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# Assessment of Radiological Consequences for the Perry Pilot Plant Application using the Revised (NUREG-1465) Source Term

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# Introduction

Since 1962, the TID-14844 source term (Reference 1) has been used by the NRC and licensees for assessment of offsite consequences for a design basis loss of coolant accident (LOCA). A revised source term was published in NUREG-1465 in 1995 (Reference 2). This revised source term is more realistic, particularly in the areas of timing and physical form. For example, the TID source term is an instantaneous release at the beginning of the accident, while the NUREG-1465 source term is released over a two-hour period. In addition, the TID source term models the dominant fission-product element in the source term (iodine) as 95% vapor, while the NUREG-1465 source term models it as 95% aerosol. Because the NUREG-1465 source term is more realistic, use of it for design basis accident radiological consequence assessment will allow removal of some systems earlier believed to be important to safety and will also permit relaxation of requirements for other safety-related systems. In some cases, use of the NUREG-1465 source term will also be accompanied by safety enhancements.

The Perry plant is proposing changes to some engineered safety features, including removal of main steam isolation valve (MSIV) leakage control system, increase in allowable MSIV leakage rate, and changing the emergency operating procedures to add containment pH control chemicals in the event of a LOCA. The first of these three changes is the removal of a system previously believed to be important to safety. The second change is a burden reduction which may also result in a reduction in occupational exposure due to reduced maintenance of the valves. The third change is a safety enhancement that will prevent long-term revolatilization of iodine that becomes dissolved in the suppression pool during a core-melt accident.

The proposed changes were submitted by the Perry plant to the NRC in a letter dated August 27, 1996 (Reference 3). This report documents the staff's evaluation of the thermal-hydraulics, fission product deposition, and resulting radiological consequences using the revised source term for the Perry plant given the proposed plant changes. This report also provides input to the development of regulatory guidance for offsite and control room radiological consequence assessment using the revised source term.

# Evaluation of Thermal Hydraulics

The main features of the Mark III containment include a drywell surrounded by a wetwell. These two compartments are connected by two flow paths. The first is flow through the suppression pool through horizontal vents in the drywell wall. The second is leakage through drywell penetrations (also called suppression pool bypass flow). For design basis accident pipe breaks, the blowdown and fission product releases are directed into the drywell. The fission product releases from the reactor coolant system can then flow to the wetwell through the cited two flow paths and leak to the environment through containment leakage. In addition, fission products that remain in the drywell can leak to the environment through leakage past closed MSIVs. For small break LOCAs that do not depressurize the reactor coolant system, the operator may depressurize the reactor coolant system by manually actuating the automatic depressurization system. In this case, fission products are released into both the drywell through the pipe break and into the suppression pool through the automatic depressurization system. Discharge from the automatic depressurization system is through quenchers located at the bottom of the suppression pool in the wetwell, resulting in scrubbing of the fission product release by the suppression pool.

The Perry plant's design basis LOCA analysis modeled the entire fission product release as occurring into the drywell. In addition, Perry modeled the flow rates between the drywell and wetwell as shown in Table 1. The flow rates shown up to 2.08 hours are derived from estimates of steam flow produced from the heated core; the very high steam flow rate (100,000 cfm) is produced as a result of reflood of the heated core. The flow rates after 2.08 hours are a result of operation of the hydrogen purge compressor.

| Phase of accident | Drywell-to-wetwell flow rate (cfm) | Wetwell-to-drywell flow rate (cfm) |
|---|---|---|
| Gap | 0 | 0 |
| In-Vessel | 6,200 | 0 |
| Remainder of accident (2 to 2.08 hours) | 100,000 | 0 |
| Remainder of accident (2.08 to 720 hours) | 500 | 500 |

Table 1. Perry Plant Flow Rates Between the Drywell and the Wetwell

<u>Assessment of Flow Rates used by Perry between Drywell and Wetwell</u>

As noted above, Perry modeled the fission product release from the reactor coolant system as being directly into the drywell. This modeling is appropriate for large break LOCAs but is conservative for transients and small pipe break accidents, because in those cases fission products are also released directly into the suppression pool through quenchers and are retained in the suppression pool. For example, for a small break LOCA with operator actuation of the automatic depressurization system, MELCOR estimates that the majority of the fission

product release (>90% of iodine release) goes directly into the suppression pool through quenchers immediately prior to and following core reflood and is retained in the suppression pool.

Early discussions with the licensee, as well as preliminary dose calculations for the Perry plant, indicated that containment mixing conditions of both the exchange flow rate between the drywell and wetwell and the degree of mixing modeled at the end of the fission product release are, in general, important factors in determining the radiological consequences. The results of the preliminary dose calculations for various containment mixing conditions are shown in Table 2. The dose calculation results shown in Table 2 are preliminary in that the fission product deposition assumptions used were intended to be similar to those used by Perry in its pilot plant submittal. Further assessment of the fission product deposition modeling is described later in this report in the section entitled "Evaluation of Fission Product Deposition."

The first area evaluated in the preliminary dose calculations was sensitivity to the flow rate modeled during the gap release phase. Accordingly, cases were run using different flow rates during the first half hour. Perry modeled the flow rate between the drywell and the wetwell to be 0 cfm during the first half hour. However, flow rates during the gap phase would be at least as large as those during the in-vessel phase. Therefore, cases were run with RADTRAD using the same flow rates for the gap phase as those for the in-vessel phase. As shown in Table 2, one case was run using 3500 cfm for both the gap and in-vessel phases and one case was run using 0 cfm for the gap phase and 3500 cfm for the in-vessel phase. Using 0 cfm for the gap phase resulted in a slight increase in the EAB TEDE dose from 25.1 rem to 25.6 rem.

The next area evaluated was the sensitivity to flow rate during the in-vessel phase. Of the areas evaluated, this one resulted in the most sensitivity of dose to flow rate as shown in a number of the results in Table 2. For example, a change in flow rate from 0 cfm to 6200 cfm for the in-vessel phase resulted in an EAB TEDE dose decrease of about 12 rem, from 33.9 rem to 21.8 rem.

The final area evaluated was the sensitivity to flow rate following the in-vessel phase. In this area, calculations were first performed using the licensee's assumption of a 100,000 cfm flow rate for .08 hours followed by a long-term flow rate of 500 cfm. Calculations were then performed modeling the drywell and wetwell as being well-mixed, with an interchange flow rate of one drywell volume per minute (i.e., 276,500 cfm). For the cases with 2900 cfm for the first two hours of the accident, use of a well-mixed assumption resulted in an EAB TEDE dose increase of about 2 rem, from 24.7 rem to 26.3 rem.

As discussed above, Perry modeled flow between the drywell and wetwell to be 0 during the gap phase of fission product release into the drywell. Therefore, during the first half hour of the accident, all offsite dose from leakage of the containment atmosphere is from drywell leakage past closed MSIVs. This model is conservative, because fission products from the gap release remain in the drywell which leaks at a higher rate than the wetwell (4 cfm vs. 2 cfm) and does not have sprays. In addition, as discussed above, this modeling does not have a significant impact on dose.

| Flow (cfm) from drywell to wetwell before 2 hr | | Flow (cfm) between drywell and wetwell after 2 hr | | Exclusion Area Boundary Dose (rem) | | | Low Population Zone Distance Dose (rem) | | |
|---|---|---|---|---|---|---|---|---|---|
| 0-.5hr | .5-2hr | 2-2.08hr | 2.08-720hr | Thyroid | Whole Body | TEDE | Thyroid | Whole Body | TEDE |
| 0 | 6200 | 100,000 | 500 | 302 (1.8 hr) | 4.9 (1.6 hr) | 19.5 (1.8 hr) | 123 | 2.3 | 7.3 |
| 0 | 0 | 276,500 | | 529 (2.0 hr) | 8.2 (1.7 hr) | 33.9 (2.0 hr) | 174 | 3.1 | 10.7 |
| 0 | 3500 | 276,500 | | 396 (2.0 hr) | 6.3 (1.8 hr) | 25.6 (2.0 hr) | 147 | 2.8 | 9.0 |
| 0 | 6200 | 276,500 | | 335 (2.0 hr) | 5.4 (1.8 hr) | 21.8 (2.0 hr) | 134 | 2.6 | 8.2 |
| 500 | | 276,500 | | 502 (2.0 hr) | 7.8 (1.8 hr) | 32.3 (2.0 hr) | 168 | 3.0 | 10.4 |
| 2814 | | 276,500 | | 408 (2.0 hr) | 6.5 (1.8 hr) | 26.5 (2.0 hr) | 148 | 2.8 | 9.2 |
| 2900 | | 276,500 | | 405 (2.0 hr) | 6.5 (1.8 hr) | 26.3 (2.0 hr) | 148 | 2.8 | 9.1 |
| 2900 | | 100,000 | 500 | 380 (1.9 hr) | 6.2 (1.7 hr) | 24.7 (1.9 hr) | 139 | 2.6 | 8.5 |
| 3000 | | 276,500 | | 402 (2.0 hr) | 6.4 (1.8 hr) | 26.1 (2.0 hr) | 147 | 2.8 | 9.1 |
| 3500 | | 276,500 | | 387 (2.0 hr) | 6.2 (1.8 hr) | 25.1 (2.0 hr) | 144 | 2.7 | 8.9 |
| 4800 | | 276,500 | | 354 (2.0 hr) | 5.7 (1.8 hr) | 23.1 (2.0 hr) | 137 | 2.6 | 8.4 |

Note: The start time of the worst-two-hours dose at the Exclusion Area Boundary is shown in parentheses following each dose.

Table 2. Dependence of radiological consequences on containment mixing conditions for the Perry plant using the revised (NUREG-1465) source term.

For the in-vessel phase, Perry modeled a flow of 6200 cfm from the drywell to the wetwell bypassing the suppression pool. Because of the large bypass area of a Mark III containment (approximately one square foot), we agree with the licensee that flow rates on the order of 6200 cfm from the reactor coolant system into the drywell are not expected to be large enough to result in flow through the suppression pool. Perry's value of 6200 cfm is based on an assessment of steam produced by decay heat in core material relocated to the lower plenum of the reactor vessel. This assessment modeled 50% of the core material as relocating to the lower plenum at a constant rate during the in-vessel phase. In an attempt to demonstrate that 6200 cfm is reasonable even with a very small amount of core relocation, Perry performed additional analysis that indicated that about 3000 cfm is supported by heating of water in the lower head without relocation and the remainder of the 6200 cfm is supported by relocation of only 5% of the core material if the sensible energy of the material is considered. Because of uncertainty in late phase core melt progression and the amount of material relocation, it is difficult to show that any relocation of core material to the lower plenum prior to reflood is realistic. Based on the licensee assessment of steaming of an intact core and the our independent MELCOR evaluation given below, we determined that a steam flow rate of 3000 cfm is appropriate.

Perry modeled the remainder of the accident as a core reflood period (100,000 cfm of steam from the drywell to the wetwell for .08 hours) followed by a steady-state period. Perry assumed a core reflood flow rate and timing sufficient to sweep all fission products from the drywell into the wetwell during the reflood. The steady-state period models 500 cfm of flow between the drywell and the wetwell as a result of operation of the hydrogen mixing system. Because different accident sequences can result in different amounts of mixing following the in-vessel phase, this modeling of the remainder of the accident does not appear to be sufficiently generic in enveloping the range of conditions. A better approach to evaluate releases from a Mark III containment for the remainder of the accident is to model the containment to be well mixed. The licensee agreed to this approach, which is consistent with that used in the design basis accident assessments performed when the plant was originally licensed.

Independent Estimate of Flow Rates

In order to confirm that a flow rate of 3000 cfm from the drywell to the wetwell was appropriate, the staff utilized the results of recent MELCOR calculations. MELCOR results for Grand Gulf for three sequences were utilized for this confirmatory analysis. The Grand Gulf facility is judged to be representative of the Perry facility, because Grand Gulf is also a General Electric BWR 6 reactor with a Mark III containment. Additional details on these MELCOR sequences are given in two Oak Ridge National Laboratory letter reports (References 4 and 5). These sequences were chosen to provide insight into the magnitude of flows expected during the in-vessel phase of a core-melt accident. The MELCOR flow results for these sequences are given in Table 3 and are discussed further below. For these sequences, the reported flow rates are for the period following the initial blowdown and before the reflood that terminates the core degradation.

| | | Average Steam Flow Rate following Initial Blowdown (cfm) |
|---|---|---|
| Large Break LOCA | | 2800 |
| Small Break LOCA (2") without ADS | | ~28000 |
| Small Break LOCA (2") with ADS | Into Drywell | 800 |
| | Into Quenchers | 250 |

Table 3. MELCOR-predicted flow rates from the reactor coolant system into the containment.

A comparison of the steam flow rates proposed by Perry with the steam flow rates for the large break LOCA in Table 3 would suggest that a steam flow rate of about 3000 cfm would be reasonable for sweeping fission products from the drywell to the wetwell. In a telephone conference with the NRC on December 3, 1998, Perry stated that hydrogen purge compressor operation with a flow rate of 500 cfm would begin by .5 hours into the accident. Because hydrogen is released from the reactor coolant system simultaneously with the fission products during the in-vessel phase, it is possible that hydrogen purge compressor operation would begin before the end of the in-vessel phase. However, not crediting operation prior to two hours would provide some margin (500 cfm). Also, hydrogen flow from the reactor coolant system during the fission product release would augment the steam flow rate sweeping the fission products from the drywell to the wetwell.

The MELCOR analysis for the small break LOCA without operator actuation of the automatic depressurization system (ADS) resulted in a steam flow rate of approximately 10 times that of the large break LOCA. Therefore, the steam flow rate for the large break LOCA is conservative in comparison with the small break LOCA without ADS.

During a small break LOCA, operator action could result in depressurizing the reactor coolant system using the ADS. The results of the MELCOR analysis for this sequence are also given in Table 3. A comparison of the steam flow rates proposed by Perry with the steam flow rates for the small break LOCA with ADS indicated that a steam flow rate of 3000 cfm is not conservative. However, additional analysis of the MELCOR results confirmed that for the small-break LOCA with ADS, the majority of the fission product release (>90% of iodine release) was released into the suppression pool through quenchers immediately prior to and following core reflood and was retained in the suppression pool. Therefore, use of a steam flow rate of 3000 cfm to sweep fission products from the drywell to the wetwell coupled with the assumption that fission products are released to the drywell (and not to the suppression pool) is a reasonable approach.

# Evaluation of Fission Product Deposition

To assess the Perry modeling of fission product deposition, an independent analysis was performed with the RADTRAD code (version 2.24) for the three areas of fission product removal investigated. Reference 6 documents RADTRAD version 2.20. Version 2.24 is the same as that described in Reference 6, with the exception that version 2.24 contains enhancements in the numerical methods.

The staff's assessment used two nodalizations. The first nodalization, given in Figure 1, was used to calculate dose from leakage of the containment atmosphere. For leakage of the containment atmosphere, two leak paths are considered. The first leak path is called containment leakage and is leakage of the wetwell airspace through cracks in the wetwell outer boundary. The second leak path is called MSIV leakage and is leakage of the drywell airspace through imperfect seating of the MSIVs. The second nodalization, given in Figure 2, was used to calculate dose from leakage of the suppression pool water through leaks in Emergency Core Cooling System components outside of the containment (ECCS leakage). Values for parameters used in these nodalizations, such as node volumes and flow rates between nodes, are given in Appendix B. The corresponding RADTRAD input decks are given in Appendix C.

Because of the large suppression pool bypass area in a Mark III containment, the fission product release into the drywell is not expected to be subsequently scrubbed by flow through the suppression pool unless significant steaming occurs as a result of water injection. In the dose calculations performed by the staff, no credit was assumed for suppression pool scrubbing. Therefore, the two areas of fission product removal in the containment modeled were spray washout of aerosols in the wetwell and aerosol deposition in the drywell by natural processes such as settling (natural deposition). Because of Perry's proposal to remove the MSIV leakage control system, natural deposition in the main steam line was also modeled.

For the first two areas of fission product removal, namely, spray scrubbing in the wetwell and natural deposition in the drywell, the independent NRC offsite and control room dose assessment used the probabilistically based NRC models built into RADTRAD. These models are documented in references 7 and 8. In the independent assessment with RADTRAD, the $10^{th}$ percentile models for spray scrubbing in the wetwell and natural deposition in the drywell were used. (In this report, lower percentiles are more conservative.) The results of the staff's radiological consequence calculations with the RADTRAD modeling for spray scrubbing in the wetwell and natural deposition in the drywell are given in Table 4. The results of the staff's radiological consequence calculations with the licensee's modeling are also given in Table 4 for comparison. These results show small dose impacts of utilizing the RADTRAD modeling in place of the licensee's modeling. In addition, these results indicate that, overall, the licensee's modeling of wetwell spray removal and drywell natural deposition is conservative.

| Modeling Used | | Exclusion Area Boundary Dose (rem) | | | Low Population Zone Distance Dose (rem) | | | Control Room Dose (rem) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| wetwell spray | drywell natural deposition | Thyroid | Whole Body | TEDE | Thyroid | Whole Body | TEDE | Thyroid | Whole Body | TEDE |
| Perry | Perry | 402 (2.0 hr) | 6.4 (1.8 hr) | 26.1 (2.0 hr) | 147 | 2.8 | 9.1 | 25.1 | .17 | 1.08 |
| RADTRAD | Perry | 328 (1.7 hr) | 6.3 (1.7 hr) | 22.0 (1.7 hr) | 118 | 2.7 | 7.4 | 22.7 | .17 | .95 |
| RADTRAD | RADTRAD | 346 (1.7 hr) | 6.3 (1.7 hr) | 23.0 (1.7 hr) | 121 | 2.7 | 7.6 | 22.9 | .17 | .96 |

Note: All cases used Perry modeling for main steam line deposition, 3000 cfm from the drywell to the wetwell before 2 hours, and well-mixed between the drywell and the wetwell after 2 hours. Also, the start time of the worst-two-hours dose at the Exclusion Area Boundary is shown in parentheses following each dose.

Table 4. Sensitivity of radiological consequence results for the Perry plant to wetwell spray and drywell natural deposition modeling using the revised (NUREG-1465) source term.

For settling in the main steam line, the flow pattern could be plug flow, well-mixed, or some combination of the two. For the same leak rate into the main steam line, plug flow is expected to result in less offsite release than well-mixed flow, because the concentration of the material released to the environment is at the concentration of the material in the plug at the end of the pipe. Plug flow effectively results in a longer fission product transport time in the pipe and more deposition in the pipe. If temperature gradients exist along the length of the pipe, then some amount of mixing would be expected to occur. Perry has performed analysis to show that flow in some parts of the steam line is plug flow. It is our view that current modeling uncertainties are such that it is problematic to treat these regions as not undergoing some degree of mixing. The staff therefore believes that, at this time, a well-mixed model is more appropriate than a plug flow model for settling in the main steam line. However, complete mixing may not occur along the entire length of the pipe and, in some pipe segments, plug flow may exist. Given the conservatism associated with using a well-mixed model for the entire length of the pipe and a number of additional conservatisms inherent in the piping deposition analysis, use of a 10$^{th}$ percentile settling velocity with a well-mixed model is not appropriate. Additional conservatisms include additional deposition by thermophoresis, diffusiophoresis, and flow irregularities; additional deposition as a result of hygroscopicity; and possible plugging of the leaking MSIV by aerosols. Given the conservatism of the well-mixed assumption, we believe it is acceptable then to utilize median values (as compared to more conservative values) for deposition parameters.

Use of the well-mixed assumption together with median values for the settling velocity produces calculated doses comfortably below the acceptance limits (TEDE doses of 18.6 rem and .87 rem for the EAB and control room, respectively). Use of more conservative deposition parameters, however, would result in acceptable doses, 22.5 rem and .91 rem for the EAB and control room, respectively. These results are given in the first two rows of Table 5.

Further examination of the analytical methods for treating natural deposition in the main steam line may reveal opportunities for additional mitigation of radiological consequences and a resultant lowering of doses. To demonstrate this, the staff utilized a plug-flow model for the main steam line together with a conservative settling velocity. The results of the staff's calculations with a plug flow model are given in the final row of Table 5. These results show an EAB TEDE dose decrease of about 13 rem, from 22.5 rem to 9.6 rem, using the plug flow model. A more detailed discussion of the use of well-mixed and plug-flow models for the Perry assessment is given in Appendix A.

| Main Steam Line Deposition Model | Percentile for Settling Velocity | Exclusion Area Boundary Dose (rem) | | | Low Population Zone Distance Dose (rem) | | | Control Room Dose (rem) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Thyroid | Whole Body | TEDE | Thyroid | Whole Body | TEDE | Thyroid | Whole Body | TEDE |
| Well mixed | 50th | 274 (1.1 hr) | 6.0 (1.6 hr) | 18.6 (1.2 hr) | 98.1 | 2.7 | 6.3 | 21.2 | .17 | .87 |
| Well mixed | 40th | 345 (1.1 hr) | 6.2 (1.6 hr) | 22.5 (1.2 hr) | 109 | 2.7 | 7.0 | 22.1 | .17 | .91 |
| Plug flow | 40th | 108 (1.4 hr) | 5.6 (1.7 hr) | 9.6 (1.6 hr) | 72.3 | 2.6 | 4.9 | 19.3 | .17 | .77 |

Note: All cases used (1) RADTRAD 10th percentile modeling for wetwell sprays and drywell natural deposition, (2) 3000 cfm from the drywell to the wetwell before 2 hours, and (3) well-mixed between the drywell and the wetwell after 2 hours. Also, the start time of the worst-two-hours dose at the Exclusion Area Boundary is shown in parentheses following each dose.

Table 5. Overall results of the independent assessment of radiological consequences for the Perry plant using the revised (NUREG-1465) source term.

# References


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3. Centerior Energy letter PY-CEI/NRR-2076L to the NRC dated August 27, 1996

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5. J. J. Carbajo, "MELCOR Small Break LOCA Calculations," Letter Report, Oak Ridge National Laboratory, ORNL/NRC/LTR-98/17 (draft), October 1998

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7. D. A. Powers, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments," NUREG/CR-6189, SAND94-0407, Sandia National Laboratories, Albuquerque, NM, 1996

8. 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

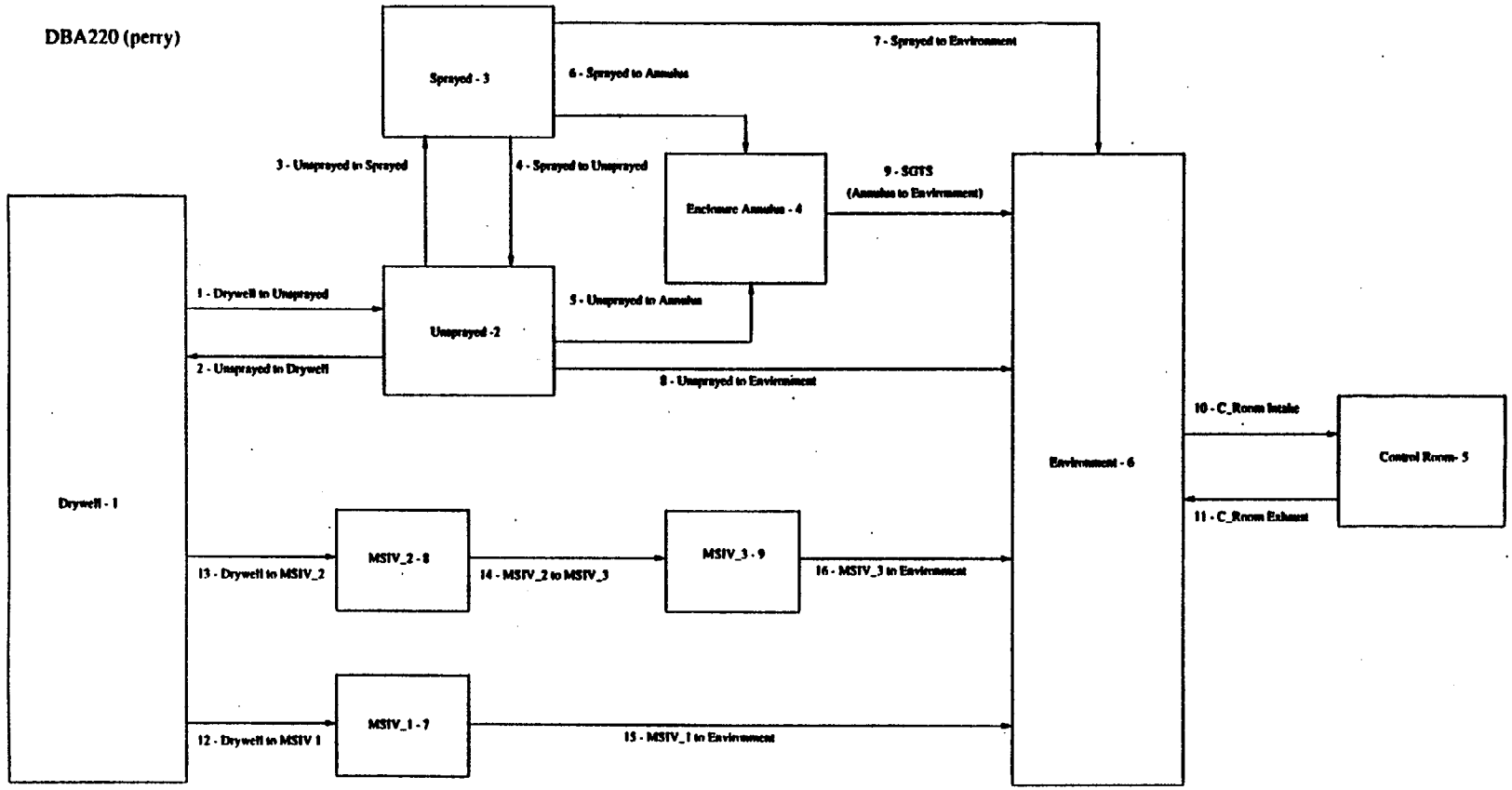
DBA220 (perry)
Sprayed - 3
7 - Sprayed to Environment
6 - Sprayed to Annulus
3 - Unsprayed to Sprayed
4 - Sprayed to Unsprayed
Enclosure Annulus - 4
9 - SGTS
(Annulus to Environment)
Drywell - 1
1 - Drywell to Unsprayed
Unsprayed -2
5 - Unsprayed to Annulus
2 - Unsprayed to Drywell
8 - Unsprayed to Environment
Environment - 6
10 - C_Room Intake
Control Room- 5
11 - C_Room Exhaust
MSIV_2 - 8
13 - Drywell to MSIV_2
14 - MSIV_2 to MSIV_3
MSIV_3 - 9
16 - MSIV_3 to Environment
MSIV_1 - 7
12 - Drywell to MSIV 1
15 - MSIV_1 to Environment

Figure 1

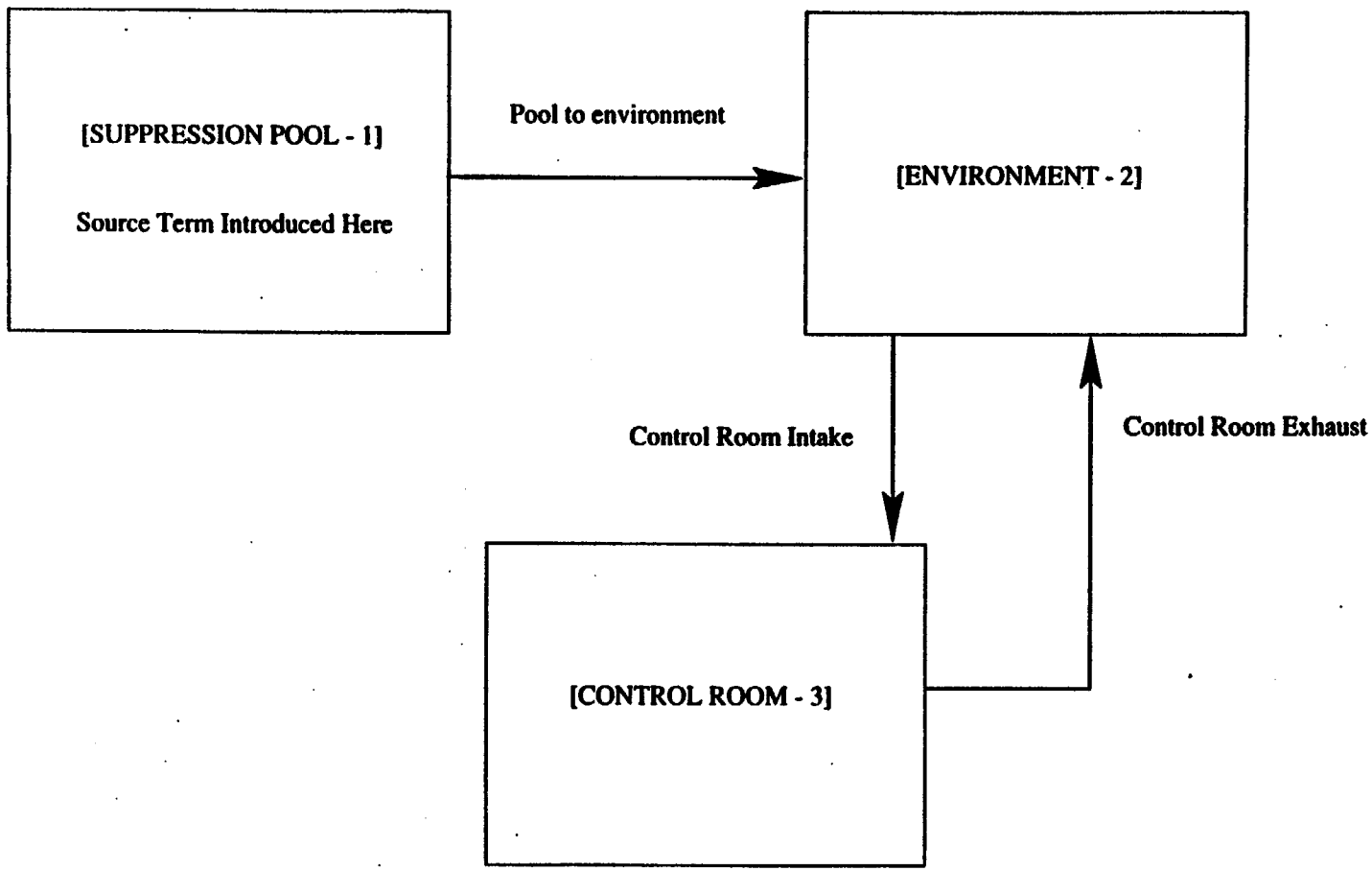
[SUPPRESSION POOL - 1]
Source Term Introduced Here
Pool to environment
[ENVIRONMENT - 2]
Control Room Intake
Control Room Exhaust
[CONTROL ROOM - 3]

Figure 2

# Appendix A

## Use of Plug-Flow and Well-Mixed Models for Fission Product Deposition in the Main Steam Line for the Perry Assessment

In August 1996, the Perry plant proposed changes to its facility, including removing the MSIV leakage control system and increasing the allowable MSIV leakage rate. Similar changes had been demonstrated to be acceptable and approved by the NRC in the past for other plants using the TID source term. To support these changes in the past, the main condenser and steam piping downstream of the MSIVs had to be qualified for accident conditions in order to be considered available for fission product deposition. Once qualified, flow in the steam piping was assumed to be plug flow for the purpose of assessing deposition in the steam piping and the condenser. The current proposal by Perry is to not qualify this piping for accident conditions and to rely only on deposition in piping upstream of the third main steam valve which has been qualified for accident conditions since the beginning of plant operation.

During a design basis LOCA, the flow pattern in the main steam line could be plug flow, well-mixed, or some combination of the two. If temperature gradients exist along the length of the pipe, then some degree of mixing would occur. For the same leak rate into the main steam line, plug flow is expected to result in less offsite release than well-mixed flow, because the concentration of the material released to the environment is at the concentration of the material in the plug at the end of the pipe. Plug flow effectively results in a longer fission product transport time in the pipe and more deposition in the pipe.

Given the availability of the condenser and piping downstream of the third main steam valve for deposition in the earlier cases, it was likely to be less important whether the flow was modeled as plug flow or well-mixed. However, we believed that having only the main steam line available for deposition in Perry warranted further consideration of the flow conditions in the main steam line. Also, Perry has performed analysis to show that flow in the steam line in some parts of the line is in plug flow.

The RADTRAD code was used to assess the effect of plug versus well-mixed flow modeling. First, the pipe deposition model built into RADTRAD was used to calculate the radiological consequences based on a plug flow model. Then, the RADTRAD code was used together with a side calculation of decontamination factors for the main steam line based on the well-mixed model described below. It was necessary to perform this side calculation because RADTRAD currently does not contain a model for pipe deposition under well-mixed conditions. The results of the staff's RADTRAD calculations are given in Table 5.

The staff's well-mixed deposition model assumes that each segment of piping in the RADTRAD nodalization is well-mixed. The unbroken main steam lines in the RADTRAD nodalization are modeled as two segments. The first segment is the length of piping between the reactor vessel and the first MSIV. The second segment is the length of piping between the first MSIV and the second MSIV. The broken main steam line is modeled as one segment of piping. This segment is the length of piping between the first MSIV and the second MSIV.

The derivation of the staff's well-mixed model begins with a mass balance as follows:

$$V \cdot \frac{dC}{dt} = Q \cdot C_{in} - Q \cdot C - \lambda_s \cdot V \cdot C \qquad (1)$$

where V = volume of well-mixed region
C = concentration of nuclides in volume
Q = volumetric flow rate into volume
$\lambda_s$ = rate constant for settling

and

$$\lambda_s = \frac{u_s \cdot A}{V} \qquad (2)$$

where $u_s$ = settling velocity
A = settling area

Under steady-state conditions, the derivative in equation (1) goes to 0. Equation (1) can be simplified to the following:

$$C = C_{in} \cdot \frac{1}{1 + \frac{\lambda_s \cdot V}{Q}} \qquad (3)$$

RADTRAD allows input of a filter efficiency for each flow path. Noting that C is also the concentration of nuclides leaving the volume, the above equation can be used to determine an equivalent filter efficiency as follows:

$$\eta_{filt} = 1 - \frac{C}{C_{in}} \qquad (4)$$

To evaluate the settling velocity, $u_s$, in both the plug flow model built into RADTRAD and the above well-mixed model, the staff utilized the following equation:

$$u_s = \frac{\rho \cdot d_e^2 \cdot g \cdot C_s}{18 \cdot \mu \cdot k} \qquad (5)$$

where $\rho$ = aerosol density
$d_e$ = aerosol diameter
g = gravitational acceleration
$C_s$ = Cunningham slip factor
$\mu$ = viscosity
k = shape factor

The values for aerosol density, diameter, and shape factor during a design basis LOCA have some uncertainty. Therefore, a Monte Carlo analysis was performed to determine the distribution of settling velocities for the main steam line during the in-vessel phase. To perform the uncertainty analysis, the staff sampled from the ranges and distributions given in recent assessments of aerosol density, diameter, and shape factor documented in References 7 and 8. For density, Reference 7 gives a range of 3.25 to 10.96 g/cm$^3$ with a log-uniform distribution over that range. For diameter, Reference 8 gives a range of 1.5 to 5.5 μm with a uniform distribution. Finally, Reference 7 cites values of packing fractions from .63 down to .18. Using the methodology in Reference 7, this translates into a range of shape factors from 1.17 to 1.77. A uniform distribution was used for the shape factors. In addition, values of 1 and $1.93 \times 10^{-5}$ Pa-sec were used for the Cunningham slip factor and viscosity, respectively. The results of the Monte Carlo analysis are given in Table A-1 and Figure A-1.

| Percentile | Settling Velocity (m/sec) | Removal Rate Constant (/hr) |
|---|---|---|
| 60$^{th}$ (average) | .00148 | 11.43 |
| 50$^{th}$ (median) | .00117 | 9.04 |
| 40$^{th}$ | .00081 | 6.26 |
| 10$^{th}$ | .00021 | 1.62 |

Table A-1. Result of Monte Carlo analysis for settling velocity in the main steam line.

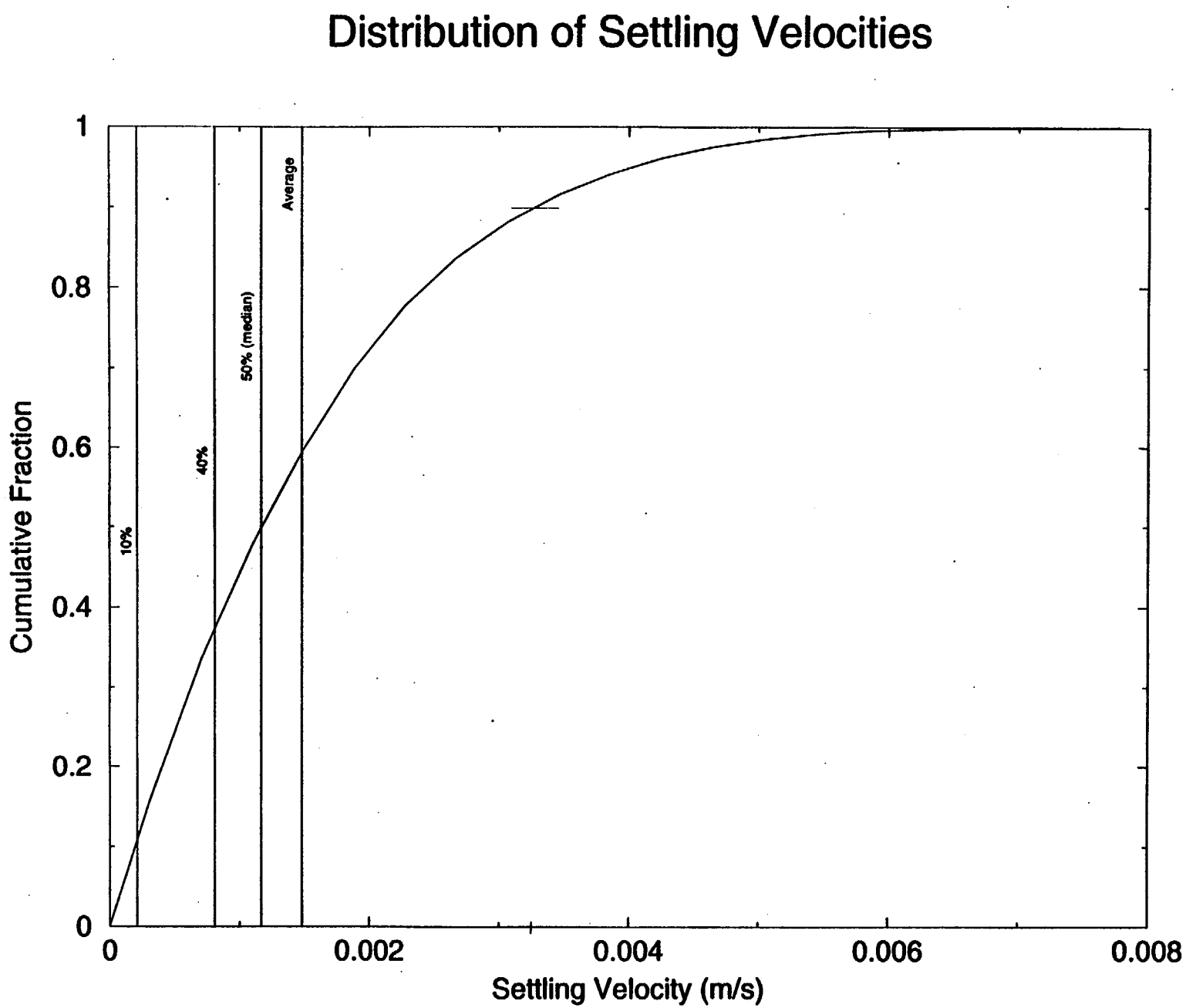
Distribution of Settling Velocities
Cumulative Fraction
Settling Velocity (m/s)
0
0.2
0.4
0.6
0.8
1
0
0.002
0.004
0.006
0.008
10%
40%
50% (median)
Average

Figure A-1

# Appendix B

## Modeling Details for the Perry Assessment

This appendix contains several tables which provide the parameter values used in the staff's independent consequence assessment for Perry given in Table 5. Volumes and flow rates in the following tables correspond to the volumes and flow paths shown in Figures 1 and 2.

| **Containment and MSIV Leakage Model** | | | |
|---|---|---|---|
| Parameter | | Value | |
| Plant Power | | 3758 MWt | |
| Release Fractions and Timing | | As specified for BWR in NUREG-1465 (gap and early in-vessel releases only) | |
| Release Location | | Directly to drywell | |
| Drywell Volume | | $2.76 \times 10^5$ ft$^3$ | |
| Wetwell Volume | | $1.16 \times 10^6$ ft$^3$ | |
| Volume of Sprayed Region | | $4.81 \times 10^5$ ft$^3$ | |
| Volume of Unsprayed Region | | $6.84 \times 10^5$ ft$^3$ | |
| Flow Rate from Drywell to Unsprayed Region | | 0 - .5 hr | 3000 ft$^3$/min |
| | | .5 - 2 hr | 3000 ft$^3$/min |
| | | 2hr - 30 days | $2.76 \times 10^5$ ft$^3$/min |
| Flow Rate from Unsprayed Region to Drywell | | 0 - .5 hr | 0 ft$^3$/min |
| | | .5 - 2 hr | 0 ft$^3$/min |
| | | 2hr - 30 days | $2.76 \times 10^5$ ft$^3$/min |
| Flow Rate between Drywell and Sprayed Region | | 0 ft$^3$/min | |
| Flow Rate From Sprayed Region to Unsprayed Region | | 70,000 ft$^3$/min | |
| Flow Rate From Unsprayed Region to Sprayed Region | | 70,000 ft$^3$/min | |
| Containment Leak Rate to Environment | From sprayed region | 0 - 40 sec | 1.00 ft$^3$/min |
| | | 40 sec - 30 days | .068 ft$^3$/min |
| | From unsprayed region | 0 - 40 sec | 2.00 ft$^3$/min |
| | | 40 sec - 30 days | .135 ft$^3$/min |

| | | | |
|---|---|---|---|
| Containment Leak Rate to Annulus | From sprayed region | 0 - 40 sec | 0 $ft^3$/min |
| | | 40 sec - 30 days | .603 $ft^3$/min |
| | From unsprayed region | 0 - 40 sec | 0 $ft^3$/min |
| | | 40 sec - 30 days | 1.205 $ft^3$/min |
| Annulus Volume | | $1.96 \times 10^5$ $ft^3$ | |
| Flow Rate from Annulus to Environment through the Standby Gas Treatment System | | 2000 $ft^3$/min | |
| Standby Gas Treatment System Filter Efficiency | | 99% for particulate<br>0% for elemental and organic | |
| First volume in intact main steam line | | 440 $ft^3$ | |
| Second volume in intact main steam line | | 292 $ft^3$ | |
| Flow Rates for Intact Main Steam Line | from drywell to first volume | 0 - 2.08 hr | 2.98 $ft^3$/min |
| | | 2.08 hr - 30 days | 2.47 $ft^3$/min |
| | from first volume to second volume | 0 - 30 days | 4.775 $ft^3$/min |
| | from second volume to environment | 0 - 30 days | 4.775 $ft^3$/min |
| Volume of ruptured main steam line | | 146 $ft^3$ | |
| Flow Rates for Ruptured Main Steam Line | from drywell to main steam line volume | 0 - 2.08 hr | 1.987 $ft^3$/min |
| | | 2.08 hr - 30 days | 1.65 $ft^3$/min |
| | from main steam line volume to environment | 0 - 30 days | 3.183 $ft^3$/min |
| Spray Removal Rate Constant for Particulates (sprayed region only) | | $10^{th}$ percentile model from NUREG/CR-5966, using .0621 ($ft^3$)/($ft^2$ min) and 53.2 ft for the spray flux and fall height, respectively | |
| Spray Removal Rate Constant for Elemental Iodine (sprayed region only) | | 0 - .7025 hr | 14.3/hr |
| | | .7025 - 1.862 hr | 3.84/hr |
| | | 1.862 - 2.049 hr | 6.55/hr |
| | | 2.049 - 2.155 hr | 3.35/hr |
| | | 2.155 hr - 30 days | 1.20/hr |

| | |
|---|---|
| Natural Removal Rate Constant for Particulates (drywell only) | $10^{th}$ percentile model from NUREG/CR-6189 |
| Natural Removal for Particulate in Each Main Steam Line Volume | As specified in the individual sensitivity calculation |
| Natural Removal for Elemental Iodine in Each Main Steam Line Volume | Decontamination factor of 2 |

| **ECCS Leakage Model** | | |
|---|---|---|
| Parameter | Value | |
| Plant Power | 3758 MWt | |
| Release Fractions and Timing | As specified for BWR in NUREG-1465 for elemental and organic iodine (gap and early in-vessel releases only) | |
| Release Location | Directly to suppression pool | |
| Suppression Pool Water Volume | $1.47 \times 10^5$ $ft^3$ | |
| ECCS Leak Rate | 0 - 24 hr | .033 $ft^3$/min |
| | 24 - 24.5 hr | 6.7 $ft^3$/min |
| | 24.5 hr - 30 days | .033 $ft^3$/min |
| Partition Factor | 10 for elemental and organic iodine (radionuclides that were aerosol in containment were modeled to not resuspend) | |

| **Meteorological Data** | |
|---|---|
| Exclusion Area Boundary | |
| Time (hr) | X/Q (sec/$m^3$) |
| 0-720 | $4.3 \times 10^{-4}$ |
| Low Population Zone Distance | |
| Time (hr) | X/Q (sec/$m^3$) |
| 0-8 | $4.8 \times 10^{-5}$ |
| 8-24 | $3.3 \times 10^{-5}$ |
| 24-96 | $1.4 \times 10^{-5}$ |
| 96-720 | $4.1 \times 10^{-6}$ |

| Control Room | |
|---|---|
| Time (hr) | X/Q (sec/$m^3$) |
| 0-8 | $7.0 \times 10^{-5}$ |
| 8-24 | $5.6 \times 10^{-5}$ |
| 24-96 | $4.3 \times 10^{-5}$ |
| 96-720 | $1.5 \times 10^{-5}$ |

| **Breathing Rates** | | |
|---|---|---|
| Exclusion Area Boundary | | |
| Time (hr) | | Breathing Rate ($m^3$/sec) |
| 0-720 | | $3.47 \times 10^{-4}$ |
| Low Population Zone Distance | | |
| Time (hr) | | Breathing Rate ($m^3$/sec) |
| 0-8 | | $3.47 \times 10^{-4}$ |
| 8-24 | | $1.75 \times 10^{-4}$ |
| 24-720 | | $2.32 \times 10^{-4}$ |
| Control Room | | |
| Time (hr) | Occupancy Factor | Effective Breathing Rate ($m^3$/sec) |
| 0-24 | 1.0 | $3.47 \times 10^{-4}$ |
| 24-96 | .6 | $2.082 \times 10^{-4}$ |
| 96-720 | .4 | $1.388 \times 10^{-4}$ |

| **Other Data** | |
|---|---|
| Nuclide Data: Isotope List, Half-Lives, and Specific Inventory (Ci/MWt) | As given in Appendix C |
| Dose Conversion Factors for Inhalation | As given in Appendix C (The dose conversion factors are from EPA Federal Guidance Report 11.) |
| Dose Conversion Factors for Cloudshine | As given in Appendix C (The dose conversion factors are from EPA Federal Guidance Report 12.) |

| Control Room Model | | |
|---|---|---|
| Volume | $3.44 \times 10^5$ $ft^3$ | |
| Flow Rate - Unfiltered Flow In | 1375 $ft^3$/min | |
| Flow Rate - Exhaust | 1375 $ft^3$/min | |
| Recirculation Flow Rate | 0 - .5083 hr | 0 |
| | .5083 hr - 30 days | $2.7 \times 10^4$ $ft^3$/min |
| Recirculation Filter Efficiencies | 95% for particulate<br>50% for elemental and organic | |

# Appendix C

## RADTRAD Input Decks for the Perry Assessment

This appendix is comprised of seven files which make up the input to the RADTRAD code for the Perry assessment. The first two files given in Appendix C.1 contain the user-supplied information including plant volumes, flow rates, and filter efficiencies for the containment and MSIV leakage model. The next two files given in Appendix C.2 contain the user-supplied information for the ECCS leakage model. The next two files given in Appendices C.3 and C.4 contain the release fraction and timing of the source term released into the containment atmosphere and suppression pool water respectively. The last two files given in Appendix C.5 contain the half-lives, specific inventories, and dose conversion factors.

# Appendix C.1

## User-Supplied Information for the Containment and MSIV Leakage Model

```
Plant Model Name:

Nuclide Inventory File:
DEFAULTS\PERRY.NIF
Plant Power Level:
 0.3758E+04
Compartments:
  9
Compartment  1:
Drywell
  3
 0.2765E+06
  0
  0
  0
  1
  0
Compartment  2:
Unsprayed
  3
 0.6842E+06
  0
  0
  0
  0
  0
Compartment  3:
Sprayed
  3
 0.4812E+06
  1
  0
  0
  0
  0
Compartment  4:
Enclosure Annulus
  3
 0.1960E+06
  0
  0
  0
  0
  0
Compartment  5:
Control Room
  1
 0.3440E+06
  0
  0
  1
  0
  0
Compartment  6:
Environment
  2
 0.0000E+00
  0
  0
  0
```

```
  0
  0
Compartment  7:
MSIV_1
  3
 0.1460E+03
  0
  0
  0
  0
  0
Compartment  8:
MSIV_2
  3
 0.4400E+03
  0
  0
  0
  0
  0
Compartment  9:
MSIV_3
  3
 0.2920E+03
  0
  0
  0
  0
  0
Pathways:
 16
Pathway   1:
Drywell to Unsprayed
  1
  2
  2
Pathway   2:
Unsprayed to Dry Well
  2
  1
  2
Pathway   3:
Unsprayed to Sprayed
  2
  3
  2
Pathway   4:
Sprayed to Unsprayed
  3
  2
  2
Pathway   5:
Unsprayed to Annulus
  2
  4
  2
Pathway   6:
Sprayed to Annulus
  3
  4
```

```
  2
Pathway   7:
Sprayed to Environment
  3
  6
  2
Pathway   8:
Unsprayed to Environment
  2
  6
  2
Pathway   9:
SGTS  (Annulus to Env)
  4
  6
  2
Pathway  10:
C_Room Intake
  6
  5
  2
Pathway  11:
C_Room Exhaust
  5
  6
  2
Pathway  12:
Drywell to MSIV_1
  1
  7
  2
Pathway  13:
Drywell to MSIV_2
  1
  8
  2
Pathway  14:
MSIV_2 to MSIV_3
  8
  9
  2
Pathway  15:
MSIV_1 to Environment
  7
  6
  2
Pathway  16:
MSIV_3 to Environment
  9
  6
  2
End of Plant Model File
```

```
Scenario Description Name:

Plant Model Filename:
PERRY\CASE17.SDF
Source Term:
  1
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:
  9
Compartment  1:
  0
  1
  0
  0
  0
  0
  0
  3
  3
  0.1000E+02
  1
  5
  0.0000E+00   0.1840E+00
  0.5186E+00   0.2500E+00
  0.8897E+00   0.3500E+00
  0.1218E+01   0.4500E+00
  0.1628E+01   0.5400E+00
Compartment  2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment  3:
  0
  1
  2
  0.0000E+00
  0.0000E+00
  0.1000E+02
  2
  0.0000E+00   0.6210E-01   0.5320E+02
  0.7200E+03   0.0000E+00   0.0000E+00
  1
  0.0000E+00
```

```
  5
  0.0000E+00   0.1430E+02
  0.7025E+00   0.3840E+01
  0.1862E+01   0.6550E+01
  0.2049E+01   0.3350E+01
  0.2155E+01   0.1200E+01
  0
  0
  0
  0
  0
Compartment  4:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment  5:
  0
  1
  0
  0
  0
  0
  1
  0.2700E+05
  2
  0.5083E+00   0.9500E+02   0.5000E+02   0.5000E+02
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Compartment  6:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment  7:
  0
  0
  0
  0
  0
  0
  0
  0
  0
Compartment  8:
  0
  0
  0
  0
```

```
  0
  0
  0
  0
  0
Compartment  9:
  0
  0
  0
  0
  0
  0
  0
  0
  0
Pathways:
 16
Pathway   1:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   0.3000E+04   0.0000E+00   0.0000E+00   0.0000E+00
  0.2000E+01   0.2765E+06   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.2765E+06   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   2:
  0
  0
  0
  0
  0
  1
  2
  0.2000E+01   0.2765E+06   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.2765E+06   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   3:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.7000E+05   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
```

```
  0
  0
  0
  0
  0
  0
Pathway   4:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.7000E+05   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   5:
  0
  0
  0
  0
  0
  1
  2
  0.1110E-01   0.1205E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   6:
  0
  0
  0
  0
  0
  1
  2
  0.1110E-01   0.6030E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   7:
  0
  0
  0
  0
  0
```

```
  1
  2
  0.0000E+00   0.1000E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0.1110E-01   0.6800E-01   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   8:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.2000E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0.1110E-01   0.1350E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   9:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.2000E+04   0.9900E+02   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway  10:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.1375E+04   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway  11:
  0
```

```
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.1375E+04   0.1000E+03   0.1000E+03   0.1000E+03
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway  12:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   0.1987E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0.2079E+01   0.1650E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway  13:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.2980E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0.2079E+01   0.2470E+01   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway  14:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.4775E+01   0.7100E+02   0.5000E+02   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
```

```
  0
  0
  0
Pathway  15:
  0
  0
  0
  0
  0
  1
  5
  0.0000E+00   0.3183E+01   0.7100E+02   0.5000E+02   0.0000E+00
  0.3330E+00   0.3183E+01   0.8500E+02   0.5000E+02   0.0000E+00
  0.5000E+00   0.3183E+01   0.8800E+02   0.5000E+02   0.0000E+00
  0.1500E+01   0.3183E+01   0.9000E+02   0.5000E+02   0.0000E+00
  0.3000E+01   0.3183E+01   0.4200E+02   0.5000E+02   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway  16:
  0
  0
  0
  0
  0
  1
  5
  0.0000E+00   0.4775E+01   0.7400E+02   0.5000E+02   0.0000E+00
  0.5000E+00   0.4775E+01   0.8300E+02   0.5000E+02   0.0000E+00
  0.1500E+01   0.4775E+01   0.8510E+02   0.5000E+02   0.0000E+00
  0.3000E+01   0.4775E+01   0.8590E+02   0.5000E+02   0.0000E+00
  0.1100E+02   0.4775E+01   0.4370E+02   0.5000E+02   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  4
Location  1:
Exclusion Area Boundary
  6
  1
  2
  0.0000E+00   0.4300E-03
  0.1000E+02   0.0000E+00
  1
  2
  0.0000E+00   0.3470E-03
  0.8000E+01   0.1750E-03
  0
Location  2:
Low Population Zone
  6
  1
  4
```

```
  0.0000E+00   0.4800E-04
  0.8000E+01   0.3300E-04
  0.2400E+02   0.1400E-04
  0.9600E+02   0.4100E-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
  5
  0
  1
  1
  0.0000E+00   0.3470E-03
  1
  3
  0.0000E+00   0.1000E+01
  0.2400E+02   0.6000E+00
  0.9600E+02   0.4000E+00
Location  4:
Control Room Inlet
  6
  1
  4
  0.0000E+00   0.7000E-04
  0.8000E+01   0.5600E-04
  0.2400E+02   0.4300E-04
  0.9600E+02   0.1500E-04
  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
  4
  0.0000E+00   0.7000E-04
  0.8000E+01   0.5600E-04
  0.2400E+02   0.4300E-04
  0.9600E+02   0.1500E-04
Simulation Parameters:
  2
  0.0000E+00   0.1000E-01
  0.5000E+01   0.0000E+00
Output Filename:
CASE17.TXT
  1
  1
  1
  1
  1
End of Scenario File
```

# Appendix C.2

## User-Supplied Information for the ECCS Leakage Model

```
Plant Model Name:

Nuclide Inventory File:
DEFAULTS\BWR_DEF.NIF
Plant Power Level:
 0.3758E+04
Compartments:
  3
Compartment  1:
Suppression Pool
  3
 0.1469E+06
  0
  0
  0
  0
  0
Compartment  2:
Environment
  2
 0.0000E+00
  0
  0
  0
  0
  0
Compartment  3:
Control Room
  1
 0.3440E+06
  0
  0
  1
  0
  0
Pathways:
  3
Pathway   1:
Pool to Environment
  1
  2
  2
Pathway   2:
Control Room Intake
  2
  3
  2
Pathway   3:
Control Room Exhaust
  3
  2
  2
End of Plant Model File
```

```
Scenario Description Name:

Plant Model Filename:
NRC3.SDF
Source Term:
  1
DEFAULTS\FGR60.INP
DEFAULTS\BWR_I.RFT
  0.0000E+00
  0
  0.0000E+00   0.7500E+00   0.2500E+00   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
  0
  0
  0
  0
  0
  1
  0.2700E+05
  2
  0.0000E+00   0.9500E+02   0.5000E+02   0.5000E+02
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  3
Pathway   1:
  0
  0
  0
```

```
  0
  0
  1
  3
  0.0000E+00   0.3300E-01   0.0000E+00   0.9000E+02   0.9000E+02
  0.2400E+02   0.6700E+01   0.0000E+00   0.9000E+02   0.9000E+02
  0.2450E+02   0.3300E-01   0.0000E+00   0.9000E+02   0.9000E+02
  0
  0
  0
  0
  0
  0
Pathway   2:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.1375E+04   0.0000E+00   0.0000E+00   0.0000E+00
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway   3:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   0.1375E+04   0.1000E+03   0.1000E+03   0.1000E+03
  0.7200E+03   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  4
Location  1:
Exclusion Area
  2
  1
  3
  0.0000E+00   0.4300E-03
  0.1000E+02   0.0000E+00
  0.7200E+03   0.0000E+00
  1
  2
  0.0000E+00   0.3470E-03
  0.8000E+01   0.1750E-03
  0
```

```
Location  2:
Low Population Zone
  2
  1
  5
  0.0000E+00    0.4800E-04
  0.2000E+01    0.4800E-04
  0.8000E+01    0.3300E-04
  0.2400E+02    0.1400E-04
  0.9600E+02    0.4100E-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 Inlet
  2
  1
  5
  0.0000E+00    0.7000E-04
  0.3330E-01    0.7000E-04
  0.8000E+01    0.5600E-04
  0.2400E+02    0.4300E-04
  0.9600E+02    0.1500E-04
  1
  3
  0.0000E+00    0.3470E-03
  0.2400E+02    0.2082E-03
  0.9600E+02    0.1388E-03
  0
Location  4:
Control Room
  3
  0
  1
  1
  0.0000E+00    0.3470E-03
  1
  3
  0.0000E+00    0.1000E+01
  0.2400E+02    0.6000E+00
  0.9600E+02    0.4000E+00
Effective Volume Location:
  1
  4
  0.0000E+00    0.7000E-04
  0.8000E+01    0.5600E-04
  0.2400E+02    0.4300E-04
  0.9600E+02    0.1500E-04
Simulation Parameters:
  2
  0.0000E+00    0.1000E-01
  0.5000E+01    0.0000E+00
Output Filename:
NRC3.TXT
  1
  1
  1
```

1
1
End of Scenario File

# Appendix C.3

## Release Fraction and Timing of the Source Term Released into the Containment Atmosphere

```
Release Fraction and Timing Name:
BWR, NUREG-1465, Tables 3.11 & 3.13, June 1992
Duration (h):
 0.5000E+00  0.1500E+01  0.3000E+01  0.1000E+02
Noble Gases:
 0.5000E-01  0.9500E+00  0.0000E+00  0.0000E+00
Iodine:
 0.5000E-01  0.2500E+00  0.3000E+00  0.1000E-01
Cesium:
 0.5000E-01  0.2000E+00  0.3500E+00  0.1000E-01
Tellurium:
 0.0000E+00  0.5000E-01  0.2500E+00  0.5000E-02
Strontium:
 0.0000E+00  0.2000E-01  0.1000E+00  0.0000E-00
Barium:
 0.0000E+00  0.2000E-01  0.1000E+00  0.0000E+00
Ruthenium:
 0.0000E+00  0.2500E-02  0.2500E-02  0.0000E+00
Cerium:
 0.0000E+00  0.5000E-03  0.5000E-02  0.0000E+00
Lanthanum:
 0.0000E+00  0.2000E-03  0.5000E-02  0.0000E+00
Non-Radioactive Aerosols (kg):
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
End of Release File
```

# Appendix C.4

## Release Fraction and Timing of the Source Term Released into the Suppression Pool Water

```
Release Fraction and Timing Name: Iodine only
NUREG 1465  BWR
Duration (h):
 0.5000E+00  1.5000E+00  0.0000E+00  0.0000E+00
Noble Gases:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Iodine:
 0.0500E+00  0.2500E+00  0.0000E+00  0.0000E+00
Cesium:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Tellurium:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Strontium:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Barium:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Ruthenium:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Cerium:
 0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
Lanthanum:
 0.0000E+00  0.0000E+00  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
```

# Appendix C.5

## Half-Lives, Specific Inventories, and Dose Conversion Factors

```
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
```

```
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
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| | | |
|---|---|---|
| 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 | 9.268E-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 |

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|---|---|---|---|---|---|---|---|
| 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 |

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|---|---|---|---|---|---|---|
| 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 | 8.890E-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 |

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|---|---|---|---|---|---|---|---|
| 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 |

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|---|---|---|---|---|---|---|---|
| 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 | 1.090E-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 |

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|---|---|---|---|---|---|---|
| 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 | 1.588E-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 |