-12 3.641E-11 6.480E-17-1.000E+00 8.960E-11 3.390E-11
BONE SUR 9.410E-15 5.166E-12 1.011E-10 1.800E-16-1.000E+00 2.540E-10 2.300E-11
THYROID 3.350E-15 2.003E-12 3.922E-11 6.980E-17-1.000E+00 2.550E-11 1.800E-13
REMAINDER 2.980E-15 1.894E-12 3.708E-11 6.600E-17-1.000E+00 1.260E-09 2.500E-09
EFFECTIVE 3.430E-15 2.118E-12 4.146E-11 7.380E-17-1.000E+00 2.420E-09 7.830E-10
SKIN(FGR) 1.020E-14 3.788E-12 7.416E-11 1.320E-16-1.000E+00 0.000E+00 0.000E+00
Ce-143
GONADS 1.280E-14 7.900E-12 4.958E-11 2.980E-16-1.000E+00 7.530E-11 2.120E-10
BREAST 1.470E-14 7.688E-12 4.825E-11 2.900E-16-1.000E+00 1.660E-11 2.320E-11
LUNGS 1.230E-14 6.893E-12 4.325E-11 2.600E-16-1.000E+00 3.880E-09 3.820E-12
RED MARR 1.170E-14 6.787E-12 4.259E-11 2.560E-16-1.000E+00 2.960E-11 5.070E-11
BONE SUR 2.520E-14 1.323E-11 8.302E-11 4.990E-16-1.000E+00 1.640E-11 1.610E-11
THYROID 1.280E-14 7.211E-12 4.525E-11 2.720E-16-1.000E+00 6.230E-12 4.350E-13
REMAINDER 1.170E-14 6.734E-12 4.226E-11 2.540E-16-1.000E+00 1.420E-09 3.890E-09
EFFECTIVE 1.290E-14 7.396E-12 4.642E-11 2.790E-16-1.000E+00 9.160E-10 1.230E-09
SKIN(FGR) 3.960E-14 1.058E-10 6.638E-10 3.990E-15-1.000E+00 0.000E+00 0.000E+00
Ce-144
GONADS 2.725E-15 6.328E-13 1.319E-11 6.088E-17-1.000E+00 2.390E-10 6.987E-11
BREAST 3.129E-15 6.274E-13 1.307E-11 5.922E-17-1.000E+00 3.480E-10 1.223E-11
LUNGS 2.639E-15 5.228E-13 1.089E-11 5.362E-17-1.000E+00 7.911E-07 6.551E-12
RED MARR 2.507E-15 4.755E-13 9.907E-12 5.247E-17-1.000E+00 2.880E-09 8.923E-11
BONE SUR 5.441E-15 1.646E-12 3.429E-11 1.127E-16-1.000E+00 4.720E-09 1.280E-10
THYROID 2.753E-15 5.529E-13 1.152E-11 5.418E-17-1.000E+00 2.920E-10 5.154E-12
REMAINDER 2.534E-15 5.086E-13 1.060E-11 5.283E-17-1.000E+00 1.910E-08 1.890E-08
EFFECTIVE 2.773E-15 5.909E-13 1.231E-11 5.766E-17-1.000E+00 1.010E-07 5.711E-09
SKIN(FGR) 8.574E-14 7.648E-13 1.594E-11 1.250E-14-1.000E+00 0.000E+00 0.000E+00
Pr-143
GONADS 2.130E-17 2.264E-14 4.032E-13 7.930E-19-1.000E+00 4.370E-18 8.990E-18
BREAST 2.550E-17 2.330E-14 4.149E-13 8.160E-19-1.000E+00 2.220E-18 1.090E-18
LUNGS 1.860E-17 1.642E-14 2.923E-13 5.750E-19-1.000E+00 1.330E-08 1.910E-19
RED MARR 1.620E-17 1.493E-14 2.659E-13 5.230E-19-1.000E+00 1.480E-11 1.030E-12
BONE SUR 5.930E-17 5.454E-14 9.711E-13 1.910E-18-1.000E+00 1.490E-11 1.030E-12
THYROID 2.050E-17 1.802E-14 3.208E-13 6.310E-19-1.000E+00 1.680E-18 2.660E-20
REMAINDER 1.760E-17 1.642E-14 2.923E-13 5.750E-19-1.000E+00 1.970E-09 4.220E-09
EFFECTIVE 2.100E-17 2.002E-14 3.564E-13 7.010E-19-1.000E+00 2.190E-09 1.270E-09
SKIN(FGR) 1.760E-14 5.711E-11 1.017E-09 2.000E-15-1.000E+00 0.000E+00 0.000E+00
Nd-147
GONADS 6.130E-15 4.218E-12 7.235E-11 1.480E-16-1.000E+00 8.410E-11 1.790E-10
BREAST 7.120E-15 4.132E-12 7.088E-11 1.450E-16-1.000E+00 3.450E-11 1.870E-11
LUNGS 5.820E-15 3.648E-12 6.257E-11 1.280E-16-1.000E+00 1.060E-08 2.440E-12
RED MARR 5.400E-15 3.505E-12 6.013E-11 1.230E-16-1.000E+00 9.190E-11 5.050E-11
BONE SUR 1.320E-14 8.265E-12 1.418E-10 2.900E-16-1.000E+00 3.260E-10 2.220E-11
THYROID 6.120E-15 3.876E-12 6.648E-11 1.360E-16-1.000E+00 1.820E-11 2.640E-13
REMAINDER 5.530E-15 3.562E-12 6.111E-11 1.250E-16-1.000E+00 1.760E-09 3.760E-09
EFFECTIVE 6.190E-15 3.961E-12 6.795E-11 1.390E-16-1.000E+00 1.850E-09 1.180E-09
SKIN(FGR) 1.950E-14 3.135E-11 5.377E-10 1.100E-15-1.000E+00 0.000E+00 0.000E+00
Np-239
GONADS 7.530E-15 4.691E-12 4.380E-11 1.710E-16-1.000E+00 7.450E-11 1.620E-10

BREAST 8.730E-15 4.636E-12 4.329E-11 1.690E-16-1.000E+00 1.630E-11 1.720E-11
LUNGS 7.180E-15 4.115E-12 3.842E-11 1.500E-16-1.000E+00 2.360E-09 2.400E-12
RED MARR 6.500E-15 4.005E-12 3.740E-11 1.460E-16-1.000E+00 2.080E-10 4.660E-11
BONE SUR 2.000E-14 1.001E-11 9.349E-11 3.650E-16-1.000E+00 2.030E-09 3.590E-11
THYROID 7.520E-15 4.197E-12 3.919E-11 1.530E-16-1.000E+00 7.620E-12 2.070E-13
REMAINDER 6.760E-15 4.005E-12 3.740E-11 1.460E-16-1.000E+00 9.590E-10 2.770E-09
EFFECTIVE 7.690E-15 4.471E-12 4.175E-11 1.630E-16-1.000E+00 6.780E-10 8.820E-10
SKIN(FGR) 1.600E-14 7.215E-12 6.737E-11 2.630E-16-1.000E+00 0.000E+00 0.000E+00
Pu-238
GONADS 6.560E-18 4.291E-14 9.011E-13 1.490E-18-1.000E+00 1.040E-05 2.330E-09
BREAST 1.270E-17 5.558E-14 1.167E-12 1.930E-18-1.000E+00 4.400E-10 1.800E-13
LUNGS 1.060E-18 2.267E-15 4.759E-14 7.870E-20-1.000E+00 3.200E-04 8.640E-14
RED MARR 1.680E-18 5.587E-15 1.173E-13 1.940E-19-1.000E+00 5.800E-05 1.270E-08
BONE SUR 9.300E-18 3.514E-14 7.378E-13 1.220E-18-1.000E+00 7.250E-04 1.580E-07
THYROID 4.010E-18 9.792E-15 2.056E-13 3.400E-19-1.000E+00 3.860E-10 7.990E-14
REMAINDER 1.990E-18 9.216E-15 1.935E-13 3.200E-19-1.000E+00 2.740E-05 2.180E-08
EFFECTIVE 4.880E-18 2.413E-14 5.068E-13 8.380E-19-1.000E+00 7.790E-05 1.340E-08
SKIN(FGR) 4.090E-17 2.776E-13 5.830E-12 9.640E-18-1.000E+00 0.000E+00 0.000E+00
Pu-239
GONADS 4.840E-18 1.768E-14 3.713E-13 6.140E-19-1.000E+00 1.200E-05 2.640E-09
BREAST 7.550E-18 2.238E-14 4.699E-13 7.770E-19-1.000E+00 3.990E-10 1.210E-13
LUNGS 2.650E-18 2.267E-15 4.760E-14 7.870E-20-1.000E+00 3.230E-04 7.890E-14
RED MARR 2.670E-18 3.456E-15 7.258E-14 1.200E-19-1.000E+00 6.570E-05 1.410E-08
BONE SUR 9.470E-18 1.673E-14 3.514E-13 5.810E-19-1.000E+00 8.210E-04 1.760E-07
THYROID 3.880E-18 5.126E-15 1.077E-13 1.780E-19-1.000E+00 3.750E-10 7.500E-14
REMAINDER 2.860E-18 4.838E-15 1.016E-13 1.680E-19-1.000E+00 3.020E-05 2.120E-08
EFFECTIVE 4.240E-18 1.057E-14 2.220E-13 3.670E-19-1.000E+00 8.330E-05 1.400E-08
SKIN(FGR) 1.860E-17 1.057E-13 2.220E-12 3.670E-18-1.000E+00 0.000E+00 0.000E+00
Pu-240
GONADS 6.360E-18 4.118E-14 8.649E-13 1.430E-18-1.000E+00 1.200E-05 2.640E-09
BREAST 1.230E-17 5.328E-14 1.119E-12 1.850E-18-1.000E+00 4.330E-10 1.730E-13
LUNGS 1.090E-18 2.249E-15 4.723E-14 7.810E-20-1.000E+00 3.230E-04 8.220E-14
RED MARR 1.650E-18 5.386E-15 1.131E-13 1.870E-19-1.000E+00 6.570E-05 1.410E-08
BONE SUR 9.260E-18 3.398E-14 7.137E-13 1.180E-18-1.000E+00 8.210E-04 1.760E-07
THYROID 3.920E-18 9.446E-15 1.984E-13 3.280E-19-1.000E+00 3.760E-10 7.510E-14
REMAINDER 1.960E-18 8.870E-15 1.863E-13 3.080E-19-1.000E+00 3.020E-05 2.130E-08
EFFECTIVE 4.750E-18 2.313E-14 4.857E-13 8.030E-19-1.000E+00 8.330E-05 1.400E-08
SKIN(FGR) 3.920E-17 2.644E-13 5.552E-12 9.180E-18-1.000E+00 0.000E+00 0.000E+00
Pu-241
GONADS 7.190E-20 6.653E-17 1.396E-15 2.310E-21-1.000E+00 2.760E-07 5.660E-11
BREAST 8.670E-20 7.229E-17 1.517E-15 2.510E-21-1.000E+00 2.140E-11 2.790E-15
LUNGS 6.480E-20 4.090E-17 8.584E-16 1.420E-21-1.000E+00 3.180E-06 4.480E-15
RED MARR 5.630E-20 4.003E-17 8.403E-16 1.390E-21-1.000E+00 1.430E-06 2.780E-10
BONE SUR 2.190E-19 1.385E-16 2.908E-15 4.810E-21-1.000E+00 1.780E-05 3.480E-09
THYROID 6.980E-20 4.522E-17 9.491E-16 1.570E-21-1.000E+00 9.150E-12 1.010E-15
REMAINDER 6.090E-20 4.291E-17 9.007E-16 1.490E-21-1.000E+00 6.020E-07 1.850E-10
EFFECTIVE 7.250E-20 5.558E-17 1.167E-15 1.930E-21-1.000E+00 1.340E-06 2.070E-10
SKIN(FGR) 1.170E-19 2.033E-16 4.268E-15 7.060E-21-1.000E+00 0.000E+00 0.000E+00
Am-241
GONADS 8.580E-16 9.360E-13 1.966E-11 3.250E-17-1.000E+00 3.250E-05 2.700E-07

BREAST 1.070E-15 1.014E-12 2.129E-11 3.520E-17-1.000E+00 2.670E-09 2.620E-11
LUNGS 6.740E-16 5.789E-13 1.216E-11 2.010E-17-1.000E+00 1.840E-05 3.360E-11
RED MARR 5.210E-16 4.838E-13 1.016E-11 1.680E-17-1.000E+00 1.740E-04 1.450E-06
BONE SUR 2.870E-15 2.678E-12 5.625E-11 9.300E-17-1.000E+00 2.170E-03 1.810E-05
THYROID 7.830E-16 6.365E-13 1.337E-11 2.210E-17-1.000E+00 1.600E-09 1.320E-11
REMAINDER 6.340E-16 5.933E-13 1.246E-11 2.060E-17-1.000E+00 7.820E-05 6.660E-07
EFFECTIVE 8.180E-16 7.920E-13 1.663E-11 2.750E-17-1.000E+00 1.200E-04 9.840E-07
SKIN(FGR) 1.280E-15 2.396E-12 5.032E-11 8.320E-17-1.000E+00 0.000E+00 0.000E+00
Cm-242
GONADS 7.830E-18 4.893E-14 1.013E-12 1.700E-18-1.000E+00 5.700E-07 5.200E-09
BREAST 1.480E-17 6.159E-14 1.275E-12 2.140E-18-1.000E+00 9.440E-10 8.950E-12
LUNGS 1.130E-18 3.022E-15 6.257E-14 1.050E-19-1.000E+00 1.550E-05 8.840E-12
RED MARR 1.890E-18 6.562E-15 1.359E-13 2.280E-19-1.000E+00 3.900E-06 3.570E-08
BONE SUR 1.060E-17 4.231E-14 8.759E-13 1.470E-18-1.000E+00 4.870E-05 4.460E-07
THYROID 4.910E-18 1.261E-14 2.610E-13 4.380E-19-1.000E+00 9.410E-10 8.820E-12
REMAINDER 2.270E-18 1.079E-14 2.235E-13 3.750E-19-1.000E+00 2.450E-06 4.020E-08
EFFECTIVE 5.690E-18 2.751E-14 5.697E-13 9.560E-19-1.000E+00 4.670E-06 3.100E-08
SKIN(FGR) 4.290E-17 2.700E-13 5.589E-12 9.380E-18-1.000E+00 0.000E+00 0.000E+00
Cm-244
GONADS 6.900E-18 4.522E-14 9.492E-13 1.570E-18-1.000E+00 1.590E-05 1.330E-07
BREAST 1.330E-17 5.702E-14 1.197E-12 1.980E-18-1.000E+00 1.040E-09 8.820E-12
LUNGS 7.080E-19 2.592E-15 5.441E-14 9.000E-20-1.000E+00 1.930E-05 8.810E-12
RED MARR 1.460E-18 5.875E-15 1.233E-13 2.040E-19-1.000E+00 9.380E-05 7.820E-07
BONE SUR 8.820E-18 3.859E-14 8.101E-13 1.340E-18-1.000E+00 1.170E-03 9.770E-06
THYROID 4.190E-18 1.146E-14 2.406E-13 3.980E-19-1.000E+00 1.010E-09 8.440E-12
REMAINDER 1.810E-18 9.821E-15 2.062E-13 3.410E-19-1.000E+00 4.780E-05 4.150E-07
EFFECTIVE 4.910E-18 2.529E-14 5.308E-13 8.780E-19-1.000E+00 6.700E-05 5.450E-07
SKIN(FGR) 3.910E-17 2.506E-13 5.260E-12 8.700E-18-1.000E+00 0.000E+00 0.000E+00

Release Fractions and Timing File: PWR_DBA.RFT

Release Fraction and Timing Name:
PWR, NUREG-1465, Tables 3.12 & 3.13, June 1992
Duration (h): Design Basis Accident
0.5000E+00 0.1300E+01 0.0000E+00 0.0000E+00
Noble Gases:
0.5000E-01 0.9500E+00 0.0000E+00 0.0000E+00
Iodine:
0.5000E-01 0.3500E+00 0.0000E+00 0.0000E+00
Cesium:
0.5000E-01 0.2500E+00 0.0000E+00 0.0000E+00
Tellurium:
0.0000E+00 0.5000E-01 0.0000E+00 0.0000E+00
Strontium:
0.0000E+00 0.2000E-01 0.0000E+00 0.0000E+00
Barium:
0.0000E+00 0.2000E-01 0.0000E+00 0.0000E+00
Ruthenium:
0.0000E+00 0.2500E-02 0.0000E+00 0.0000E+00
Cerium:
0.0000E+00 0.5000E-03 0.0000E+00 0.0000E+00
Lanthanum:
0.0000E+00 0.2000E-03 0.0000E+00 0.0000E+00
Non-Radioactive Aerosols (kg):
0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00
End of Release File

Nuclide Information File: PWR_DEF.NIF

```
Nuclide Inventory Name:
Normalized MACCS Sample 3412 MWth PWR Core Inventory
Power Level:
 0.1000E+01
Nuclides:
 60
Nuclide 001:
Co-58
 7
 0.6117120000E+07
 0.5800E+02
 0.2553E+03
none    0.0000E+00
none    0.0000E+00
none    0.0000E+00
Nuclide 002:
Co-60
 7
 0.1663401096E+09
 0.6000E+02
 0.1953E+03
none    0.0000E+00
none    0.0000E+00
none    0.0000E+00
Nuclide 003:
Kr-85
 1
 0.3382974720E+09
 0.8500E+02
 0.1960E+03
none    0.0000E+00
none    0.0000E+00
none    0.0000E+00
Nuclide 004:
Kr-85m
 1
 0.1612800000E+05
 0.8500E+02
 0.9181E+04
Kr-85   0.2100E+00
none    0.0000E+00
none    0.0000E+00
Nuclide 005:
Kr-87
 1
 0.4578000000E+04
 0.8700E+02
```

0.1678E+05
Rb-87 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 006:
Kr-88
1
0.1022400000E+05
0.8800E+02
0.2269E+05
Rb-88 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 007:
Rb-86
3
0.1612224000E+07
0.8600E+02
0.1496E+02
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 008:
Sr-89
5
0.4363200000E+07
0.8900E+02
0.2844E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 009:
Sr-90
5
0.9189573120E+09
0.9000E+02
0.1535E+04
Y-90 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 010:
Sr-91
5
0.3420000000E+05
0.9100E+02
0.3656E+05
Y-91m 0.5800E+00
Y-91 0.4200E+00
none 0.0000E+00
Nuclide 011:

Sr-92
5
0.9756000000E+04
0.9200E+02
0.3805E+05
Y-92 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 012:
Y-90
9
0.2304000000E+06
0.9000E+02
0.1647E+04
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 013:
Y-91
9
0.5055264000E+07
0.9100E+02
0.3465E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 014:
Y-92
9
0.1274400000E+05
0.9200E+02
0.3819E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 015:
Y-93
9
0.3600000000E+05
0.9300E+02
0.4320E+05
Zr-93 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 016:
Zr-95
9
0.5527872000E+07
0.9500E+02
0.4377E+05

```
Nb-95m   0.7000E-02
Nb-95    0.9900E+00
none     0.0000E+00
Nuclide 017:
Zr-97
 9
 0.6084000000E+05
 0.9700E+02
 0.4562E+05
Nb-97m   0.9500E+00
Nb-97    0.5300E-01
none     0.0000E+00
Nuclide 018:
Nb-95
 9
 0.3036960000E+07
 0.9500E+02
 0.4138E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 019:
Mo-99
 7
 0.2376000000E+06
 0.9900E+02
 0.4830E+05
Tc-99m   0.8800E+00
Tc-99    0.1200E+00
none     0.0000E+00
Nuclide 020:
Tc-99m
 7
 0.2167200000E+05
 0.9900E+02
 0.4169E+05
Tc-99    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 021:
Ru-103
 7
 0.3393792000E+07
 0.1030E+03
 0.3598E+05
Rh-103m  0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 022:
Ru-105
```

7
0.1598400000E+05
0.1050E+03
0.2340E+05
Rh-105 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 023:
Ru-106
7
0.3181248000E+08
0.1060E+03
0.8175E+04
Rh-106 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 024:
Rh-105
7
0.1272960000E+06
0.1050E+03
0.1621E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 025:
Sb-127
4
0.3326400000E+06
0.1270E+03
0.2208E+04
Te-127m 0.1800E+00
Te-127 0.8200E+00
none 0.0000E+00
Nuclide 026:
Sb-129
4
0.1555200000E+05
0.1290E+03
0.7820E+04
Te-129m 0.2200E+00
Te-129 0.7700E+00
none 0.0000E+00
Nuclide 027:
Te-127
4
0.3366000000E+05
0.1270E+03
0.2132E+04
none 0.0000E+00

```
none     0.0000E+00
none     0.0000E+00
Nuclide 028:
Te-127m
 4
 0.9417600000E+07
 0.1270E+03
 0.2823E+03
Te-127   0.9800E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 029:
Te-129
 4
 0.4176000000E+04
 0.1290E+03
 0.7341E+04
I-129    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 030:
Te-129m
 4
 0.2903040000E+07
 0.1290E+03
 0.1935E+04
Te-129   0.6500E+00
I-129    0.3500E+00
none     0.0000E+00
Nuclide 031:
Te-131m
 4
 0.1080000000E+06
 0.1310E+03
 0.3707E+04
Te-131   0.2200E+00
I-131    0.7800E+00
none     0.0000E+00
Nuclide 032:
Te-132
 4
 0.2815200000E+06
 0.1320E+03
 0.3690E+05
I-132    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 033:
I-131
 2
```

0.6946560000E+06
0.1310E+03
0.2540E+05
Xe-131m 0.1100E-01
none 0.0000E+00
none 0.0000E+00
Nuclide 034:
I-132
2
0.8280000000E+04
0.1320E+03
0.3743E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 035:
I-133
2
0.7488000000E+05
0.1330E+03
0.5370E+05
Xe-133m 0.2900E-01
Xe-133 0.9700E+00
none 0.0000E+00
Nuclide 036:
I-134
2
0.3156000000E+04
0.1340E+03
0.5893E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 037:
I-135
2
0.2379600000E+05
0.1350E+03
0.5063E+05
Xe-135m 0.1500E+00
Xe-135 0.8500E+00
none 0.0000E+00
Nuclide 038:
Xe-133
1
0.4531680000E+06
0.1330E+03
0.5372E+05
none 0.0000E+00
none 0.0000E+00

```
none     0.0000E+00
Nuclide 039:
Xe-135
 1
 0.3272400000E+05
 0.1350E+03
 0.1008E+05
Cs-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 040:
Cs-134
 3
 0.6507177120E+08
 0.1340E+03
 0.3425E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 041:
Cs-136
 3
 0.1131840000E+07
 0.1360E+03
 0.1042E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 042:
Cs-137
 3
 0.9467280000E+09
 0.1370E+03
 0.1915E+04
Ba-137m  0.9500E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 043:
Ba-139
 6
 0.4962000000E+04
 0.1390E+03
 0.4976E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 044:
Ba-140
 6
 0.1100736000E+07
```

0.1400E+03
0.4924E+05
La-140 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 045:
La-140
9
0.1449792000E+06
0.1400E+03
0.5032E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 046:
La-141
9
0.1414800000E+05
0.1410E+03
0.4615E+05
Ce-141 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 047:
La-142
9
0.5550000000E+04
0.1420E+03
0.4449E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 048:
Ce-141
8
0.2808086400E+07
0.1410E+03
0.4476E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 049:
Ce-143
8
0.1188000000E+06
0.1430E+03
0.4352E+05
Pr-143 0.1000E+01
none 0.0000E+00
none 0.0000E+00

Nuclide 050:
Ce-144
8
0.2456352000E+08
0.1440E+03
0.2697E+05
Pr-144m 0.1800E-01
Pr-144 0.9800E+00
none 0.0000E+00
Nuclide 051:
Pr-143
9
0.1171584000E+07
0.1430E+03
0.4273E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 052:
Nd-147
9
0.9486720000E+06
0.1470E+03
0.1911E+05
Pm-147 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 053:
Np-239
8
0.2034720000E+06
0.2390E+03
0.5120E+06
Pu-239 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 054:
Pu-238
8
0.2768863824E+10
0.2380E+03
0.2902E+02
U-234 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 055:
Pu-239
8
0.7594336440E+12
0.2390E+03

0.6545E+01
U-235 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 056:
Pu-240
8
0.2062920312E+12
0.2400E+03
0.8254E+01
U-236 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 057:
Pu-241
8
0.4544294400E+09
0.2410E+03
0.1390E+04
U-237 0.2400E-04
Am-241 0.1000E+01
none 0.0000E+00
Nuclide 058:
Am-241
9
0.1363919472E+11
0.2410E+03
0.9181E+00
Np-237 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 059:
Cm-242
9
0.1406592000E+08
0.2420E+03
0.3514E+03
Pu-238 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 060:
Cm-244
9
0.571508136E+9
0.2440E+03
0.2056E+02
Pu-240 0.1000E+01
none 0.0000E+00
none 0.0000E+00
End of Nuclear Inventory File

Release Fractions and Timing File: BWR_DBA.RFT

Release Fraction and Timing Name:
BWR, NUREG-1465, Tables 3.11 & 3.13, June 1992
Duration (h): Design Basis Accident
0.5000E+00 0.1500E+01 0.0000E+00 0.0000E+00
Noble Gases:
0.5000E-01 0.9500E+00 0.0000E+00 0.0000E+00
Iodine:
0.5000E-01 0.2500E+00 0.0000E+00 0.0000E+00
Cesium:
0.5000E-01 0.2000E+00 0.0000E+00 0.0000E+00
Tellurium:
0.0000E+00 0.0500E+00 0.0000E+00 0.0000E+00
Strontium:
0.0000E+00 0.2000E-01 0.0000E+00 0.0000E+00
Barium:
0.0000E+00 0.2000E-01 0.0000E+00 0.0000E+00
Ruthenium:
0.0000E+00 0.2500E-02 0.0000E+00 0.0000E+00
Cerium:
0.0000E+00 0.5000E-03 0.0000E+00 0.0000E+00
Lanthanum:
0.0000E+00 0.2000E-03 0.0000E+00 0.0000E+00
Non-Radioactive Aerosols (kg):
0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00
End of Release File

Nuclide Information File: BWR_DEF.NIF

```
Nuclide Inventory Name:
Normalized MACCS Sample 3578 MWth BWR Core Inventory
Power Level:
 0.1000E+01
Nuclides:
 60
Nuclide 001:
Co-58
  7
 0.6117120000E+07
 0.5800E+02
 0.1529E+03
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
 Nuclide 002:
 Co-60
  7
 0.1663401096E+09
 0.6000E+02
 0.1830E+03
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
 Nuclide 003:
 Kr-85
  1
 0.3382974720E+09
 0.8500E+02
 0.2506E+03
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
 Nuclide 004:
 Kr-85m
  1
 0.1612800000E+05
 0.8500E+02
 0.9110E+04
Kr-85    0.2100E+00
none     0.0000E+00
none     0.0000E+00
 Nuclide 005:
 Kr-87
  1
 0.4578000000E+04
 0.8700E+02
```

0.1657E+05
Rb-87 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 006:
Kr-88
1
0.1022400000E+05
0.8800E+02
0.2236E+05
Rb-88 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 007:
Rb-86
3
0.1612224000E+07
0.8600E+02
0.1402E+02
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 008:
Sr-89
5
0.4363200000E+07
0.8900E+02
0.2774E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 009:
Sr-90
5
0.9189573120E+09
0.9000E+02
0.1963E+04
Y-90 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 010:
Sr-91
5
0.3420000000E+05
0.9100E+02
0.3604E+05
Y-91m 0.5800E+00
Y-91 0.4200E+00
none 0.0000E+00
Nuclide 011:

Sr-92
5
0.9756000000E+04
0.9200E+02
0.3765E+05
Y-92 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 012:
Y-90
9
0.2304000000E+06
0.9000E+02
0.2102E+04
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 013:
Y-91
9
0.5055264000E+07
0.9100E+02
0.3386E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 014:
Y-92
9
0.1274400000E+05
0.9200E+02
0.3780E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 015:
Y-93
9
0.3636000000E+05
0.9300E+02
0.4298E+05
Zr-93 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 016:
Zr-95
9
0.5527872000E+07
0.9500E+02
0.4456E+05

Nb-95m 0.7000E-02
Nb-95 0.9900E+00
none 0.0000E+00
Nuclide 017:
Zr-97
9
0.6084000000E+05
0.9700E+02
0.4587E+05
Nb-97m 0.9500E+00
Nb-97 0.5300E-01
none 0.0000E+00
Nuclide 018:
Nb-95
9
0.3036960000E+07
0.9500E+02
0.4216E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 019:
Mo-99
7
0.2376000000E+06
0.9900E+02
0.4862E+05
Tc-99m 0.8800E+00
Tc-99 0.1200E+00
none 0.0000E+00
Nuclide 020:
Tc-99m
7
0.2167200000E+05
0.9900E+02
0.4195E+05
Tc-99 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 021:
Ru-103
7
0.3393792000E+07
0.1030E+03
0.3691E+05
Rh-103m 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 022:
Ru-105

```
 7
0.1598400000E+05
0.1050E+03
 0.2458E+05
Rh-105   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 023:
Ru-106
 7
 0.3181248000E+08
 0.1060E+03
 0.1002E+05
Rh-106   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 024:
Rh-105
 7
 0.1272960000E+06
 0.1050E+03
 0.1835E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 025:
Sb-127
 4
 0.3326400000E+06
 0.1270E+03
 0.2324E+04
Te-127m  0.1800E+00
Te-127   0.8200E+00
none     0.0000E+00
Nuclide 026:
Sb-129
 4
 0.1555200000E+05
 0.1290E+03
 0.8067E+04
Te-129m  0.2200E+00
Te-129   0.7700E+00
none     0.0000E+00
Nuclide 027:
Te-127
 4
 0.3366000000E+05
 0.1270E+03
 0.2250E+04
none     0.0000E+00
```

none 0.0000E+00
none 0.0000E+00
Nuclide 028:
Te-127m
4
0.9417600000E+07
0.1270E+03
0.3029E+03
Te-127 0.9800E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 029:
Te-129
4
0.4176000000E+04
0.1290E+03
0.7569E+04
I-129 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 030:
Te-129m
4
0.2903040000E+07
0.1290E+03
0.1990E+04
Te-129 0.6500E+00
I-129 0.3500E+00
none 0.0000E+00
Nuclide 031:
Te-131m
4
0.1080000000E+06
0.1310E+03
0.3821E+04
Te-131 0.2200E+00
I-131 0.7800E+00
none 0.0000E+00
Nuclide 032:
Te-132
4
0.2815200000E+06
0.1320E+03
0.3735E+05
I-132 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 033:
I-131
2

```
0.6946560000E+06
0.1310E+03
0.2581E+05
Xe-131m  0.1100E-01
none     0.0000E+00
none     0.0000E+00
Nuclide 034:
I-132
 2
0.8280000000E+04
0.1320E+03
0.3792E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 035:
I-133
 2
0.7488000000E+05
0.1330E+03
0.5417E+05
Xe-133m  0.2900E-01
Xe-133   0.9700E+00
none     0.0000E+00
Nuclide 036:
I-134
 2
0.3156000000E+04
0.1340E+03
0.5930E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 037:
I-135
 2
0.2379600000E+05
0.1350E+03
0.5099E+05
Xe-135m  0.1500E+00
Xe-135   0.8500E+00
none     0.0000E+00
Nuclide 038:
Xe-133
 1
0.4531680000E+06
0.1330E+03
0.5425E+05
none     0.0000E+00
none     0.0000E+00
```

none 0.0000E+00
Nuclide 039:
Xe-135
1
0.3272400000E+05
0.1350E+03
0.1289E+05
Cs-135 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 040:
Cs-134
3
0.6507177120E+08
0.1340E+03
0.4227E+04
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 041:
Cs-136
3
0.1131840000E+07
0.1360E+03
0.1134E+04
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 042:
Cs-137
3
0.9467280000E+09
0.1370E+03
0.2530E+04
Ba-137m 0.9500E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 043:
Ba-139
6
0.4962000000E+04
0.1390E+03
0.4994E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 044:
Ba-140
6
0.1100736000E+07

0.1400E+03
0.4927E+05
La-140 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 045:
La-140
9
0.1449792000E+06
0.1400E+03
0.5027E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 046:
La-141
9
0.1414800000E+05
0.1410E+03
0.4642E+05
Ce-141 0.1000E+01
none 0.0000E+00
none 0.0000E+00
Nuclide 047:
La-142
9
0.5550000000E+04
0.1420E+03
0.4466E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 048:
Ce-141
8
0.2808086400E+07
0.1410E+03
0.4473E+05
none 0.0000E+00
none 0.0000E+00
none 0.0000E+00
Nuclide 049:
Ce-143
8
0.1188000000E+06
0.1430E+03
0.4355E+05
Pr-143 0.1000E+01
none 0.0000E+00
none 0.0000E+00

Nuclide 050:
Ce-144
 8
 0.2456352000E+08
 0.1440E+03
 0.2901E+05
Pr-144m 0.1800E-01
Pr-144   0.9800E+00
none   0.0000E+00
Nuclide 051:
Pr-143
 9
 0.1171584000E+07
 0.1430E+03
 0.4263E+05
none   0.0000E+00
none   0.0000E+00
none   0.0000E+00
Nuclide 052:
Nd-147
 9
 0.9486720000E+06
 0.1470E+03
 0.1905E+05
Pm-147   0.1000E+01
none   0.0000E+00
none   0.0000E+00
Nuclide 053:
Np-239
 8
 0.2034720000E+06
 0.2390E+03
 0.5677E+06
Pu-239   0.1000E+01
none   0.0000E+00
none   0.0000E+00
Nuclide 054:
Pu-238
 8
 0.2768863824E+10
 0.2380E+03
 0.3948E+02
U-234   0.1000E+01
none   0.0000E+00
none   0.0000E+00
Nuclide 055:
Pu-239
 8
 0.7594336440E+12
 0.2390E+03

```
 0.1001E+02
U-235    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 056:
Pu-240
 8
 0.2062920312E+12
 0.2400E+03
 0.1253E+02
U-236    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 057:
Pu-241
 8
 0.4544294400E+09
 0.2410E+03
 0.2157E+04
U-237    0.2400E-04
Am-241   0.1000E+01
none     0.0000E+00
Nuclide 058:
Am-241
 9
 0.1363919472E+11
 0.2410E+03
 0.2193E+01
Np-237   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 059:
Cm-242
 9
 0.1406592000E+08
 0.2420E+03
 0.5791E+03
Pu-238   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 060:
Cm-244
 9
 0.5715081360E+09
 0.2440E+03
 0.3125E+02
Pu-240   0.1000E+01
none     0.0000E+00
none     0.0000E+00
End of Nuclear Inventory File
```