Attachment 5

Peach Bottom Atomic Power Station, Units 2 and 3

NRC Docket Nos. 50-277 and 50-278

Revise Technical Specifications to Eliminate Main Steam Line Radiation Monitor Trip Function

PBAPS Calculation PM-1168, *"Post-CRDA Release From RCS Sample Line,"* Revision 0

ATTACHMENT 1
Design Analysis Cover Sheet

Design Analysis		Last Page No. [6] 67	
Analysis No.: [1]	PM-1168	Revision: [2]	0 Major ☒ Minor ☐
Title: [3]	Post-CRDA Release From RCS Sample Line		
EC/ECR No.: [4]	13-00494	Revision: [5]	0

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Unit No.: [8]	2 and 3	N/A	
Discipline: [9]	PEDM		
Descrip. Code/Keyword: [10]	EPU; AST		
Safety/QA Class: [11]	SR		
System Code: [12]	912		
Structure: [13]	N/A		

CONTROLLED DOCUMENT REFERENCES [15]

Document No.:	From/To	Document No.:	From/To
PM-1057	From	M-00300	From
PEAM-EPU-63	From	M-388	From
PM-1055	From	CH-407	From
6280-M-884	From	UFSAR Tables 14.9.10 & 14.9.7	To

Is this Design Analysis Safeguards Information? [16] Yes ☐ No ☒ If yes, see SY-AA-101-106

Does this Design Analysis contain Unverified Assumptions? [17] Yes ☐ No ☒ If yes, ATI/AR#:

This Design Analysis SUPERCEDES: [18] N/A in its entirety.

Description of Revision (list changed pages when all pages of original analysis were not changed): [19]

This calculation analyzes the radiological consequences of post-CRDA release from the reactor water (RW) sample line and occupational dose rate in the sampling area.

Preparer: [20]	Gopal J. Patel (NUCORE)		07/14/2014
	Print Name	Sign Name	Date
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	Print Name	Sign Name	Date
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REVISION HISTORY

Revision	Description
0	Initial issue

SHEET REVISION INDEX

SHEET	REV	SHEET	REV
1	0		
2	0		
3	0		
4	0	Attachment 13.1	0
5	0	Attachment 13.2	0
6	0	Attachment 13.3	0
7	0	Attachment 13.4	0
8	0	Attachment 13.5	0
9	0		
10	0		
11	0		
12	0		
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1.0 PURPOSE

The purpose of this calculation is to determine the Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and Control Room (CR) doses due to the Post-Control Rod Drop Accident (CRDA) release from the Reactor Coolant System (RCS) sample line. This calculation uses the Alternative Source Term (AST) methodology, the TEDE dose criteria of 10 CFR 50.67, guidance in RG 1.183, Appendix C and NEDO-31400A, and the Extended Power Uprate (EPU) core inventory. This calculation assumes that the main steam line radiation monitors (MSLRM) no longer provide a signal for automatic closure of the main steam line drain valves and main steam and reactor water sample line valves, which establishes an unprocessed release to the environment.

2.0 METHODOLOGY

2.1 Post-CRDA Release Path

Elimination of the MSLRM system high radiation trip functions for initiating automatic closure of the Main Steam line drain valves and Main Steam and Reactor Water (RW) sample line valves were not evaluated in NEDO-31400A (Ref. 9.6). The flow from the Main Steam line drain valves ultimately travels to the main condenser just as the flow from the main steam isolation valves (MSIVs). Therefore, any radioactive material passing through the Main Steam line drain valves to the main condenser and through the Offgas Treatment system is treated identically to any radioactive material that would pass through the MSIVs and the resulting dose consequences would be the same as those in Reference 9.12, Section 8.1.

With respect to deleting the MSLRM high radiation trip function to close the Main Steam and Reactor Water sample line valves on a MSLRM system high radiation signal, the following bounding reactor water sampling scenario is postulated based on the PBAPS Chemistry Procedure for Sampling of Reactor Water (Reference 9.10). As discussed in Section 2.4, the post-CRDA dose rate from the RW sample will instantly exceed the radiation zone allowable dose rate limit and the area radiation monitor located in the sample room will alarm to alert the chemist to evacuate the area. Also, the occurrence of a CRDA activates the emergency level, which further alerts the non-essential plant personnel to evacuate protected area immediately in a safe manner (Ref. 9.19, Sections 3.0 & 4.0). No credit is taken for the chemist securing the sampling process. Instead, it is assumed that the purging of the RW sample line continues for 60 minutes until the sample valves are closed by a Control Room operator. This assumption, combined with a nominal flowrate, provide a conservative total release.

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Sample purge rate = 500 ml/min = 500 cc/min (Ref. 9.10, Section 8.5.6)

Total RW released during 1 hr purging before the sample valves are closed

= 60 minutes x 500 cc/min = 30,000 cc

Total RW release during sampling

= 30,000 cc x $(1000\ cc/liter)^{-1}$ x $(3.785\ liter/gallon)^{-1}$ x $(7.481\ gallon/ft^3)^{-1}$ = $1.06\ ft^3$

Therefore, a maximum volume of $1.06\ ft^3$ of reactor water is expected to be released during the sampling process. The post CRDA activity listed in Table 3 is postulated to be directly released to the environment via the reactor building vent stack (Ref. 9.15) without being filtered by any charcoal filter.

2.2 CRDA Source Term

The post-CRDA reactor coolant (RC) isotopic activity is calculated in Tables 1 & 2 using the design input information from Reference 9.12 including the uprated core inventory, peaking factor, number of

fuel rods damaged during the CRDA, fission product release fractions from the damaged and melted fuel, and gap release fractions.

Consistent with RG 1.183 (Ref. 9.1, Appendix C, Sections 3.3 and 3.4), the CRDA gap activity transport from the damaged fuel through the turbine and to the condense consists of iodine, noble gases, and alkali metals (cesium and rubidium).

The post-CRDA RC activity is distributed over the total RC volume to calculate the RC activity concentration (Ci/ft^3) in Table 3, which is multiplied by the released reactor water (RW) volume of 0.265 ft^3 (Section 2.1) to calculate the post-CRDA isotopic activity in the RW sample (Table 3).

Since the temperature of the RW liquid exceeds 212°F, the fraction of iodine and alkali metals in the RW liquid that become airborne is assumed equal to the fraction of the leakage that flashes to vapor. All of the noble gas in the RW liquid is assumed to become airborne.

The RADTRAD Nuclide Inventory File (NIF) PBCRDASMP_def.txt (Table 3) is created to be used with the post-CRDA RW sample release.

2.3 RADTRAD Release Models

This analysis uses Version 3.03 of the RADTRAD computer code to calculate the post-CRDA radiological consequences from the RW sample release. The RADTRAD code was developed by Sandia National Laboratories, the NRC's technical contractor, for the staff to use in establishing fission product transport and removal models and in estimating radiological doses at selected receptors at nuclear power plants. The RADTRAD3.03 code is documented in NUREG/CR-6604 (Ref. 9.2) and maintained as Exelon Software ID Number EX0004754 (Ref. 9.11).

The post-CRDA activity from the RW sample is postulated to directly release to the environment at the ground level release as shown in Figure 1 from the reactor building vent stack (Reference 9.15). The χ/Qs for these release paths are listed in Design Input sections 5.3.3.7 (CR) and 5.3.4 (offsite locations).

The Control Room Emergency Ventilation (CREV) system is not credited in the analysis. The CR is assumed to operate in a normal mode of operation with a maximum HVAC inflow rate of 20,600 cfm (Design Input section 5.3.3.2) plus an additional unfiltered inleakage of 500 cfm for the entire duration of the accident. The resulting doses at the EAB, LPZ, and CR locations are compared with the dose acceptance criteria in Section 8.0.

The RADTRAD V3.03 (References 9.2 & 9.11) nuclide inventory file (NIF) PBCRDASMP_def.txt is developed using the post-CRDA activity in curies released to the environment from the RW sample (Table 3); therefore, the thermal power level is set to unity in the RADTRAD input. The release fraction and timing file (pbcrda_rft.txt) is used to postulate an instantaneous post-CRDA release. The RADTRAD V3.03 dose conversion factor (DCF) File (pbcrda_fg11&12.txt) is based on DCFs obtained from References 9.7 & 9.8. The NIF and DCF files are modified to include additional significant radionuclides. The EAB, LPZ, and CR doses from RADTRAD output file PCRDASMP00.o0 are listed in Section 8.1.

2.4 Post-CRDA Sample Line Dose Rate

The size of the sample line is bounded by a stainless steel Schedule 80S 3/4" diameter pipe per M-326 sheets 2 and 10 (Ref. 9.24). The piping data for 3/4" Schedule 80S for RW sample line is obtained from Reference 9.14 (see Design Input 5.3.2.6). The MicroShield model is developed for a dose receptor 1 foot away from the midpoint of a 20 feet long RW sample line having the nominal inside diameter of 0.742" with nominal wall thickness of 0.154" and nominal outside diameter of 1.05". Due to

self-shielding and distance, the dose contribution is negligible from the ends of the small diameter RW sample line (i.e., at or further away than 10 feet).

The post-CRDA isotopic activities in the RW sample line are determined in Table 4 using the RW sample line volume and the post-CRDA contact dose rate was determined at one foot from the surface of the RW sample line to be 27.250 rem/hr (MicroShield Run PBRWSAMP.MS5), which exceeds allowable dose rate limit of < 0.5 mRem/hr. This means that the dose rate in the sample room would immediately exceed the local area radiation monitor setpoint, and the resulting radiation monitor alarm would alert ~~the chemist to secure the sampling process in a safe condition and evacuate the area immediately. However, no credit is taken for the chemist securing the sampling process.~~ personnel to evacuate the area immediately. No credit is taken for the chemist securing the sampling process prior to evacuating. AEH 7/15/14

3.0 ACCEPTANCE CRITERIA

Two acceptance criteria sets apply to the Post-CRDA release from the RCS sample line. The first acceptance criteria are the following NRC regulatory requirement and guidance documents which are applicable to a PBAPS CRDA analysis:

- RG 1.183 (Ref. 9.1, Table 6)
- 10CFR50.67 (Ref. 9.4)
- Standard Review Plan section 15.0.1 (Ref. 9.23)

Dose Acceptance Criteria are:

CRDA Regulatory Dose Limits

Dose Type	Control Room (rem TEDE)	EAB and LPZ (rem TEDE)
TEDE Dose	5	6.3

4.0 ASSUMPTIONS

Assumptions for Evaluating the Radiological Consequences of a Control Rod Drop Accident (CRDA)

The analysis in this calculation complies with the line-by-line requirements in Regulatory Guide 1.183 including its Appendix C (Ref. 9.1). The assumptions in Reference 9.12, Section 4.0 are applicable to analysis in this calculation with the following additional assumption:

4.1 It is assumed that the purging of the RW sample line continues for 60 minutes until the sample valves are closed by a Control Room operator.

5.0 DESIGN INPUTS

5.1 General Considerations

5.1.1 Applicability of Prior Licensing Basis

The PBAPS current licensing basis (CLB) for the CRDA event is AST methodology per Amendments 269 and 273 (Ref. 9.9) based on Regulatory Guide 1.183 guidance. The analysis in this calculation uses the CLB AST guidance in Regulatory Guide 1.183, Appendix C (Ref. 9.1).

5.1.2 Credit for Engineered Safety Features

Credit is taken only for accident mitigation features that are classified as safety-related, are required to be operable by technical specifications, are powered by emergency power sources, and are either automatically actuated or, in limited cases, have actuation requirements explicitly addressed in emergency operating procedures. The safety-related CR emergency ventilation system is not credited for dose mitigation.

5.1.3 Assignment of Numeric Input Values

The numeric values that are chosen as inputs to the analyses required by 10 CFR 50.67 (Ref. 9.4) are compatible to AST and TEDE dose criteria and selected with the objective of producing conservative radiological consequences. As a conservative alternative, the limiting value applicable to each portion of the analysis is used in the evaluation of that portion.

5.1.4 Meteorology Considerations

The ground-level control room atmospheric dispersion factors (χ/Qs) for the Reactor Building vent stack release point were previously developed using the PBAPS plant specific meteorology and appropriate regulatory guidance, including the NRC sponsored computer code ARCON96 (Ref. 9.5, Table 5-1). The control room χ/Qs were accepted by the NRC staff in previous licensing proceedings (Ref. 9.9, Table 3-1).

The ground-level EAB and LPZ χ/Qs were previously developed using the PBAPS plant specific meteorology and appropriate regulatory guidance (Ref. 9.5, Table 5-1). The off-site χ/Qs were accepted by the NRC staff in previous licensing proceedings (Ref. 9.9, Tables 3-2 and 3-3).

5.2 Accident-Specific Design Inputs/Assumptions

The design inputs/assumptions utilized in the EAB, LPZ, and CR habitability analyses are listed in the following sections. The design inputs are compatible with the AST and TEDE dose criteria. Assumptions are consistent with those identified in Appendix C of RG 1.183 (Ref. 9.1). The design inputs and assumptions in the following sections represent the as-built design of the plant.

Design Input Parameter	Value Assigned	Reference
5.3 CRDA Parameters		
5.3.1 Source Term		
5.3.1.1 Rated power level	3,293 MW_t (Original) 3,951 MW_t (LPU) 4,030 MWt used in analysis (Includes 2% uncertainty)	9.3, Section 1.1 Item #4, and Section 3.2.1 Item #1

5.3.1.2 Isotopic Core Inventory In Ci/MWt at 4,030 MWt				9.3, Appendix B	
Isotope	**Activity**	**Isotope**	**Activity**	**Isotope**	**Activity**
KR-83M	3.848E+03	I-134	6.179E+04	RB-86	6.473E+01
KR-85	3.658E+02	I-135	5.198E+04	RB-88	2.408E+04
KR-85M	8.555E+03	XE-131M	3.024E+02	CS-134	6.832E+03
KR-87	1.686E+04	XE-133	5.488E+04	CS-136	1.933E+03
KR-88	2.379E+04	XE-133M	1.714E+03	CS-137	4.118E+03
I-131	2.704E+04	XE-135	2.140E+04	CS-138	5.270E+04
I-132	3.901E+04	XE-135M	1.081E+04		
I-133	5.564E+04	XE-138	4.815E+04		

5.3.1.3 Radionuclide Composition		
Group	**Elements**	9.1, Section 3.4, Table 5
Noble gases	Xe, Kr	
Halogens	I, Br	
Alkali metals	Cs, Rb	
5.3.1.4 Number of fuel rods in fuel assembly	85.6	9.12, Section 5.3.1.4
5.3.1.5 Damaged fuel rods: Breached Fuel Rods Melted Fuel Rods	 1200 5.0% of the breached fuel rods melted	 9.12, Section 5.3.1.5 Conservative bounding value
5.3.1.6 Number of fuel assemblies in core	764	9.12, Section 5.3.1.6
5.3.1.7 Radial peaking factor	1.70	9.12, Section 5.3.1.10
5.3.1.8 Sample purge rate	500 cc/min	9.10, Section 8.5.6
5.3.1.9 Chemical form of iodine available for release to environment		
Elemental	97%	9.1, Appendix C, Section 3.6
Organic	3%	
5.3.2 Activity Transport (see Figure 1)		
5.3.2.1 RW sample release rate	0.084 cfm	Section 7.1
5.3.2.2 Duration of RW sample release	1 hour (= 60 minutes)	Section 2.1
5.3.2.3 Reactor Building Vent Stack leak to the atmosphere	Ground level release	9.1, Appendix C, Section 3.4
5.3.2.4 Reactor coolant volumes: RPV liquid volume RPV attached Piping volume	 11,790 ft^3 4,142 ft^3	9.16, Table 2.6-2

Design Input Parameter	Value Assigned	Reference
5.3.2.5 Reactor coolant temperature (Overpressure protection)	532.7^{0}F	9.16, Figure 1-3
5.3.2.6 RW sample line data Nominal Outside Diameter Nominal Inside Diameter Wall thickness	Schedule 80S 3/4-inch diameter 1.05" 0.742" 0.154"	9.14, Page 44
5.3.2.7 Sample Sink Radiation Zone designation Maximum allowable dose rate	 I ≤ 0.5 mRem/hr	 9.20.2 9.20.1
5.3.2.8 RW sample volume	0.265 ft^3	Section 2.1
5.3.2.9 RW sample activity release rate	0.0814 cfm	Section 7.1
5.3.2.10 Reactor coolant volume	15,932 ft^3	Section 7.2
5.3.2.11 RW Iodine and Alkali Metals flashing factor	0.40	Section 7.3
5.3.2.12 RW sample density	0.754 g/cc	Section 7.3
5.3.2.13 RW activity release point	Reactor Building Vent Stack	9.15
5.3.3 Control Room Parameters (see Figure 2)		
5.3.3.1 CR volume	176,000 ft^3	9.17, Attachment 2, page 4
5.3.3.2 CR maximum air inflow rate during CRDA	20,600 cfm + 500 cfm inleakage 21,100 cfm	9.13 Assumed in Item 5.3.3.4 used in the analysis
5.3.3.3 CR charcoal iodine & HEPA particulate filter efficiencies	0% removal	Not credited in this analysis
5.3.3.4 CR Unfiltered Inleakage	500 cfm	Assumed
5.3.3.5 CR occupancy factors		
Time (Hr)	**%**	9.1, Section 4.2.6
0-24	100	
24-96	60	
96-720	40	
5.3.3.6 CR breathing rate	3.5E-04 m^3/sec	9.1, Section 4.2.6
5.3.3.7 CR atmospheric dispersion factors for Reactor Building Vent Stack ground level release (X/Qs)		
Time (Hr)	**X/Q (sec/m^3)**	9.5, Table 5-1
0-2	1.18E-03	
2-8	9.08E-04	
8-24	4.14E-04	
24-96	2.90E-04	
96-720	2.26E-04	
5.3.4 Site Boundary Release Model Parameters		
5.3.4.1 EAB atmospheric dispersion factor for ground level release (χ/Q)	9.11E-04 sec/m^3	9.5, Table 5-1

Design Input Parameter	Value Assigned	Reference
5.3.4.2 LPZ Atmospheric dispersion factors for ground level release (X/Qs)		
Time (Hr)	**X/Q (sec/m^3)**	9.5, Table 5-1
0-2	1.38E-04	
2-8	5.81E-05	
8-24	3.77E-05	
24-96	1.48E-05	
96-720	4.15E-06	
5.3.4.3 EAB breathing rate	3.5E-04 m^3/sec	9.1, Section 4.1.6
5.3.4.4 LPZ breathing rates		
Time (Hr)	**(m^3/sec)**	9.1, Section 4.1.6
0-8	3.5E-04	
8-24	1.8E-04	
24-720	2.3E-04	

6.0 COMPUTER CODES & REGULATORY COMPLIANCE

6.1 Computer Codes

All computer codes used in this calculation have been approved for use with appropriate Verification and Validation (V&V) documentation. Computer codes used in this analysis include:

- **RADTRAD 3.03** (Ref. 9.2): This is an NRC-sponsored code approved for use in determining control room and offsite doses from releases due to reactor accidents. This code was used by most of the AST license amendments that have been approved by the NRC. A rigorous high quality code qualification process was adopted to develop and procure the code by testing of the program elements, verification of input/output files, and examination of design specification. Therefore, the RADTRAD3.03 computer code is considered to be qualified to comply with the quality assurance requirements of 10 CFR50, Appendix B and it can be safely used to perform the design basis accident analyses. This code was used by EXELON in various AST license amendments, which are approved by the NRC. Therefore, the code is considered validated to be used for the PBAPS AST analysis.

  The Exelon V&V of the RADTRAD3.03 code is documented as DTSQA Number EX0004754 and is classified as SQA Level AA per IT-AA-101 (Ref. 9.11).

- **MicroShield 5.05** (Ref. 9.21): A commercially available and accepted code used to determine dose rates at various source-receptor combinations. Several runs were made at various times during the LOCA since the source strength varies over time.

  The Exelon V&V of the MicroShield 5.05 code is documented as DTSQA Number EX0001136 (Ref. 9.22).

6.2 Regulatory Compliance

As discussed in Section 4.0, Assumptions, the analysis in this calculation complies with the line-by-line requirements in Regulatory Guide 1.183 including its Appendix C (Ref. 9.1).

7.0 CALCULATIONS

7.1 Reactor Water Sample Activity Release Rate

$A / A_0 = \exp[-\lambda t]$
Where:
A_0 = Initial Activity in RW Sample
A = Final Activity in RW Sample
λ = Removal Rate (volume/hr)
t = Removal Time (hr)
Assuming that 99% of the reactor coolant activity within a reactor water sample volume of 1.06 ft^3 is released to the main condenser within 1 hour (per Section 2.1):
$A / A_0 = 0.01 = \exp[-\lambda t]$

Therefore,
$\ln (0.01) = -\lambda t$
$-4.605 = -\lambda \times 1$ hr
$\lambda = (4.605) / 1$ hr = 4.065 volume/hr = 4.605 x (1.06 ft^3 / hr) / 60 min/hr = 0.0814 cfm

7.2 Total Reactor Coolant Volume

Reactor coolant volume in Reactor Pressure Vessel (RPV) = 11,790 ft^3 (Ref. 9.16, Table 2.6-2)

Reactor coolant volume in RPV attached piping = 4,142 ft^3 (Ref. 9.16, Table 2.6-2)

Total reactor coolant volume = 11,790 ft^3 + 4,142 ft^3 = 15,932 ft^3 used in Table 3

7.3 Post-CRDA Airborne Mass of RW Sample

Reactor Vessel dome temperature = 532.7^0 F (Section 5.3.2.5)
The non-safety related sample chillers are not assumed to function after a CRDA, and therefore, the RW liquid is conservatively assumed to be the same as the vessel dome temperature, 532.7^{0}F, which results in a considerably large amount iodine that becomes airborne from the RW sample.

Since the temperature of the RW liquid exceeds 212°F, the fraction of iodine and alkali metals in the RW liquid that becomes airborne is assumed equal to the fraction of the leakage that flashes to vapor. The flashing fraction (FF) is calculated using the constant enthalpy method (Ref. 9.1, Appendix A, Section 5.4) as follows:

$FF = (h - h_{liquid}) / (h_{steam} - h_{liquid})$

Where: h is the enthalpy of the RW liquid at system design temperature and pressure
h_{liquid} is the enthalpy of water at saturation conditions (14.7 psia, 212°F)
h_{steam} is the enthalpy of steam at saturation conditions (14.7 psia, 212°F)

RW Liquid enthalpy of @ 532.7^0 F = 527.63 BTU/lb (Ref. 9.18, page 182)

Saturated Steam enthalpy @ 14.7 psia and 212^0 F = 1150.5 BTU/lb (Ref. 9.18, page 184)
Saturated Water enthalpy @ 14.7 psia and 212^0 F = 180.17 BTU/lb (Ref. 9.18, page 184)

Substituting,
FF = (527.63 - 180.17) / (1150.5 – 180.17) = 0.358
For conservatism, a value of 0.40 or 40% is used in Table 3.

RW Liquid specific volume = 0.021251 ft^3/lb
RW Liquid density = 1 / RW Liquid specific volume = $(0.021251\ ft^3/lb)^{-1}$
= 47.057 lb/ft^3 x (453.6 gm/lb) x $(30.48\ cm/ft)^{-3}$ = 0.754 g/cc

7.4 Sample Volume in RW Sample Line

3/4" RW Sample Pipe Nominal Outside Diameter (OD) = 1.05" (Ref. 9.14, Page 44)
3/4" RW Sample Pipe Inside Diameter (ID) = 0.742" (Ref. 9.14, Page 44)

Volume of Sample in a 20 feet long sample line
= $\pi/4$ x ID^2 x 20 ft = $\pi/4$ x $(0.742/12\ ft/inch)^2$ x 20 ft = 0.06 ft^3

8.0 RESULTS SUMMARY & CONCLUSIONS

Results Summary:

8.1 The resulting doses from the post-CRDA RW sample line release are summarized in the following table:

Post-CRDA Activity Release Path	Post-CRDA TEDE Dose (Rem) Receptor Location		
	Control Room	EAB	LPZ
Design Basis CRDA (1)	1.77	2.04	0.35
RW Sample Release	0.290	0.286	0.043
Total Dose	2.06E+00	2.33E+00	3.93E-01
Allowable TEDE Limit	5.00E+00	6.30E+00	6.30E+00
	RADTRAD Computer Run No.		
RW Sample Release	PCRDASMP00.o0	PCRDASMP00.o0	PCRDASMP00.o0

(1) From Reference 9.12, Section 8.1 - Main & Gland Seal Condenser Leakage Case

8.2 The resulting post-CRDA whole body gamma dose rate in the sampling area is summarized in the following table.

Post-CRDA Activity in RW Sample Line Area	Dose Rate	
	Calculated Dose Rate mRem/hr	Allowable Dose Rate Limit mRem/hr
Whole Body Gamma Dose Rate at 1 foot from RW sample line	27250	$\leq$ 2.5

8.3 Conclusions:

The comparison of resulting doses with the licensing basis CRDA doses in Section 8.1 indicates that the post-CRDA EAB, LPZ, and CR doses due to a reactor water sample line release are a fraction (less than 20 percent) of the CRDA doses for the most conservative case of continuous purging of RW sample line for 1 hour.

The analysis result presented in Section 8.2 indicates that the post-CRDA contact dose rate of the RW sample line in the sampling area is expected to instantly exceed the radiation zone allowable dose rate limit, and the resulting radiation monitor alarm would alert the chemist to secure the sampling process in a safe condition and evacuate the area immediately.

A Control Room operator action item to close the RW sample valves following a CRDA should be captured in the CRDA "Emergency Operation Instructions (EOIs)."

9.0 REFERENCES

1. U.S. NRC Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors", July 2000
2. S.L. Humphreys et al., NUREG/CR-6604 (including Supplements 1 and 2), "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation," (originally published December 1997; Supplement 1 dated June 8, 1999, and Supplement 2 dated October 2002).
3. PEAM-EPU-63; GEH Project Task Report 0000-0117-7472-R2 (DRF 0000-0105-2456 Revision 2) for Peach Bottom Atomic Power Station Units 2 and 3; Extended Power Uprate Task T0802, Revision 2, "Core Source Term", January 2011
4. 10 CFR 50.67, "Accident Source Term."
5. PBAPS Calculation PM-1055, Revision 1, "Calculation of Alternative Source Term (AST) Onsite and Offsite X/Q Values".
6. General Electric (GE) document NEDO-31400A, October 1992, "Safety Evaluation for Eliminating The Boiling Water Reactor Main Steam Isolation Valve Closure Function and Scram Function of The Main Steam Line Radiation Monitor."
7. Federal Guidance Report 11, EPA-520/1-88-020, Environmental Protection Agency.
8. Federal Guidance Report 12, EPA-402-R-93-081, Environmental Protection Agency.
9. Peach Bottom Atomic Power Station Amendment Nos. 269 and 273 to Renewed Facility Operating License Nos. DPR-44 and DPR-56 for the Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. RE: Application Of Alternative Source Term Methodology; September 5, 2008 (ADAMS Accession Number ML082320406).
10. PBAPS Chemistry Procedure No. CH-407, Revision 8, "Sampling of Reactor Water."
11. Exelon DTSQA Number EX0004754 for RADTRAD V&V Version 3.03.
12. PBAPS Calculation PM-1057, Revision 5, "EAB, LPZ, and CR Doses due to Control Rod Drop Accident (CRDA) (Task T0901)."
13. PBAPS Drawing 6280-M-884, Sheet 2, "QAD Diagram Control Room HVAC", Revision 2.
14. PBAPS Specification No. M-00300, Revision 18, "Specification for Piping Materials, Instrument Piping Standards, and Valve Classifications for PBAPS Units 2 & 3."
15. PBAPS P&I Diagram No. M-388, Revision 35, "Reactor Building Ventilation Flow Diagram."
16. NEDO-33566, Revision 0, " Safety Analysis Report for EXELON Peach Bottom Atomic Power Station Units 2 & 3 Constant Pressure Power Uprate."
17. Bechtel Letter No. BLP 22066, 05/18/1982, "Design Review of Plant Shielding."
18. ASME Steam Tables, Sixth Edition.
19. EXELON Procedure No. GP-15, Revision 7, "Local Evacuation."
20. PBAPS UFSAR
    - 20.1 UFSAR Section 12.3.3, Revision 17, "Radiation Zoning and Access Control"
    - 20.2 UFSAR Figure 12.3.4, Revision 12, "RADIATION ZONES – UNITS 2 AND 3; EL 165FT 0 IN (IN OPERATION)"
21. MicroShield Computer Code, V&V Version 5.05, Grove Engineering.

22. Exelon DTSQA Number EX0001136 for MicroShield V&V Version 5.05

23. NUREG-0800, Standard Review Plan, "Radiological Consequence Analyses Using Alternative Source Terms," SRP 15.0.1, Revision 0, July 2000.

24. P&ID Diagrams:

    24.1 6280-M-326, Sheet 2, Revision 37, "Process Sampling."

    24.2 6280-M-326, Sheet 10, Revision 52, "Process Sampling."

10.0 TABLES

Table 1
Post-CRDA Activity In Damaged Fuel Rods

Isotope	Core Isotopic Inventory (Ci/MWt) A	Core Thermal Power Level (MWt) B	Radial Peaking Factor C	Average Number of Fuel Rods Per Bundle D	Total Number of Fuel Rods In Core E=D*764	Number of Damaged Fuel Rods By CRDA F	Total Peak Core Activity In Damaged Fuel Rods (Ci) G=(A*B*C*F)/E
I-131	2.704E+04	4030	1.7	85.6	65398	1200	3.399E+06
I-132	3.901E+04	4030	1.7	85.6	65398	1200	4.904E+06
I-133	5.564E+04	4030	1.7	85.6	65398	1200	6.994E+06
I-134	6.179E+04	4030	1.7	85.6	65398	1200	7.768E+06
I-135	5.198E+04	4030	1.7	85.6	65398	1200	6.534E+06
KR-83M	3.848E+03	4030	1.7	85.6	65398	1200	4.837E+05
KR- 85	3.658E+02	4030	1.7	85.6	65398	1200	4.598E+04
KR- 85M	8.555E+03	4030	1.7	85.6	65398	1200	1.075E+06
KR- 87	1.686E+04	4030	1.7	85.6	65398	1200	2.119E+06
KR-88	2.379E+04	4030	1.7	85.6	65398	1200	2.991E+06
XE131M	3.024E+02	4030	1.7	85.6	65398	1200	3.801E+04
XE-133	5.488E+04	4030	1.7	85.6	65398	1200	6.899E+06
XE-133M	1.714E+03	4030	1.7	85.6	65398	1200	2.155E+05
XE-135	2.140E+04	4030	1.7	85.6	65398	1200	2.690E+06
XE-135M	1.081E+04	4030	1.7	85.6	65398	1200	1.359E+06
XE-138	4.815E+04	4030	1.7	85.6	65398	1200	6.053E+06
RB-86	6.473E+01	4030	1.7	85.6	65398	1200	8.137E+03
RB-88	2.408E+04	4030	1.7	85.6	65398	1200	3.027E+06
CS-134	6.832E+03	4030	1.7	85.6	65398	1200	8.588E+05
CS-136	1.933E+03	4030	1.7	85.6	65398	1200	2.430E+05
CS-137	4.118E+03	4030	1.7	85.6	65398	1200	5.177E+05
CS-138	5.270E+04	4030	1.7	85.6	65398	1200	6.625E+06

A From Reference 9.3, Appendix B
B From Reference 9.12, Section 5.3.1.1
C From Reference 9.12, Section 5.3.1.10
D From Reference 9.12, Section 5.3.1.4
E From Reference 9.12, Section 5.3.1.6
F From Reference 9.12, Section 5.3.1.5

Table 2

Total CRDA Activity Released To Reactor Water

Isotope	Total Peak Core Activity In Damaged Fuel Rods (Ci) A	Gap Activity Release Fraction From Damaged Fuel Rods (Ci) B	Total Gap Activity Released To Reactor Water (Ci) C = A x B	Reactor Coolant Volume (ft^3) D	Post-CRDA Reactor Coolant Concentration (Ci/ft^3) E = C / D
I-131	3.399E+06	0.1200	4.079E+05	1.5932E+04	2.560E+01
I-132	4.904E+06	0.1200	5.885E+05		3.694E+01
I-133	6.994E+06	0.1200	8.393E+05		5.268E+01
I-134	7.768E+06	0.1200	9.321E+05		5.851E+01
I-135	6.534E+06	0.1200	7.841E+05		4.922E+01
KR-83M	4.837E+05	0.1450	7.014E+04		4.403E+00
KR- 85	4.598E+04	0.1450	6.668E+03		4.185E-01
KR- 85M	1.075E+06	0.1450	1.559E+05		9.788E+00
KR- 87	2.119E+06	0.1450	3.073E+05		1.929E+01
KR-88	2.991E+06	0.1450	4.336E+05		2.722E+01
XE131M	3.801E+04	0.1450	5.512E+03		3.460E-01
XE-133	6.899E+06	0.1450	1.000E+06		6.279E+01
XE-133M	2.155E+05	0.1450	3.124E+04		1.961E+00
XE-135	2.690E+06	0.1450	3.901E+05		2.448E+01
XE-135M	1.359E+06	0.1450	1.970E+05		1.237E+01
XE-138	6.053E+06	0.1450	8.777E+05		5.509E+01
RB-86	8.137E+03	0.1265	1.029E+03		6.461E-02
RB-88	3.027E+06	0.1265	3.829E+05		2.404E+01
CS-134	8.588E+05	0.1265	1.086E+05		6.819E+00
CS-136	2.430E+05	0.1265	3.074E+04		1.929E+00
CS-137	5.177E+05	0.1265	6.549E+04		4.110E+00
CS-138	6.625E+06	0.1265	8.380E+05		5.260E+01

A From Table 1

B From Reference 9.12, Section 7.1

D From Section 7.2

Table 3
Post-CRDA Reactor Water Sample Activity

Isotope	Post-CRDA Reactor Coolant Concentration (Ci/ft^3) A	Reactor Water Sample Volume (ft^3) B	Flashing Fraction C	Post-CRDA Reactor Water Sample	
				Activity (Ci) D = A x B	Activity Available For Release (Ci) E = C x D
I-131	2.560E+01	1.06	0.40	2.714E+01	1.086E+01
I-132	3.694E+01		0.40	3.915E+01	1.566E+01
I-133	5.268E+01		0.40	5.584E+01	2.234E+01
I-134	5.851E+01		0.40	6.202E+01	2.481E+01
I-135	4.922E+01		0.40	5.217E+01	2.087E+01
KR-83M	4.403E+00		1.00	4.667E+00	4.667E+00
KR- 85	4.185E-01		1.00	4.436E-01	4.436E-01
KR- 85M	9.788E+00		1.00	1.038E+01	1.038E+01
KR- 87	1.929E+01		1.00	2.045E+01	2.045E+01
KR-88	2.722E+01		1.00	2.885E+01	2.885E+01
XE131M	3.460E-01		1.00	3.667E-01	3.667E-01
XE-133	6.279E+01		1.00	6.656E+01	6.656E+01
XE-133M	1.961E+00		1.00	2.079E+00	2.079E+00
XE-135	2.448E+01		1.00	2.595E+01	2.595E+01
XE-135M	1.237E+01		1.00	1.311E+01	1.311E+01
XE-138	5.509E+01		1.00	5.839E+01	5.839E+01
RB-86	6.461E-02		0.40	6.849E-02	2.739E-02
RB-88	2.404E+01		0.40	2.548E+01	1.019E+01
CS-134	6.819E+00		0.40	7.228E+00	2.891E+00
CS-136	1.929E+00		0.40	2.045E+00	8.181E-01
CS-137	4.110E+00		0.40	4.357E+00	1.743E+00
CS-138	5.260E+01		0.40	5.576E+01	2.230E+01

A From Table 2
B From Section 2.1
C = 40% of Iodine & Alkali Metal Activity From RW Sample Becomes (Flashes) Airborne - Section 7.3
C = 100% of NG Activity From RW Sample Becomes (Flashes) Airborne - Section 7.3

Table 4

Post-CRDA Activity in RW Sample Line (20 foot pipe length)

Isotope	Post-CRDA Reactor Coolant Concentration (Ci/ft^3) A	Reactor Water Sample Line Volume (ft^3) B	Post-CRDA Reactor Water Sample Line Activity (Ci) C = A x B
I-131	2.560E+01	0.060	1.536E+00
I-132	3.694E+01		2.216E+00
I-133	5.268E+01		3.161E+00
I-134	5.851E+01		3.510E+00
I-135	4.922E+01		2.953E+00
KR-83M	4.403E+00		2.642E-01
KR- 85	4.185E-01		2.511E-02
KR- 85M	9.788E+00		5.873E-01
KR- 87	1.929E+01		1.157E+00
KR-88	2.722E+01		1.633E+00
XE131M	3.460E-01		2.076E-02
XE-133	6.279E+01		3.767E+00
XE-133M	1.961E+00		1.177E-01
XE-135	2.448E+01		1.469E+00
XE-135M	1.237E+01		7.421E-01
XE-138	5.509E+01		3.305E+00
RB-86	6.461E-02		3.877E-03
RB-88	2.404E+01		1.442E+00
CS-134	6.819E+00		4.092E-01
CS-136	1.929E+00		1.158E-01
CS-137	4.110E+00		2.466E-01
CS-138	5.260E+01		3.156E+00

A From Table 2

B From Section 7.4

11.0 FIGURES

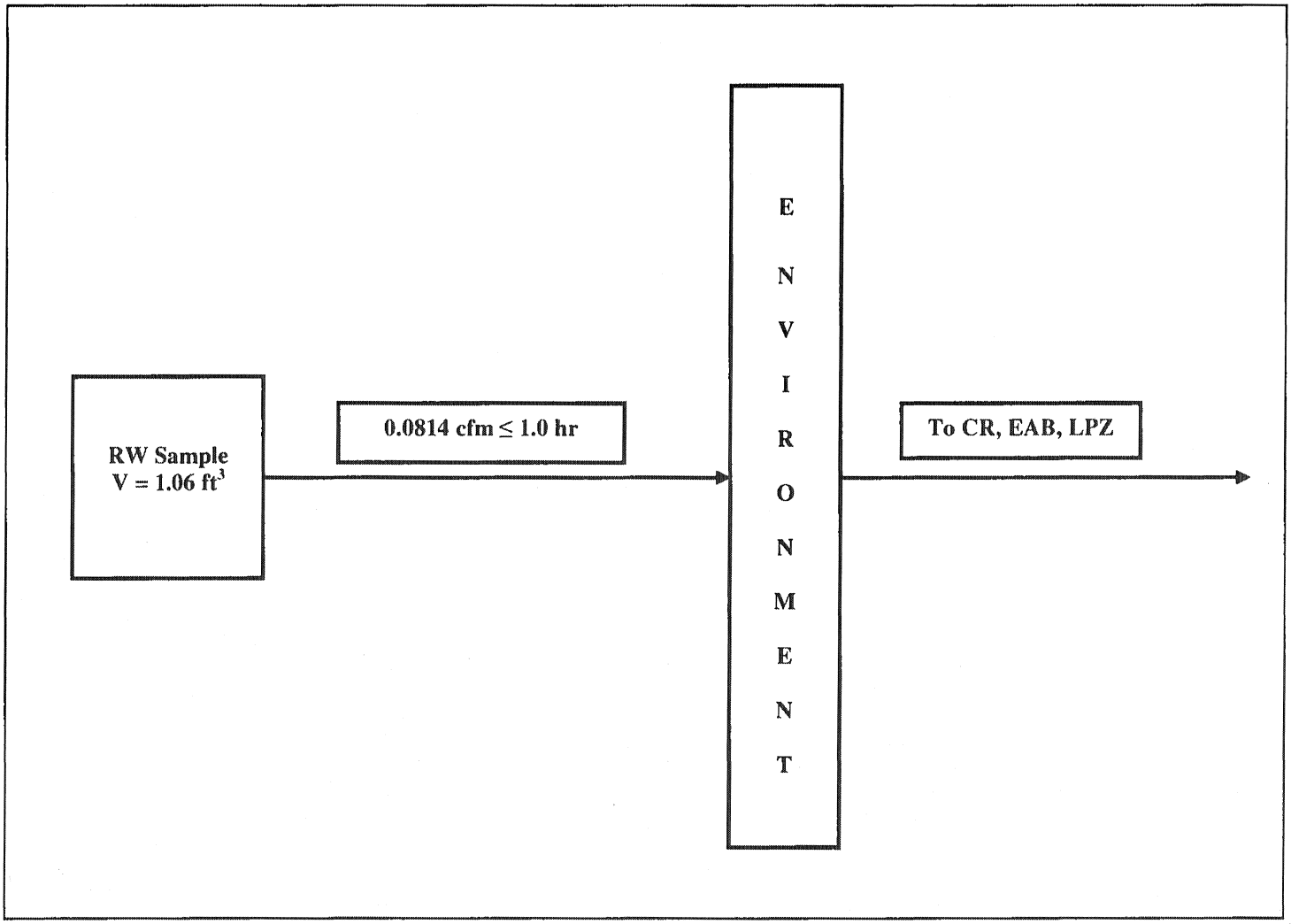

Figure 1: Post-CRDA RW Sample Release

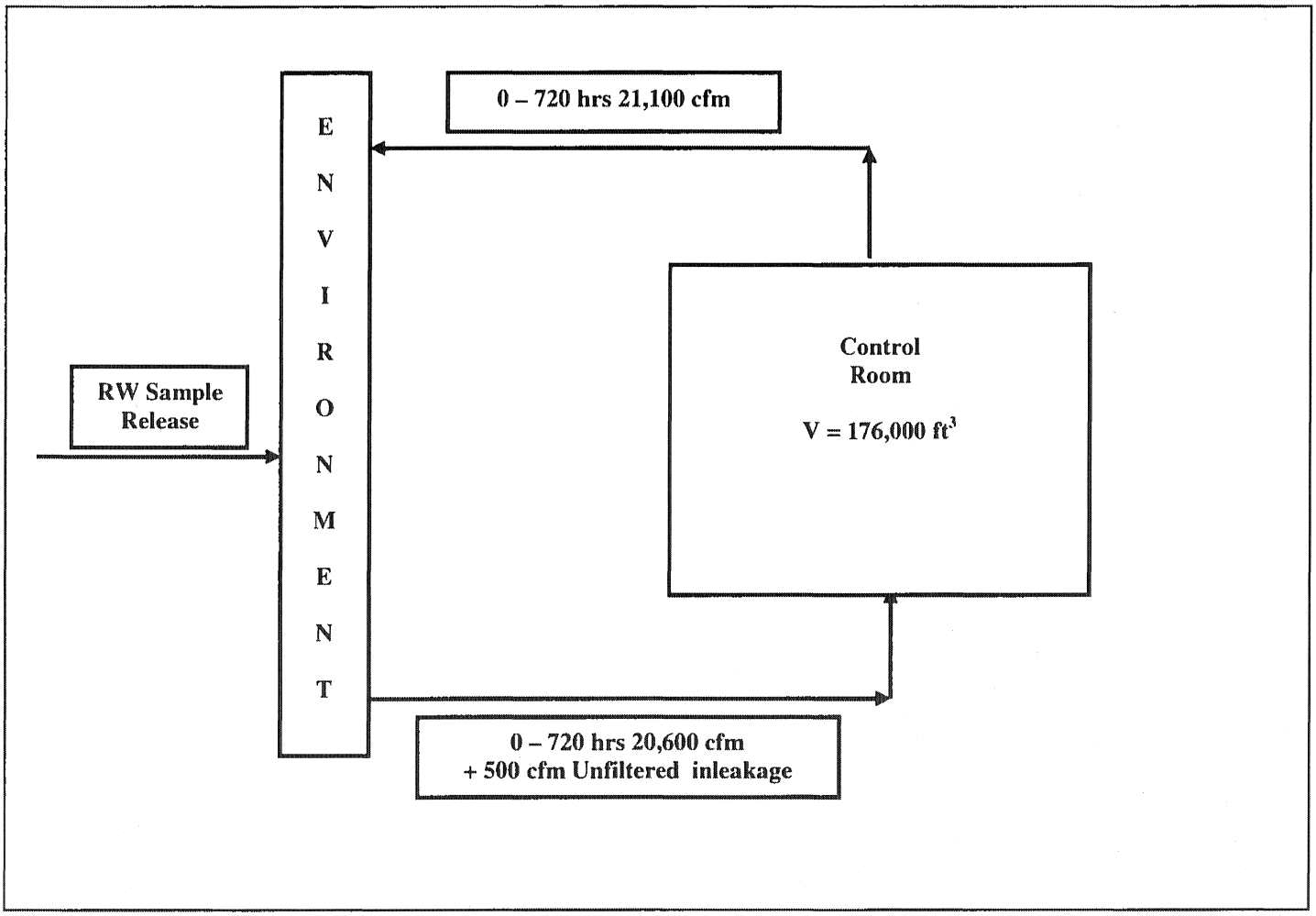

Figure 2 – PBAPS Control Room RADTRAD Nodalization

12.0 AFFECTED DOCUMENTS

The following documents will be either superseded or revised:

Document to be superseded

~~None~~ See ECR 13-00494

11/5/13 TEH

Documents to be revised:

~~None~~ See ECR 13-00494

13.0 ATTACHMENTS

13.1 RADTRAD Output File: PCRDASMP00.o0
13.2 MicroShield Output File: PBRWSAMP.MS5
13.3 RADTRAD Nuclide Inventory File: PBCRDASMP00_def.txt
13.4 RADTRAD Release Fraction and Timing File: pbcrda_rft.txt
13.5 RADTRAD Dose Conversion Factor File: pbcrda_fg11&12.txt

Attachment 13.1
RADTRAD Output File: PCRDASMP00.o0

```
##############################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  5/21/2014  at 18:11:52
 ##############################################################################

 ##############################################################################
                    File information
 ##############################################################################

 Plant file           = G:\Radtrad 3.03\Input\PM-1168\PCRDASMP00.psf
 Inventory file       = G:\Radtrad 3.03\Defaults\PBCRDASMP00_def.txt
 Release file         = g:\radtrad 3.03\defaults\pbcrda_rft.txt
 Dose Conversion file = g:\radtrad 3.03\defaults\pbcrda_fg11&12.txt




     #####    ####   #####    #  #     #  #####   #    #  #####
     #    #  #       #        #  ##    #  #    #  #    #    #
     #    #  #       #        #  # #   #  #    #  #    #    #
     #####    ####   ####     #  #  #  #  #####   #    #    #
     #            #  #        #  #   # #  #       #    #    #
     #            #  #        #  #    ##  #       #    #    #
     #        ####   #        #  #     #  #        ####     #


 Radtrad 3.03 4/15/2001
 PBAPS Post-CRDA EAB, LPZ, & CR Doses Due To Release from RW Sample With Iodine
Flashing Factor of 40% and Using Guidance in RG 1.183, Appendix C
 Nuclide Inventory File:
 G:\Radtrad 3.03\Defaults\PBCRDASMP00_def.txt
 Plant Power Level:
  1.0000E+00
 Compartments:
   3
 Compartment 1:
 RCS Sample
   3
  1.0600E+00
   0
   0
   0
   0
   0
 Compartment 2:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
   0
 Compartment 3:
```

```
Control Room
  1
 1.7600E+05
  0
  0
  0
  0
  0
Pathways:
  3
Pathway 1:
Environment to Control Room
  2
  3
  2
Pathway 2:
Control Room Exhaust to Environment
  3
  2
  2
Pathway 3:
RCS Sample to  Environment
  1
  2
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
g:\radtrad 3.03\defaults\pbcrda_fg11&12.txt
g:\radtrad 3.03\defaults\pbcrda_rft.txt
  0.0000E+00
  1
  0.0000E+00   9.7000E-01   3.0000E-02   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  3
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 2:
```

```
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   2.1100E+04   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   2.1100E+04   1.0000E+02   1.0000E+02   1.0000E+02
  7.2000E+02   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   8.1400E-02   0.0000E+00   0.0000E+00   0.0000E+00
  1.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
Exclusion Area Boundary
  2
  1
  2
  0.0000E+00   9.1100E-04
  7.2000E+02   0.0000E+00
  1
  2
  0.0000E+00   3.5000E-04
  7.2000E+02   0.0000E+00
  0
Location 2:
Low Population Zone
  2
  1
  6
  0.0000E+00   1.3800E-04
  2.0000E+00   5.8100E-05
  8.0000E+00   3.7700E-05
  2.4000E+01   1.4800E-05
  9.6000E+01   4.1500E-06
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   3.5000E-04
  8.0000E+00   1.8000E-04
  2.4000E+01   2.3000E-04
  7.2000E+02   0.0000E+00
  0
Location 3:
Control Room
  3
  0
  1
  2
  0.0000E+00   3.5000E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   1.0000E+00
  2.4000E+01   6.0000E-01
  9.6000E+01   4.0000E-01
  7.2000E+02   0.0000E+00
Effective Volume Location:
```

```
  1
  6
  0.0000E+00   1.1800E-03
  2.0000E+00   9.0800E-04
  8.0000E+00   4.1400E-04
  2.4000E+01   2.9000E-04
  9.6000E+01   2.2600E-04
  7.2000E+02   0.0000E+00
Simulation Parameters:
  6
  0.0000E+00   1.0000E-01
  2.0000E+00   5.0000E-01
  8.0000E+00   1.0000E+00
  2.4000E+01   2.0000E+00
  9.6000E+01   8.0000E+00
  7.2000E+02   0.0000E+00
Output Filename:
G:\Radtrad 3.o19
  1
  1
  1
  0
  0
End of Scenario File
```

```
##############################################################################
    RADTRAD Version 3.03 (Spring 2001) run on  5/21/2014  at 18:11:52
 ##############################################################################

 ##############################################################################
                     Plant Description
 ##############################################################################

 Number of Nuclides =  60

 Inventory Power =    1.0000E+00 MWth
 Plant Power Level =    1.0000E+00 MWth

 Number of compartments     =    3

 Compartment information

 Compartment number  1  (Source term fraction =    1.0000E+00
 )
 Name: RCS Sample
 Compartment volume =    1.0600E+00 (Cubic feet)
 Compartment type is Normal
 Pathways into and out of compartment  1
    Exit Pathway Number     3: RCS Sample to  Environment

 Compartment number  2
 Name: Environment
 Compartment type is Environment
 Pathways into and out of compartment  2
    Inlet Pathway Number    2: Control Room Exhaust to Environment
    Inlet Pathway Number    3: RCS Sample to  Environment
    Exit Pathway Number     1: Environment to Control Room

 Compartment number  3
 Name: Control Room
 Compartment volume =    1.7600E+05 (Cubic feet)
 Compartment type is Control Room
 Pathways into and out of compartment  3
    Inlet Pathway Number    1: Environment to Control Room
    Exit Pathway Number     2: Control Room Exhaust to Environment

 Total number of pathways =    3
```

```
##############################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  5/21/2014  at 18:11:52
##############################################################################

##############################################################################
                    Scenario Description
##############################################################################

Radioactive Decay is enabled
Calculation of Daughters is enabled
```

Release Fractions and Timings

	GAP	EARLY IN-VESSEL	LATE RELEASE	RELEASE MASS
	0.003600 hr	0.0000 hrs	0.0000 hrs	(gm)
NOBLES	1.0000E+00	0.0000E+00	0.0000E+00	1.510E-03
IODINE	1.0000E+00	0.0000E+00	0.0000E+00	1.157E-04
CESIUM	1.0000E+00	0.0000E+00	0.0000E+00	2.229E-02
TELLURIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
STRONTIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
BARIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
RUTHENIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
CERIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
LANTHANUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00

Inventory Power = 1. MWt

Nuclide Name	Group	Specific Inventory (Ci/MWt)	half life (s)	Whole Body DCF (Sv-m3/Bq-s)	Inhaled Thyroid (Sv/Bq)	Inhaled Effective (Sv/Bq)
Kr-83m	1	4.667E+00	6.588E+03	1.500E-18	0.000E+00	0.000E+00
Kr-85	1	4.436E-01	3.383E+08	1.190E-16	0.000E+00	0.000E+00
Kr-85m	1	1.038E+01	1.613E+04	7.480E-15	0.000E+00	0.000E+00
Kr-87	1	2.045E+01	4.578E+03	4.120E-14	0.000E+00	0.000E+00
Kr-88	1	2.885E+01	1.022E+04	1.020E-13	0.000E+00	0.000E+00
Rb-86	3	2.739E-02	1.612E+06	4.810E-15	1.330E-09	1.790E-09
Rb-88	3	1.019E+01	1.068E+03	3.360E-14	1.370E-12	2.260E-11
I-131	2	1.086E+01	6.947E+05	1.820E-14	2.920E-07	8.890E-09
I-132	2	1.566E+01	8.280E+03	1.120E-13	1.740E-09	1.030E-10
I-133	2	2.234E+01	7.488E+04	2.940E-14	4.860E-08	1.580E-09
I-134	2	2.481E+01	3.156E+03	1.300E-13	2.880E-10	3.550E-11
I-135	2	2.087E+01	2.380E+04	8.294E-14	8.460E-09	3.320E-10
Xe-131m	1	3.367E-01	1.028E+06	3.890E-16	0.000E+00	0.000E+00
Xe-133	1	6.656E+01	4.532E+05	1.560E-15	0.000E+00	0.000E+00
Xe-133m	1	2.079E+00	1.890E+05	1.370E-15	0.000E+00	0.000E+00
Xe-135	1	2.595E+01	3.272E+04	1.190E-14	0.000E+00	0.000E+00
Xe-135m	1	1.311E+01	9.174E+02	2.040E-14	0.000E+00	0.000E+00
Xe-138	1	5.839E+01	8.502E+02	5.770E-14	0.000E+00	0.000E+00
Cs-134	3	2.891E+00	6.507E+07	7.570E-14	1.110E-08	1.250E-08
Cs-136	3	8.181E-01	1.132E+06	1.060E-13	1.730E-09	1.980E-09
Cs-137	3	1.743E+00	9.467E+08	2.725E-14	7.930E-09	8.630E-09
Cs-138	3	2.230E+01	1.932E+03	1.210E-13	3.570E-12	2.740E-11

Nuclide	Daughter	Fraction	Daughter	Fraction	Daughter	Fraction
Kr-85m	Kr-85	0.21	none	0.00	none	0.00
Kr-87	Rb-87	1.00	none	0.00	none	0.00
Kr-88	Rb-88	1.00	none	0.00	none	0.00
I-131	Xe-131m	0.01	none	0.00	none	0.00

I-133	Xe-133m	0.03	Xe-133	0.97	none	0.00
I-135	Xe-135m	0.15	Xe-135	0.85	none	0.00
Xe-133m	Xe-133	1.00	none	0.00	none	0.00
Xe-135	Cs-135	1.00	none	0.00	none	0.00
Xe-135m	Xe-135	1.00	none	0.00	none	0.00
Xe-138	Cs-138	1.00	none	0.00	none	0.00
Cs-137	Ba-137m	0.95	none	0.00	none	0.00

Iodine fractions

Aerosol	=	0.0000E+00
Elemental	=	9.7000E-01
Organic	=	3.0000E-02

COMPARTMENT DATA

Compartment number 1: RCS Sample

Compartment number 2: Environment

Compartment number 3: Control Room

PATHWAY DATA

Pathway number 1: Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.1100E+04	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Control Room Exhaust to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.1100E+04	1.0000E+02	1.0000E+02	1.0000E+02
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 3: RCS Sample to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	8.1400E-02	0.0000E+00	0.0000E+00	0.0000E+00
1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

LOCATION DATA

Location Exclusion Area Boundary is in compartment 2

Location X/Q Data

Time (hr)	X/Q (s * m^-3)
0.0000E+00	9.1100E-04
7.2000E+02	0.0000E+00

```
Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  0.0000E+00                  3.5000E-04
  7.2000E+02                  0.0000E+00
Location Low Population Zone     is in compartment    2

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  0.0000E+00           1.3800E-04
  2.0000E+00           5.8100E-05
  8.0000E+00           3.7700E-05
  2.4000E+01           1.4800E-05
  9.6000E+01           4.1500E-06
  7.2000E+02           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  0.0000E+00                  3.5000E-04
  8.0000E+00                  1.8000E-04
  2.4000E+01                  2.3000E-04
  7.2000E+02                  0.0000E+00
Location Control Room     is in compartment    3

Location X/Q Data
 Time (hr)          X/Q (s * m^-3)
  0.0000E+00           1.1800E-03
  2.0000E+00           9.0800E-04
  8.0000E+00           4.1400E-04
  2.4000E+01           2.9000E-04
  9.6000E+01           2.2600E-04
  7.2000E+02           0.0000E+00

Location Breathing Rate Data
 Time (hr)          Breathing Rate (m^3 * sec^-1)
  0.0000E+00                  3.5000E-04
  7.2000E+02                  0.0000E+00

Location Occupancy Factor Data
 Time (hr)          Occupancy Factor
  0.0000E+00            1.0000E+00
  2.4000E+01            6.0000E-01
  9.6000E+01            4.0000E-01
  7.2000E+02            0.0000E+00

USER SPECIFIED TIME STEP DATA - SUPPLEMENTAL TIME STEPS
     Time            Time step
  0.0000E+00        1.0000E-01
  2.0000E+00        5.0000E-01
  8.0000E+00        1.0000E+00
  2.4000E+01        2.0000E+00
  9.6000E+01        8.0000E+00
  7.2000E+02        0.0000E+00
```

```
##############################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  5/21/2014  at 18:11:52
##############################################################################


      ####   #     #  #####  #####   #     #  #####
     #    #  #     #    #    #    #  #     #    #
     #    #  #     #    #    #    #  #     #    #
     #    #  #     #    #    #####   #     #    #
     #    #  #     #    #    #       #     #    #
     #    #  #     #    #    #       #     #    #
      ####    ####      #    #        ####     #

##############################################################################
                                Dose Output
##############################################################################

Exclusion Area Boundary Doses:

Time (h) =    0.0036    Whole Body   Thyroid       TEDE
Delta dose (rem)         5.2448E-04  4.3935E-02  2.4215E-03
Accumulated dose (rem)   5.2448E-04  4.3935E-02  2.4215E-03

Low Population Zone Doses:

Time (h) =    0.0036    Whole Body   Thyroid       TEDE
Delta dose (rem)         7.9450E-05  6.6553E-03  3.6681E-04
Accumulated dose (rem)   7.9450E-05  6.6553E-03  3.6681E-04

Control Room Doses:

Time (h) =    0.0036    Whole Body   Thyroid       TEDE
Delta dose (rem)         3.4386E-07  5.6989E-04  2.4950E-05
Accumulated dose (rem)   3.4386E-07  5.6989E-04  2.4950E-05

Exclusion Area Boundary Doses:

Time (h) =    1.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)         5.8398E-02  5.2144E+00  2.8379E-01
Accumulated dose (rem)   5.8922E-02  5.2584E+00  2.8621E-01

Low Population Zone Doses:

Time (h) =    1.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)         8.8462E-03  7.8989E-01  4.2988E-02
Accumulated dose (rem)   8.9257E-03  7.9655E-01  4.3355E-02

Control Room Doses:

Time (h) =    1.0000    Whole Body   Thyroid       TEDE
Delta dose (rem)         3.4917E-03  6.5060E+00  2.8488E-01
Accumulated dose (rem)   3.4921E-03  6.5066E+00  2.8490E-01
```

Exclusion Area Boundary Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	5.8922E-02	5.2584E+00	2.8621E-01

Low Population Zone Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.9257E-03	7.9655E-01	4.3355E-02

Control Room Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.3839E-05	1.1695E-01	5.1026E-03
Accumulated dose (rem)	3.5359E-03	6.6235E+00	2.9001E-01

Exclusion Area Boundary Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	5.8922E-02	5.2584E+00	2.8621E-01

Low Population Zone Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.9257E-03	7.9655E-01	4.3355E-02

Control Room Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.2820E-08	8.6624E-05	3.7693E-06
Accumulated dose (rem)	3.5359E-03	6.6236E+00	2.9001E-01

Exclusion Area Boundary Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	5.8922E-02	5.2584E+00	2.8621E-01

Low Population Zone Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.9257E-03	7.9655E-01	4.3355E-02

Control Room Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.5162E-27	1.4444E-23	6.3435E-25
Accumulated dose (rem)	3.5359E-03	6.6236E+00	2.9001E-01

Exclusion Area Boundary Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00

Accumulated dose (rem)	5.8922E-02	5.2584E+00	2.8621E-01

Low Population Zone Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.9257E-03	7.9655E-01	4.3355E-02

Control Room Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.3348E-77	2.6612E-73	1.2149E-74
Accumulated dose (rem)	3.5359E-03	6.6236E+00	2.9001E-01

Exclusion Area Boundary Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	5.8922E-02	5.2584E+00	2.8621E-01

Low Population Zone Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	0.0000E+00	0.0000E+00	0.0000E+00
Accumulated dose (rem)	8.9257E-03	7.9655E-01	4.3355E-02

Control Room Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.9505-303	1.4055-298	7.3542-300
Accumulated dose (rem)	3.5359E-03	6.6236E+00	2.9001E-01

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##
I-131 Summary
##

Time (hr)	RCS Sample I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
0.000	1.6738E+00	2.1431E-03	2.5150E-05
0.004	1.0770E+01	8.9571E-02	1.0435E-03
0.400	1.7314E+00	9.1197E+00	2.3306E-02
0.700	4.3413E-01	1.0416E+01	7.5957E-03
1.000	1.0885E-01	1.0741E+01	2.1068E-03
1.300	1.0874E-01	1.0741E+01	2.4320E-04
1.600	1.0862E-01	1.0741E+01	2.8074E-05
1.900	1.0850E-01	1.0741E+01	3.2408E-06
2.000	1.0846E-01	1.0741E+01	1.5780E-06
2.300	1.0835E-01	1.0741E+01	1.8216E-07
2.600	1.0823E-01	1.0741E+01	2.1027E-08
2.900	1.0811E-01	1.0741E+01	2.4273E-09
3.200	1.0800E-01	1.0741E+01	2.8020E-10
3.500	1.0788E-01	1.0741E+01	3.2346E-11
3.800	1.0776E-01	1.0741E+01	3.7339E-12
4.100	1.0765E-01	1.0741E+01	4.3103E-13
4.400	1.0753E-01	1.0741E+01	4.9757E-14
4.700	1.0742E-01	1.0741E+01	5.7438E-15

5.000	1.0730E-01	1.0741E+01	6.6304E-16
5.300	1.0719E-01	1.0741E+01	7.6539E-17
5.600	1.0707E-01	1.0741E+01	8.8354E-18
5.900	1.0695E-01	1.0741E+01	1.0199E-18
6.200	1.0684E-01	1.0741E+01	1.1774E-19
6.500	1.0672E-01	1.0741E+01	1.3591E-20
6.800	1.0661E-01	1.0741E+01	1.5689E-21
7.100	1.0649E-01	1.0741E+01	1.8111E-22
7.400	1.0638E-01	1.0741E+01	2.0907E-23
7.700	1.0627E-01	1.0741E+01	2.4134E-24
8.000	1.0615E-01	1.0741E+01	2.7860E-25
8.300	1.0604E-01	1.0741E+01	3.2161E-26
8.600	1.0592E-01	1.0741E+01	3.7125E-27
8.900	1.0581E-01	1.0741E+01	4.2856E-28
9.200	1.0569E-01	1.0741E+01	4.9472E-29
9.500	1.0558E-01	1.0741E+01	5.7109E-30
9.800	1.0547E-01	1.0741E+01	6.5925E-31
10.100	1.0535E-01	1.0741E+01	7.6101E-32
10.400	1.0524E-01	1.0741E+01	8.7849E-33
24.000	1.0022E-01	1.0741E+01	2.7275E-75
96.000	7.7382E-02	1.0741E+01	2.4687-300
720.000	8.2254E-03	1.0741E+01	0.0000E+00

##

Cumulative Dose Summary

##

	Exclusion Area Bounda		Low Population Zone		Control Room	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.004	4.3935E-02	2.4215E-03	6.6553E-03	3.6681E-04	5.6989E-04	2.4950E-05
0.400	4.4687E+00	2.4451E-01	6.7693E-01	3.7038E-02	4.3262E+00	1.8950E-01
0.700	5.1006E+00	2.7803E-01	7.7264E-01	4.2117E-02	6.0017E+00	2.6284E-01
1.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.5066E+00	2.8490E-01
1.300	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6101E+00	2.8942E-01
1.600	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6221E+00	2.8994E-01
1.900	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6234E+00	2.9000E-01
2.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6235E+00	2.9001E-01
2.300	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
2.600	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
2.900	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
3.200	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
3.500	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
3.800	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
4.100	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
4.400	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
4.700	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
5.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
5.300	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
5.600	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
5.900	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
6.200	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
6.500	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
6.800	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
7.100	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
7.400	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
7.700	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01

8.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
8.300	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
8.600	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
8.900	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
9.200	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
9.500	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
9.800	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
10.100	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
10.400	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
24.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
96.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01
720.000	5.2584E+00	2.8621E-01	7.9655E-01	4.3355E-02	6.6236E+00	2.9001E-01

##
Worst Two-Hour Doses
##

Exclusion Area Boundary

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	5.8922E-02	5.2584E+00	2.8621E-01

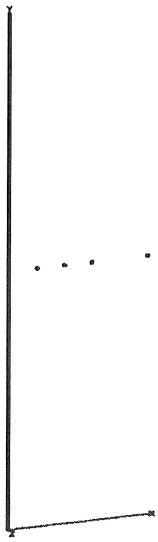
Attachment 13.2
MicroShield Output File: PBRWSAMP.MS5

MicroShield v5.05 (5.05-00238)
PSEG Nuclear LLC

Page : 1
DOS File: PBRWSAMP.MS5
Run Date: April 10, 2014
Run Time: 2:29:15 PM
Duration: 00:00:17

File Ref:
Date:
By:
Checked:

Case Title: Case 1
Description: PB 3/4" RW Sample Line Dose Rates - CRDA
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	609.6 cm	20 ft 0.0 in
Radius	0.942 cm	0.4 in

Dose Points

	X	Y	Z
# 1	31.8135 cm	304.8 cm	0 cm
	1 ft 0.5 in	10 ft 0.0 in	0.0 in
# 2	62.2935 cm	304.8 cm	0 cm
	2 ft 0.5 in	10 ft 0.0 in	0.0 in
# 3	92.7735 cm	304.8 cm	0 cm
	3 ft 0.5 in	10 ft 0.0 in	0.0 in
# 4	153.7335 cm	304.8 cm	0 cm
	5 ft 0.5 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	103.779 in³	Water	0.754
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.154 in	Iron	7.87

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	uCi/cm³	Bq/cm³
Cs-134	4.0920e-001	1.5140e+010	2.4062e+002	8.9028e+006
Cs-136	1.1580e-001	4.2846e+009	6.8092e+001	2.5194e+006
Cs-137	2.4660e-001	9.1242e+009	1.4501e+002	5.3652e+006
Cs-138	3.1560e+000	1.1677e+011	1.8558e+003	6.8664e+007
I-131	1.5360e+000	5.6832e+010	9.0319e+002	3.3418e+007
I-132	2.2160e+000	8.1992e+010	1.3030e+003	4.8213e+007
I-133	3.1610e+000	1.1696e+011	1.8587e+003	6.8773e+007
I-134	3.5100e+000	1.2987e+011	2.0639e+003	7.6366e+007
I-135	2.9530e+000	1.0926e+011	1.7364e+003	6.4247e+007
Kr-83m	2.6420e-001	9.7754e+009	1.5535e+002	5.7481e+006
Kr-85	2.5110e-002	9.2907e+008	1.4765e+001	5.4631e+005
Kr-85m	5.8730e-001	2.1730e+010	3.4534e+002	1.2778e+007
Kr-87	1.1570e+000	4.2809e+010	6.8034e+002	2.5172e+007
Kr-88	1.6330e+000	6.0421e+010	9.6023e+002	3.5529e+007
Rb-86	3.8770e-003	1.4345e+008	2.2797e+000	8.4350e+004
Rb-88	1.4420e+000	5.3354e+010	8.4792e+002	3.1373e+007
Xe-131m	2.0760e-002	7.6812e+008	1.2207e+001	4.5167e+005
Xe-133	3.7670e+000	1.3938e+011	2.2151e+003	8.1957e+007
Xe-133m	1.1770e-001	4.3549e+009	6.9210e+001	2.5608e+006
Xe-135	1.4690e+000	5.4353e+010	8.6380e+002	3.1960e+007
Xe-135m	7.4210e-001	2.7458e+010	4.3637e+002	1.6146e+007
Xe-138	3.3050e+000	1.2229e+011	1.9434e+003	7.1906e+007

Buildup

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Run Time: 2:29:15 PM
Duration: 00:00:17

The material reference is : Source

Integration Parameters

Radial	15
Circumferential	15
Y Direction (axial)	15

Results - Dose Point # 1 - (12.525,120,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	8.956e+10	4.649e-08	1.006e-06	4.607e-10	9.971e-09
0.04	3.907e+08	4.707e-04	1.975e-02	2.082e-06	8.737e-05
0.06	5.340e+08	2.815e+00	1.011e+02	5.591e-03	2.009e-01
0.08	5.291e+10	3.354e+03	5.574e+04	5.308e+00	8.821e+01
0.1	2.881e+08	5.395e+01	4.768e+02	8.253e-02	7.295e-01
0.15	3.447e+10	1.987e+04	7.987e+04	3.272e+01	1.315e+02
0.2	7.931e+10	7.617e+04	2.203e+05	1.344e+02	3.888e+02
0.3	5.653e+10	9.693e+04	2.060e+05	1.839e+02	3.907e+02
0.4	1.363e+11	3.394e+05	6.268e+05	6.613e+02	1.221e+03
0.5	2.216e+11	7.301e+05	1.232e+06	1.433e+03	2.417e+03
0.6	1.772e+11	7.311e+05	1.160e+06	1.427e+03	2.263e+03
0.8	3.713e+11	2.176e+06	3.166e+06	4.138e+03	6.023e+03
1.0	1.782e+11	1.367e+06	1.890e+06	2.520e+03	3.484e+03
1.5	2.014e+11	2.499e+06	3.183e+06	4.204e+03	5.356e+03
2.0	1.442e+11	2.495e+06	3.048e+06	3.857e+03	4.714e+03
3.0	1.774e+10	4.830e+05	5.644e+05	6.553e+02	7.657e+02
5.0	7.650e+07	3.610e+03	4.044e+03	4.139e+00	4.635e+00
TOTALS:	1.762e+12	1.102e+07	1.544e+07	1.926e+04	2.725e+04

Results - Dose Point # 2 - (24.525,120,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	8.956e+10	1.897e-08	4.098e-07	1.880e-10	4.061e-09
0.04	3.907e+08	2.146e-04	9.230e-03	9.491e-07	4.082e-05
0.06	5.340e+08	1.442e+00	5.198e+01	2.864e-03	1.032e-01
0.08	5.291e+10	1.715e+03	2.846e+04	2.713e+00	4.503e+01
0.1	2.881e+08	2.750e+01	2.427e+02	4.207e-02	3.714e-01
0.15	3.447e+10	1.009e+04	3.996e+04	1.662e+01	6.580e+01
0.2	7.931e+10	3.859e+04	1.090e+05	6.810e+01	1.924e+02
0.3	5.653e+10	4.895e+04	1.013e+05	9.285e+01	1.921e+02
0.4	1.363e+11	1.710e+05	3.075e+05	3.332e+02	5.992e+02
0.5	2.216e+11	3.672e+05	6.037e+05	7.208e+02	1.185e+03
0.6	1.772e+11	3.672e+05	5.682e+05	7.167e+02	1.109e+03
0.8	3.713e+11	1.090e+06	1.550e+06	2.073e+03	2.948e+03
1.0	1.782e+11	6.831e+05	9.245e+05	1.259e+03	1.704e+03
1.5	2.014e+11	1.243e+06	1.554e+06	2.092e+03	2.615e+03
2.0	1.442e+11	1.237e+06	1.487e+06	1.913e+03	2.299e+03
3.0	1.774e+10	2.386e+05	2.749e+05	3.238e+02	3.730e+02
5.0	7.650e+07	1.778e+03	1.969e+03	2.038e+00	2.258e+00
TOTALS:	1.762e+12	5.499e+06	7.551e+06	9.614e+03	1.333e+04

Results - Dose Point # 3 - (36.525,120,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	8.956e+10	1.259e-08	2.735e-07	1.248e-10	2.711e-09

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Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.04	3.907e+08	1.450e-04	6.218e-03	6.412e-07	2.750e-05
0.06	5.340e+08	9.608e-01	3.472e+01	1.908e-03	6.897e-02
0.08	5.291e+10	1.142e+03	1.898e+04	1.808e+00	3.004e+01
0.1	2.881e+08	1.829e+01	1.598e+02	2.798e-02	2.445e-01
0.15	3.447e+10	6.658e+03	2.556e+04	1.096e+01	4.209e+01
0.2	7.931e+10	2.533e+04	6.902e+04	4.470e+01	1.218e+02
0.3	5.653e+10	3.195e+04	6.401e+04	6.061e+01	1.214e+02
0.4	1.363e+11	1.113e+05	1.944e+05	2.169e+02	3.788e+02
0.5	2.216e+11	2.384e+05	3.818e+05	4.680e+02	7.494e+02
0.6	1.772e+11	2.380e+05	3.594e+05	4.645e+02	7.014e+02
0.8	3.713e+11	7.043e+05	9.807e+05	1.340e+03	1.865e+03
1.0	1.782e+11	4.405e+05	5.849e+05	8.119e+02	1.078e+03
1.5	2.014e+11	7.983e+05	9.829e+05	1.343e+03	1.654e+03
2.0	1.442e+11	7.924e+05	9.397e+05	1.225e+03	1.453e+03
3.0	1.774e+10	1.524e+05	1.737e+05	2.067e+02	2.357e+02
5.0	7.650e+07	1.133e+03	1.244e+03	1.298e+00	1.427e+00
TOTALS:	1.762e+12	3.542e+06	4.776e+06	6.195e+03	8.433e+03

Results - Dose Point # 4 - (60.525,120,0) in

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	8.956e+10	7.513e-09	1.630e-07	7.446e-11	1.616e-09
0.04	3.907e+08	8.580e-05	3.687e-03	3.795e-07	1.631e-05
0.06	5.340e+08	5.709e-01	2.069e+01	1.134e-03	4.110e-02
0.08	5.291e+10	6.732e+02	1.098e+04	1.065e+00	1.737e+01
0.1	2.881e+08	1.062e+01	8.836e+01	1.624e-02	1.352e-01
0.15	3.447e+10	3.761e+03	1.353e+04	6.194e+00	2.229e+01
0.2	7.931e+10	1.413e+04	3.610e+04	2.495e+01	6.371e+01
0.3	5.653e+10	1.765e+04	3.362e+04	3.347e+01	6.378e+01
0.4	1.363e+11	6.113e+04	1.023e+05	1.191e+02	1.993e+02
0.5	2.216e+11	1.305e+05	2.012e+05	2.561e+02	3.949e+02
0.6	1.772e+11	1.298e+05	1.895e+05	2.534e+02	3.700e+02
0.8	3.713e+11	3.826e+05	5.178e+05	7.277e+02	9.849e+02
1.0	1.782e+11	2.385e+05	3.088e+05	4.396e+02	5.693e+02
1.5	2.014e+11	4.298e+05	5.190e+05	7.231e+02	8.732e+02
2.0	1.442e+11	4.252e+05	4.961e+05	6.575e+02	7.671e+02
3.0	1.774e+10	8.147e+04	9.167e+04	1.105e+02	1.244e+02
5.0	7.650e+07	6.037e+02	6.570e+02	6.921e-01	7.532e-01
TOTALS:	1.762e+12	1.916e+06	2.521e+06	3.353e+03	4.451e+03

Attachment 13.3
RADTRAD Nuclide Inventory File: PBCRDASMP00_def.txt

```
Nuclide Inventory Name: Post-CRDA RW Sample Line Activity
 Normalized MACCS Sample 4030 MWt BWR Core Inventory
 Power Level:
  0.1000E+01
 Nuclides:
  60
 Nuclide 001:
 Co-58
   7
  0.6117120000E+07
  0.5800E+02
  0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 002:
 Co-60
   7
  0.1663401096E+09
  0.6000E+02
  0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 003:
 Kr-83m
   1
  0.6588000000E+04
  0.8300E+02
  0.4667E+01
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 004:
 Kr-85
   1
  0.3382974720E+09
  0.8500E+02
  0.4436E+00
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 005:
 Kr-85m
   1
  0.1612800000E+05
  0.8500E+02
  0.1038E+02
 Kr-85     0.2100E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 006:
 Kr-87
```

```
  1
 0.4578000000E+04
 0.8700E+02
 0.2045E+02
Rb-87     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 007:
Kr-88
  1
 0.1022400000E+05
 0.8800E+02
 0.2885E+02
Rb-88     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 008:
Rb-86
  3
 0.1612224000E+07
 0.8600E+02
 0.2739E-01
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 009:
Rb-88
  3
 0.1068000000E+04
 0.8800E+02
 0.1019E+02
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 010:
Sr-90
  5
 0.9189573120E+09
 0.9000E+02
 0.0000E+00
Y-90      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 011:
Sr-91
  5
 0.3420000000E+05
 0.9100E+02
 0.0000E+00
Y-91m     0.5800E+00
Y-91      0.4200E+00
none      0.0000E+00
Nuclide 012:
Sr-92
  5
 0.9756000000E+04
 0.9200E+02
 0.0000E+00
```

```
Y-92      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 013:
Y-90
  9
 0.2304000000E+06
 0.9000E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 014:
Y-91
  9
 0.5055264000E+07
 0.9100E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 015:
Y-92
  9
 0.1274400000E+05
 0.9200E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 016:
Y-93
  9
 0.3636000000E+05
 0.9300E+02
 0.0000E+00
Zr-93     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 017:
Zr-95
  9
 0.5527872000E+07
 0.9500E+02
 0.0000E+00
Nb-95m    0.7000E-02
Nb-95     0.9900E+00
none      0.0000E+00
Nuclide 018:
Zr-97
  9
 0.6084000000E+05
 0.9700E+02
 0.0000E+00
Nb-97m    0.9500E+00
Nb-97     0.5300E-01
none      0.0000E+00
Nuclide 019:
```

```
Nb-95
  9
 0.3036960000E+07
 0.9500E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 020:
Mo-99
  7
 0.2376000000E+06
 0.9900E+02
 0.0000E+00
Tc-99m    0.8800E+00
Tc-99     0.1200E+00
none      0.0000E+00
Nuclide 021:
Tc-99m
  7
 0.2167200000E+05
 0.9900E+02
 0.0000E+00
Tc-99     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 022:
Ru-103
  7
 0.3393792000E+07
 0.1030E+03
 0.0000E+00
Rh-103m   0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 023:
Ru-105
  7
 0.1598400000E+05
 0.1050E+03
 0.0000E+00
Rh-105    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 024:
Ru-106
  7
 0.3181248000E+08
 0.1060E+03
 0.0000E+00
Rh-106    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 025:
Rh-105
  7
 0.1272960000E+06
 0.1050E+03
```

```
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 026:
Sb-127
  4
 0.3326400000E+06
 0.1270E+03
 0.0000E+00
Te-127m   0.1800E+00
Te-127    0.8200E+00
none      0.0000E+00
Nuclide 027:
Sb-129
  4
 0.1555200000E+05
 0.1290E+03
 0.0000E+00
Te-129m   0.2200E+00
Te-129    0.7700E+00
none      0.0000E+00
Nuclide 028:
Te-127
  4
 0.3366000000E+05
 0.1270E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 029:
Te-127m
  4
 0.9417600000E+07
 0.1270E+03
 0.0000E+00
Te-127    0.9800E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 030:
Te-129
  4
 0.4176000000E+04
 0.1290E+03
 0.0000E+00
I-129     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 031:
Te-129m
  4
 0.2903040000E+07
 0.1290E+03
 0.0000E+00
Te-129    0.6500E+00
I-129     0.3500E+00
none      0.0000E+00
```

```
Nuclide 032:
Te-131m
  4
 0.1080000000E+06
 0.1310E+03
 0.0000E+00
Te-131    0.2200E+00
I-131     0.7800E+00
none      0.0000E+00
Nuclide 033:
Te-132
  4
 0.2815200000E+06
 0.1320E+03
 0.0000E+00
I-132     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 034:
I-131
  2
 0.6946560000E+06
 0.1310E+03
 0.1086E+02
Xe-131m   0.1100E-01
none      0.0000E+00
none      0.0000E+00
Nuclide 035:
I-132
  2
 0.8280000000E+04
 0.1320E+03
 0.1566E+02
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 036:
I-133
  2
 0.7488000000E+05
 0.1330E+03
 0.2234E+02
Xe-133m   0.2900E-01
Xe-133    0.9700E+00
none      0.0000E+00
Nuclide 037:
I-134
  2
 0.3156000000E+04
 0.1340E+03
 0.2481E+02
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 038:
I-135
  2
 0.2379600000E+05
```

```
 0.1350E+03
 0.2087E+02
Xe-135m  0.1500E+00
Xe-135   0.8500E+00
none     0.0000E+00
Nuclide 039:
Xe-131m
  1
 0.1028160000E+07
 0.1310E+03
 0.3367E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 040:
Xe-133
  1
 0.4531680000E+06
 0.1330E+03
 0.6656E+02
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 041:
Xe-133m
  1
 0.1890432000E+06
 0.1330E+03
 0.2079E+01
Xe-133   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 042:
Xe-135
  1
 0.3272400000E+05
 0.1350E+03
 0.2595E+02
Cs-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 043:
Xe-135m
  1
 0.9174000000E+03
 0.1350E+03
 0.1311E+02
Xe-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 044:
Xe-138
  1
 0.8502000000E+03
 0.1380E+03
 0.5839E+02
Cs-138   0.1000E+01
none     0.0000E+00
```

```
none      0.0000E+00
Nuclide 045:
Cs-134
  3
 0.6507177120E+08
 0.1340E+03
 0.2891E+01
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 046:
Cs-136
  3
 0.1131840000E+07
 0.1360E+03
 0.8181E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 047:
Cs-137
  3
 0.9467280000E+09
 0.1370E+03
 0.1743E+01
Ba-137m   0.9500E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 048:
Cs-138
  3
 0.1932000000E+04
 0.1380E+03
 0.2230E+02
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 049:
Ba-140
  6
 0.1100736000E+07
 0.1400E+03
 0.0000E+00
La-140    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 050:
La-140
  9
 0.1449792000E+06
 0.1400E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 051:
La-141
  9
```

```
 0.1414800000E+05
 0.1410E+03
 0.0000E+00
Ce-141    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 052:
La-142
  9
 0.5550000000E+04
 0.1420E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 053:
Ce-141
  8
 0.2808086400E+07
 0.1410E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 054:
Ce-143
  8
 0.1188000000E+06
 0.1430E+03
 0.0000E+00
Pr-143    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 055:
Ce-144
  8
 0.2456352000E+08
 0.1440E+03
 0.0000E+00
Pr-144m   0.1800E-01
Pr-144    0.9800E+00
none      0.0000E+00
Nuclide 056:
Pr-143
  9
 0.1171584000E+07
 0.1430E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 057:
Nd-147
  9
 0.9486720000E+06
 0.1470E+03
 0.0000E+00
Pm-147    0.1000E+01
```

```
none      0.0000E+00
none      0.0000E+00
Nuclide 058:
Np-239
   8
 0.2034720000E+06
 0.2390E+03
 0.0000E+00
Pu-239    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 059:
Pu-241
   8
 0.4544294400E+09
 0.2410E+03
 0.0000E+00
U-237     0.2400E-04
Am-241    0.1000E+01
none      0.0000E+00
Nuclide 060:
Cm-242
   9
 0.1406592000E+08
 0.2420E+03
 0.0000E+00
Pu-238    0.1000E+01
none      0.0000E+00
none      0.0000E+00
End of Nuclear Inventory File
```

Attachment 13.4
RADTRAD Release Fraction and Timing File: pbcrda_rft.txt

```
Release Fraction and Timing Name: PBAPS Control Rod Drop Accident
 Fission Product Gap Inventory
 Duration (h):   NON-LOCA Accident chk inventory
  0.0036E+00  0.0000E+00  0.0000E+00  0.0000E+00
 Noble Gases:
  0.1000E+01  0.0000E+00  0.0000E+00  0.0000E+00
 Iodine:
  0.1000E+01 0.0000E+00  0.0000E+00  0.0000E+00
 Cesium:
  0.1000E+01  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
```

Attachment 13.5
RADTRAD Dose Conversion Factor File: pbcrda_fg11&12.txt

```
HCGS_FGR11&12 added 7 nuclides; deleted Sr-89,Ba-139,Cm244,AM-242,Pu238-240 2/2001
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-83m           data entered by Gopal J. Patel NUCORE
Kr-85
Kr-85m
Kr-87
Kr-88
Rb-86     D
Rb-88            data entered by Gopal J. Patel NUCORE
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-131m         data entered by Gopal J. Patel NUCORE
Xe-133
Xe-133m         data entered by Gopal J. Patel NUCORE
Xe-135
Xe-135m         data entered by Gopal J. Patel NUCORE/10/08/2001
Xe-138          data entered by Gopal J. Patel NUCORE/10/08/2001
Cs-134    D
Cs-136    D
Cs-137    D     Including:Ba-137m
Cs-138          data entered by Gopal J. Patel NUCORE
Ba-140    D
```

La-140 W
La-141 D
La-142 D
Ce-141 Y
Ce-143 Y
Ce-144 Y Including:Pr-144m, Including:Pr-144
Pr-143 Y
Nd-147 Y
Np-239 W
Pu-241 Y
Cm-242 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-83m							
GONADS	1.710E-18	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BREAST	5.050E-18	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
LUNGS	1.640E-19	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
RED MARR	3.830E-19	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BONE SUR	2.250E-18	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
THYROID	6.430E-19	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
REMAINDER	5.300E-19	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
EFFECTIVE	1.500E-18	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
SKIN(FGR)	3.560E-17	0.000E+00	0.000E+00	0.000E+00-1.000E+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
Rb-88							
GONADS	3.260E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.310E-12	2.780E-12
BREAST	3.670E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.430E-12	2.820E-12
LUNGS	3.310E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.470E-10	2.910E-12
RED MARR	3.300E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.450E-12	2.760E-12
BONE SUR	4.620E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.470E-12	2.750E-12
THYROID	3.370E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.370E-12	2.430E-12
REMAINDER	3.210E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	1.380E-11	1.500E-10
EFFECTIVE	3.360E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	2.260E-11	4.710E-11
SKIN(FGR)	1.830E-13	0.000E+00	0.000E+00	0.000E+00	-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
BONE SUR	9.490E-14	2.010E-11	2.308E-11	1.640E-15	-1.000E+00	4.360E-12	8.490E-12
THYROID	6.820E-14	1.446E-11	1.661E-11	1.180E-15	-1.000E+00	3.920E-12	1.300E-12
REMAINDER	6.450E-14	1.471E-11	1.689E-11	1.200E-15	-1.000E+00	2.900E-10	1.720E-09
EFFECTIVE	6.790E-14	1.532E-11	1.759E-11	1.250E-15	-1.000E+00	2.180E-10	5.430E-10
SKIN(FGR)	8.560E-14	2.280E-11	2.618E-11	1.860E-15	-1.000E+00	0.000E+00	0.000E+00
Y-90							

GONADS	1.890E-16	1.586E-13	1.601E-12	5.750E-18	1.000E+00	5.170E-13	1.430E-14
BREAST	2.200E-16	1.578E-13	1.593E-12	5.720E-18	1.000E+00	5.170E-13	1.270E-14
LUNGS	1.770E-16	1.313E-13	1.326E-12	4.760E-18	1.000E+00	9.310E-09	1.260E-14
RED MARR	1.620E-16	1.261E-13	1.273E-12	4.570E-18	1.000E+00	1.520E-11	3.700E-13
BONE SUR	4.440E-16	3.228E-13	3.259E-12	1.170E-17	1.000E+00	1.510E-11	3.670E-13
THYROID	1.870E-16	1.385E-13	1.398E-12	5.020E-18	1.000E+00	5.170E-13	1.260E-14
REMAINDER	1.680E-16	1.291E-13	1.303E-12	4.680E-18	1.000E+00	3.870E-09	9.680E-09
EFFECTIVE	1.900E-16	1.468E-13	1.482E-12	5.320E-18	1.000E+00	2.280E-09	2.910E-09
SKIN(FGR)	6.240E-14	2.897E-10	2.924E-09	1.050E-14	1.000E+00	0.000E+00	0.000E+00
Y-91							
GONADS	2.560E-16	1.756E-13	3.546E-12	6.110E-18	1.000E+00	8.200E-12	3.540E-12
BREAST	2.930E-16	1.713E-13	3.459E-12	5.960E-18	1.000E+00	8.920E-12	5.540E-13
LUNGS	2.500E-16	1.526E-13	3.082E-12	5.310E-18	1.000E+00	9.870E-08	2.020E-13
RED MARR	2.410E-16	1.521E-13	3.070E-12	5.290E-18	1.000E+00	3.190E-10	6.590E-12
BONE SUR	4.560E-16	2.903E-13	5.862E-12	1.010E-17	1.000E+00	3.180E-10	6.130E-12
THYROID	2.600E-16	1.564E-13	3.157E-12	5.440E-18	1.000E+00	8.500E-12	1.290E-13
REMAINDER	2.390E-16	1.509E-13	3.047E-12	5.250E-18	1.000E+00	4.200E-09	8.570E-09
EFFECTIVE	2.600E-16	1.650E-13	3.332E-12	5.740E-18	1.000E+00	1.320E-08	2.570E-09
SKIN(FGR)	3.850E-14	1.989E-10	4.016E-09	6.920E-15	1.000E+00	0.000E+00	0.000E+00
Y-92							
GONADS	1.270E-14	3.855E-12	4.872E-12	2.650E-16	1.000E+00	2.610E-12	1.960E-11
BREAST	1.440E-14	3.680E-12	4.652E-12	2.530E-16	1.000E+00	1.500E-12	3.550E-12
LUNGS	1.270E-14	3.535E-12	4.468E-12	2.430E-16	1.000E+00	1.240E-09	1.390E-12
RED MARR	1.250E-14	3.608E-12	4.560E-12	2.480E-16	1.000E+00	2.070E-12	4.910E-12
BONE SUR	1.950E-14	5.091E-12	6.435E-12	3.500E-16	1.000E+00	1.510E-12	1.750E-12
THYROID	1.300E-14	3.579E-12	4.523E-12	2.460E-16	1.000E+00	1.050E-12	1.770E-13
REMAINDER	1.220E-14	3.506E-12	4.431E-12	2.410E-16	1.000E+00	2.030E-10	1.700E-09
EFFECTIVE	1.300E-14	3.680E-12	4.652E-12	2.530E-16	1.000E+00	2.110E-10	5.150E-10
SKIN(FGR)	1.140E-13	2.022E-10	2.556E-10	1.390E-14	1.000E+00	0.000E+00	0.000E+00
Y-93							
GONADS	4.670E-15	2.108E-12	4.989E-12	9.510E-17	1.000E+00	5.310E-12	2.200E-11
BREAST	5.300E-15	2.026E-12	4.794E-12	9.140E-17	1.000E+00	1.740E-12	3.130E-12
LUNGS	4.680E-15	1.937E-12	4.585E-12	8.740E-17	1.000E+00	2.520E-09	8.670E-13
RED MARR	4.580E-15	1.972E-12	4.669E-12	8.900E-17	1.000E+00	4.040E-12	4.930E-12
BONE SUR	7.580E-15	2.948E-12	6.977E-12	1.330E-16	1.000E+00	3.140E-12	1.730E-12
THYROID	4.790E-15	1.908E-12	4.516E-12	8.610E-17	1.000E+00	9.260E-13	1.260E-13
REMAINDER	4.510E-15	1.919E-12	4.543E-12	8.660E-17	1.000E+00	9.250E-10	4.090E-09
EFFECTIVE	4.800E-15	2.021E-12	4.784E-12	9.120E-17	1.000E+00	5.820E-10	1.230E-09
SKIN(FGR)	8.500E-14	2.726E-10	6.452E-10	1.230E-14	1.000E+00	0.000E+00	0.000E+00
Zr-95							
GONADS	3.530E-14	2.182E-11	4.421E-10	7.590E-16	1.000E+00	1.880E-09	8.160E-10
BREAST	4.010E-14	2.084E-11	4.223E-10	7.250E-16	1.000E+00	1.910E-09	1.050E-10
LUNGS	3.510E-14	1.989E-11	4.030E-10	6.920E-16	1.000E+00	2.170E-09	2.340E-11
RED MARR	3.430E-14	2.030E-11	4.112E-10	7.060E-16	1.000E+00	1.300E-08	2.140E-10
BONE SUR	5.620E-14	2.875E-11	5.824E-10	1.000E-15	1.000E+00	1.030E-07	4.860E-10
THYROID	3.610E-14	2.076E-11	4.205E-10	7.220E-16	1.000E+00	1.440E-09	8.270E-12
REMAINDER	3.360E-14	1.963E-11	3.978E-10	6.830E-16	1.000E+00	2.280E-09	2.530E-09
EFFECTIVE	3.600E-14	2.078E-11	4.211E-10	7.230E-16	1.000E+00	6.390E-09	1.020E-09
SKIN(FGR)	4.500E-14	2.561E-11	5.190E-10	8.910E-16	1.000E+00	0.000E+00	0.000E+00
Zr-97							
GONADS	4.331E-14	2.179E-11	7.799E-11	9.253E-16	1.000E+00	1.840E-10	6.228E-10
BREAST	4.928E-14	2.083E-11	7.455E-11	8.846E-16	1.000E+00	4.706E-11	8.137E-11
LUNGS	4.322E-14	1.992E-11	7.127E-11	8.456E-16	1.000E+00	4.108E-09	1.770E-11
RED MARR	4.224E-14	2.034E-11	7.279E-11	8.634E-16	1.000E+00	6.376E-11	1.302E-10
BONE SUR	6.897E-14	2.881E-11	1.031E-10	1.224E-15	1.000E+00	3.504E-11	4.558E-11
THYROID	4.443E-14	2.061E-11	7.377E-11	8.755E-16	1.000E+00	2.315E-11	2.671E-12
REMAINDER	4.139E-14	1.966E-11	7.035E-11	8.345E-16	1.000E+00	2.041E-09	6.990E-09
EFFECTIVE	4.432E-14	2.078E-11	7.438E-11	8.824E-16	1.000E+00	1.171E-09	2.283E-09
SKIN(FGR)	9.835E-14	2.281E-10	8.148E-10	9.587E-15	1.000E+00	0.000E+00	0.000E+00
Nb-95							
GONADS	3.660E-14	2.253E-11	4.435E-10	7.850E-16	1.000E+00	4.320E-10	8.050E-10
BREAST	4.160E-14	2.150E-11	4.231E-10	7.490E-16	1.000E+00	4.070E-10	1.070E-10
LUNGS	3.650E-14	2.055E-11	4.045E-10	7.160E-16	1.000E+00	8.320E-09	2.740E-11
RED MARR	3.560E-14	2.101E-11	4.135E-10	7.320E-16	1.000E+00	4.420E-10	1.990E-10
BONE SUR	5.790E-14	2.957E-11	5.819E-10	1.030E-15	1.000E+00	5.130E-10	2.940E-10
THYROID	3.750E-14	2.144E-11	4.220E-10	7.470E-16	1.000E+00	3.580E-10	1.180E-11
REMAINDER	3.490E-14	2.032E-11	4.000E-10	7.080E-16	1.000E+00	1.070E-09	1.470E-09

EFFECTIVE	3.740E-14	2.147E-11	4.226E-10	7.480E-16-1.000E+00	1.570E-09	6.950E-10
SKIN(FGR)	4.300E-14	2.598E-11	5.112E-10	9.050E-16-1.000E+00	0.000E+00	0.000E+00
Mo-99						
GONADS	7.130E-15	4.282E-12	4.403E-11	1.550E-16-1.000E+00	9.510E-11	2.180E-10
BREAST	8.130E-15	4.116E-12	4.233E-11	1.490E-16-1.000E+00	2.750E-11	3.430E-11
LUNGS	7.060E-15	3.867E-12	3.977E-11	1.400E-16-1.000E+00	4.290E-09	1.510E-11
RED MARR	6.820E-15	3.923E-12	4.034E-11	1.420E-16-1.000E+00	5.240E-11	8.320E-11
BONE SUR	1.240E-14	6.105E-12	6.278E-11	2.210E-16-1.000E+00	4.130E-11	6.320E-11
THYROID	7.270E-15	4.033E-12	4.147E-11	1.460E-16-1.000E+00	1.520E-11	1.030E-11
REMAINDER	6.740E-15	3.812E-12	3.920E-11	1.380E-16-1.000E+00	1.740E-09	4.280E-09
EFFECTIVE	7.280E-15	4.061E-12	4.176E-11	1.470E-16-1.000E+00	1.070E-09	1.360E-09
SKIN(FGR)	3.140E-14	1.039E-10	1.068E-09	3.760E-15-1.000E+00	0.000E+00	0.000E+00
Tc-99m						
GONADS	5.750E-15	2.334E-12	3.877E-12	1.240E-16-1.000E+00	2.770E-12	9.750E-12
BREAST	6.650E-15	2.258E-12	3.752E-12	1.200E-16-1.000E+00	2.150E-12	3.570E-12
LUNGS	5.490E-15	2.127E-12	3.533E-12	1.130E-16-1.000E+00	2.280E-11	3.140E-12
RED MARR	4.910E-15	2.070E-12	3.439E-12	1.100E-16-1.000E+00	3.360E-12	6.290E-12
BONE SUR	1.630E-14	5.383E-12	8.942E-12	2.860E-16-1.000E+00	2.620E-12	4.060E-12
THYROID	5.750E-15	2.145E-12	3.564E-12	1.140E-16-1.000E+00	5.010E-11	8.460E-11
REMAINDER	5.150E-15	2.070E-12	3.439E-12	1.100E-16-1.000E+00	1.020E-11	3.340E-11
EFFECTIVE	5.890E-15	2.277E-12	3.783E-12	1.210E-16-1.000E+00	8.800E-12	1.680E-11
SKIN(FGR)	7.140E-15	2.710E-12	4.502E-12	1.440E-16-1.000E+00	0.000E+00	0.000E+00
Ru-103						
GONADS	2.191E-14	1.404E-11	2.783E-10	4.892E-16-1.000E+00	3.070E-10	5.720E-10
BREAST	2.512E-14	1.350E-11	2.677E-10	4.705E-16-1.000E+00	3.110E-10	1.200E-10
LUNGS	2.180E-14	1.273E-11	2.522E-10	4.432E-16-1.000E+00	1.561E-08	7.310E-11
RED MARR	2.100E-14	1.287E-11	2.551E-10	4.483E-16-1.000E+00	3.190E-10	1.660E-10
BONE SUR	3.892E-14	1.958E-11	3.882E-10	6.823E-16-1.000E+00	2.370E-10	9.631E-11
THYROID	2.241E-14	1.331E-11	2.639E-10	4.638E-16-1.000E+00	2.570E-10	6.250E-11
REMAINDER	2.080E-14	1.248E-11	2.472E-10	4.346E-16-1.000E+00	1.250E-09	2.110E-09
EFFECTIVE	2.251E-14	1.332E-11	2.641E-10	4.642E-16-1.000E+00	2.421E-09	8.271E-10
SKIN(FGR)	2.774E-14	1.785E-11	3.543E-10	6.229E-16-1.000E+00	0.000E+00	0.000E+00
Ru-105						
GONADS	3.720E-14	1.327E-11	1.861E-11	8.070E-16-1.000E+00	1.590E-11	9.670E-11
BREAST	4.240E-14	1.271E-11	1.783E-11	7.730E-16-1.000E+00	6.610E-12	1.590E-11
LUNGS	3.700E-14	1.210E-11	1.697E-11	7.360E-16-1.000E+00	5.730E-10	6.210E-12
RED MARR	3.590E-14	1.230E-11	1.725E-11	7.480E-16-1.000E+00	7.700E-12	2.350E-11
BONE SUR	6.280E-14	1.809E-11	2.537E-11	1.100E-15-1.000E+00	4.620E-12	8.890E-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
BONE SUR	1.720E-14	8.883E-12	1.856E-10	3.090E-16-1.000E+00	1.610E-09	1.430E-09
THYROID	1.030E-14	6.066E-12	1.268E-10	2.110E-16-1.000E+00	1.720E-09	1.410E-09
REMAINDER	9.630E-15	5.721E-12	1.196E-10	1.990E-16-1.000E+00	1.200E-08	2.110E-08
EFFECTIVE	1.040E-14	6.095E-12	1.274E-10	2.120E-16-1.000E+00	1.290E-07	7.400E-09
SKIN(FGR)	1.090E-13	4.082E-10	8.531E-09	1.420E-14-1.000E+00	0.000E+00	0.000E+00
Rh-105						
GONADS	3.640E-15	2.127E-12	1.411E-11	7.980E-17-1.000E+00	2.110E-11	5.800E-11
BREAST	4.160E-15	2.063E-12	1.369E-11	7.740E-17-1.000E+00	5.610E-12	8.970E-12
LUNGS	3.570E-15	1.935E-12	1.284E-11	7.260E-17-1.000E+00	9.580E-10	3.860E-12
RED MARR	3.380E-15	1.946E-12	1.291E-11	7.300E-17-1.000E+00	7.770E-12	1.470E-11
BONE SUR	7.530E-15	3.332E-12	2.210E-11	1.250E-16-1.000E+00	4.460E-12	6.750E-12
THYROID	3.680E-15	1.983E-12	1.316E-11	7.440E-17-1.000E+00	2.880E-12	2.910E-12
REMAINDER	3.390E-15	1.885E-12	1.250E-11	7.070E-17-1.000E+00	4.530E-10	1.270E-09
EFFECTIVE	3.720E-15	2.031E-12	1.347E-11	7.620E-17-1.000E+00	2.580E-10	3.990E-10
SKIN(FGR)	1.070E-14	4.691E-12	3.112E-11	1.760E-16-1.000E+00	0.000E+00	0.000E+00
Sb-127						
GONADS	3.260E-14	1.985E-11	2.441E-10	7.100E-16-1.000E+00	2.520E-10	6.140E-10
BREAST	3.720E-14	1.904E-11	2.341E-10	6.810E-16-1.000E+00	9.120E-11	7.600E-11
LUNGS	3.240E-14	1.809E-11	2.224E-10	6.470E-16-1.000E+00	6.940E-09	1.570E-11
RED MARR	3.140E-14	1.834E-11	2.255E-10	6.560E-16-1.000E+00	1.610E-10	1.330E-10

BONE SUR	5.520E-14	2.720E-11	3.345E-10	9.730E-16-1.000E+00	1.340E-10	5.240E-11
THYROID	3.330E-14	1.884E-11	2.317E-10	6.740E-16-1.000E+00	6.150E-11	4.640E-12
REMAINDER	3.090E-14	1.775E-11	2.183E-10	6.350E-16-1.000E+00	2.330E-09	5.870E-09
EFFECTIVE	3.330E-14	1.890E-11	2.324E-10	6.760E-16-1.000E+00	1.630E-09	1.950E-09
SKIN(FGR)	5.580E-14	7.967E-11	9.799E-10	2.850E-15-1.000E+00	0.000E+00	0.000E+00
Sb-129						
GONADS	6.970E-14	2.336E-11	3.231E-11	1.440E-15-1.000E+00	2.150E-11	1.510E-10
BREAST	7.910E-14	2.222E-11	3.074E-11	1.370E-15-1.000E+00	1.280E-11	2.560E-11
LUNGS	6.980E-14	2.141E-11	2.962E-11	1.320E-15-1.000E+00	8.980E-10	9.390E-12
RED MARR	6.860E-14	2.190E-11	3.029E-11	1.350E-15-1.000E+00	1.700E-11	3.670E-11
BONE SUR	1.070E-13	3.033E-11	4.196E-11	1.870E-15-1.000E+00	1.460E-11	1.340E-11
THYROID	7.160E-14	2.174E-11	3.007E-11	1.340E-15-1.000E+00	9.720E-12	1.470E-12
REMAINDER	6.710E-14	2.125E-11	2.939E-11	1.310E-15-1.000E+00	1.870E-10	1.450E-09
EFFECTIVE	7.140E-14	2.238E-11	3.096E-11	1.380E-15-1.000E+00	1.740E-10	4.840E-10
SKIN(FGR)	1.050E-13	8.273E-11	1.144E-10	5.100E-15-1.000E+00	0.000E+00	0.000E+00
Te-127						
GONADS	2.370E-16	1.191E-13	2.661E-13	5.480E-18-1.000E+00	2.020E-12	4.020E-12
BREAST	2.730E-16	1.158E-13	2.588E-13	5.330E-18-1.000E+00	1.880E-12	3.000E-12
LUNGS	2.320E-16	1.060E-13	2.370E-13	4.880E-18-1.000E+00	4.270E-10	2.890E-12
RED MARR	2.210E-16	1.058E-13	2.365E-13	4.870E-18-1.000E+00	4.090E-12	6.570E-12
BONE SUR	4.650E-16	1.862E-13	4.162E-13	8.570E-18-1.000E+00	4.090E-12	6.460E-12
THYROID	2.400E-16	1.106E-13	2.472E-13	5.090E-18-1.000E+00	1.840E-12	2.860E-12
REMAINDER	2.210E-16	1.036E-13	2.316E-13	4.770E-18-1.000E+00	1.110E-10	6.130E-10
EFFECTIVE	2.420E-16	1.125E-13	2.515E-13	5.180E-18-1.000E+00	8.600E-11	1.870E-10
SKIN(FGR)	1.140E-14	1.173E-11	2.622E-11	5.400E-16-1.000E+00	0.000E+00	0.000E+00
Te-127m						
GONADS	1.900E-16	4.689E-13	9.642E-12	1.630E-17-1.000E+00	1.100E-10	1.250E-10
BREAST	2.690E-16	5.150E-13	1.059E-11	1.790E-17-1.000E+00	1.100E-10	9.740E-11
LUNGS	7.620E-17	1.602E-13	3.295E-12	5.570E-18-1.000E+00	3.340E-08	9.620E-11
RED MARR	6.430E-17	1.249E-13	2.567E-12	4.340E-18-1.000E+00	5.360E-09	5.430E-09
BONE SUR	3.940E-16	9.005E-13	1.852E-11	3.130E-17-1.000E+00	2.040E-08	2.070E-08
THYROID	1.500E-16	2.779E-13	5.714E-12	9.660E-18-1.000E+00	9.660E-11	9.430E-11
REMAINDER	8.640E-17	1.999E-13	4.111E-12	6.950E-18-1.000E+00	1.660E-09	2.980E-09
EFFECTIVE	1.470E-16	3.251E-13	6.684E-12	1.130E-17-1.000E+00	5.810E-09	2.230E-09
SKIN(FGR)	8.490E-16	1.496E-12	3.076E-11	5.200E-17-1.000E+00	0.000E+00	0.000E+00
Te-129						
GONADS	2.710E-15	3.889E-13	3.922E-13	6.510E-17-1.000E+00	5.050E-13	1.590E-12
BREAST	3.120E-15	3.800E-13	3.832E-13	6.360E-17-1.000E+00	5.390E-13	6.050E-13
LUNGS	2.640E-15	3.298E-13	3.326E-13	5.520E-17-1.000E+00	1.530E-10	4.910E-13
RED MARR	2.540E-15	3.298E-13	3.326E-13	5.520E-17-1.000E+00	6.190E-13	7.640E-13
BONE SUR	4.880E-15	5.753E-13	5.802E-13	9.630E-17-1.000E+00	6.220E-13	5.400E-13
THYROID	2.740E-15	3.525E-13	3.555E-13	5.900E-17-1.000E+00	5.090E-13	3.360E-13
REMAINDER	2.520E-15	3.262E-13	3.289E-13	5.460E-17-1.000E+00	7.280E-12	1.790E-10
EFFECTIVE	2.750E-15	3.590E-13	3.621E-13	6.010E-17-1.000E+00	2.090E-11	5.450E-11
SKIN(FGR)	3.570E-14	3.429E-11	3.458E-11	5.740E-15-1.000E+00	0.000E+00	0.000E+00
Te-129m						
GONADS	3.321E-15	2.206E-12	4.799E-11	8.561E-17-1.000E+00	1.783E-10	2.420E-10
BREAST	3.838E-15	2.181E-12	4.739E-11	8.454E-17-1.000E+00	1.694E-10	1.664E-10
LUNGS	3.176E-15	1.741E-12	3.815E-11	6.808E-17-1.000E+00	4.040E-08	1.593E-10
RED MARR	3.071E-15	1.729E-12	3.793E-11	6.768E-17-1.000E+00	3.100E-09	3.500E-09
BONE SUR	5.772E-15	3.287E-12	7.147E-11	1.275E-16-1.000E+00	7.050E-09	7.990E-09
THYROID	3.341E-15	1.923E-12	4.201E-11	7.495E-17-1.000E+00	1.563E-10	1.572E-10
REMAINDER	3.048E-15	1.746E-12	3.822E-11	6.819E-17-1.000E+00	3.275E-09	7.196E-09
EFFECTIVE	3.337E-15	1.974E-12	4.308E-11	7.686E-17-1.000E+00	6.484E-09	2.925E-09
SKIN(FGR)	3.811E-14	1.501E-10	3.360E-09	6.001E-15-1.000E+00	0.000E+00	0.000E+00
Te-131m						
GONADS	7.292E-14	4.020E-11	2.343E-10	1.535E-15-1.000E+00	2.345E-10	7.415E-10
BREAST	8.286E-14	3.853E-11	2.246E-10	1.472E-15-1.000E+00	9.309E-11	1.361E-10
LUNGS	7.265E-14	3.657E-11	2.131E-10	1.397E-15-1.000E+00	2.296E-09	6.335E-11
RED MARR	7.097E-14	3.736E-11	2.178E-10	1.427E-15-1.000E+00	1.417E-10	2.435E-10
BONE SUR	1.174E-13	5.467E-11	3.189E-10	2.090E-15-1.000E+00	2.276E-10	3.248E-10
THYROID	7.471E-14	3.741E-11	2.181E-10	1.429E-15-1.000E+00	3.669E-08	4.383E-08
REMAINDER	6.965E-14	3.626E-11	2.113E-10	1.385E-15-1.000E+00	9.509E-10	3.153E-09
EFFECTIVE	7.463E-14	3.825E-11	2.229E-10	1.461E-15-1.000E+00	1.758E-09	2.514E-09
SKIN(FGR)	1.038E-13	1.033E-10	6.188E-10	4.056E-15-1.000E+00	0.000E+00	0.000E+00
Te-132						
GONADS	1.020E-14	6.812E-12	7.706E-11	2.450E-16-1.000E+00	4.150E-10	5.410E-10

BREAST	1.180E-14	6.756E-12	7.643E-11	2.430E-16	-1.000E+00	3.630E-10	3.500E-10
LUNGS	9.650E-15	5.727E-12	6.479E-11	2.060E-16	-1.000E+00	1.670E-09	3.300E-10
RED MARR	8.950E-15	5.588E-12	6.322E-11	2.010E-16	-1.000E+00	4.270E-10	4.440E-10
BONE SUR	2.420E-14	1.273E-11	1.441E-10	4.580E-16	-1.000E+00	7.120E-10	8.300E-10
THYROID	1.020E-14	5.978E-12	6.762E-11	2.150E-16	-1.000E+00	6.280E-08	5.950E-08
REMAINDER	9.160E-15	5.644E-12	6.385E-11	2.030E-16	-1.000E+00	7.890E-10	1.490E-09
EFFECTIVE	1.030E-14	6.339E-12	7.171E-11	2.280E-16	-1.000E+00	2.550E-09	2.540E-09
SKIN(FGR)	1.390E-14	8.313E-12	9.405E-11	2.990E-16	-1.000E+00	0.000E+00	0.000E+00
I-131							
GONADS	1.780E-14	1.119E-11	1.789E-10	3.940E-16	-1.000E+00	2.530E-11	4.070E-11
BREAST	2.040E-14	1.082E-11	1.730E-10	3.810E-16	-1.000E+00	7.880E-11	1.210E-10
LUNGS	1.760E-14	1.016E-11	1.626E-10	3.580E-16	-1.000E+00	6.570E-10	1.020E-10
RED MARR	1.680E-14	1.022E-11	1.635E-10	3.600E-16	-1.000E+00	6.260E-11	9.440E-11
BONE SUR	3.450E-14	1.675E-11	2.679E-10	5.900E-16	-1.000E+00	5.730E-11	8.720E-11
THYROID	1.810E-14	1.053E-11	1.685E-10	3.710E-16	-1.000E+00	2.920E-07	4.760E-07
REMAINDER	1.670E-14	9.908E-12	1.585E-10	3.490E-16	-1.000E+00	8.030E-11	1.570E-10
EFFECTIVE	1.820E-14	1.067E-11	1.707E-10	3.760E-16	-1.000E+00	8.890E-09	1.440E-08
SKIN(FGR)	2.980E-14	1.825E-11	2.920E-10	6.430E-16	-1.000E+00	0.000E+00	0.000E+00
I-132							
GONADS	1.090E-13	2.523E-11	2.771E-11	2.320E-15	-1.000E+00	9.950E-12	2.330E-11
BREAST	1.240E-13	2.414E-11	2.652E-11	2.220E-15	-1.000E+00	1.410E-11	2.520E-11
LUNGS	1.090E-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-131m							
GONADS	4.570E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BREAST	6.020E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
LUNGS	2.670E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
RED MARR	2.270E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	1.060E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
THYROID	3.910E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	2.710E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	3.890E-16	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00

SKIN(FGR)	4.820E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+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-133m							
GONADS	1.420E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BREAST	1.700E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
LUNGS	1.190E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
RED MARR	1.100E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BONE SUR	3.230E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
THYROID	1.360E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
REMAINDER	1.150E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
EFFECTIVE	1.370E-15	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
SKIN(FGR)	1.040E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+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	
Xe-135m							
GONADS	2.000E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BREAST	2.290E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
LUNGS	1.980E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
RED MARR	1.910E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BONE SUR	3.500E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
THYROID	2.040E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
REMAINDER	1.890E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
EFFECTIVE	2.040E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
SKIN(FGR)	2.970E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
Xe-138							
GONADS	5.590E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BREAST	6.320E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
LUNGS	5.660E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
RED MARR	5.600E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
BONE SUR	8.460E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
THYROID	5.770E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
REMAINDER	5.490E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
EFFECTIVE	5.770E-14	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
SKIN(FGR)	1.070E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	0.000E+00	0.000E+00	
Cs-134							
GONADS	7.400E-14	4.607E-11	9.646E-10	1.600E-15-1.000E+00	1.300E-08	2.060E-08	
BREAST	8.430E-14	4.406E-11	9.224E-10	1.530E-15-1.000E+00	1.080E-08	1.720E-08	
LUNGS	7.370E-14	4.204E-11	8.802E-10	1.460E-15-1.000E+00	1.180E-08	1.760E-08	
RED MARR	7.190E-14	4.262E-11	8.922E-10	1.480E-15-1.000E+00	1.180E-08	1.870E-08	
BONE SUR	1.200E-13	6.105E-11	1.278E-09	2.120E-15-1.000E+00	1.100E-08	1.740E-08	
THYROID	7.570E-14	4.377E-11	9.163E-10	1.520E-15-1.000E+00	1.110E-08	1.760E-08	
REMAINDER	7.060E-14	4.147E-11	8.681E-10	1.440E-15-1.000E+00	1.390E-08	2.210E-08	
EFFECTIVE	7.570E-14	4.377E-11	9.163E-10	1.520E-15-1.000E+00	1.250E-08	1.980E-08	
SKIN(FGR)	9.450E-14	6.249E-11	1.308E-09	2.170E-15-1.000E+00	0.000E+00	0.000E+00	
Cs-136							
GONADS	1.040E-13	6.223E-11	1.102E-09	2.180E-15-1.000E+00	1.880E-09	3.040E-09	
BREAST	1.180E-13	5.966E-11	1.056E-09	2.090E-15-1.000E+00	1.670E-09	2.650E-09	
LUNGS	1.040E-13	5.710E-11	1.011E-09	2.000E-15-1.000E+00	2.320E-09	2.620E-09	
RED MARR	1.010E-13	5.824E-11	1.031E-09	2.040E-15-1.000E+00	1.860E-09	2.950E-09	
BONE SUR	1.660E-13	8.422E-11	1.491E-09	2.950E-15-1.000E+00	1.700E-09	2.710E-09	

THYROID	1.070E-13	5.852E-11	1.036E-09	2.050E-15-1.000E+00	1.730E-09	2.740E-09
REMAINDER	9.950E-14	5.652E-11	1.001E-09	1.980E-15-1.000E+00	2.190E-09	3.520E-09
EFFECTIVE	1.060E-13	5.966E-11	1.056E-09	2.090E-15-1.000E+00	1.980E-09	3.040E-09
SKIN(FGR)	1.250E-13	7.251E-11	1.284E-09	2.540E-15-1.000E+00	0.000E+00	0.000E+00
Cs-137						
GONADS	2.669E-14	1.669E-11	3.530E-10	5.840E-16-1.000E+00	8.760E-09	1.390E-08
BREAST	3.047E-14	1.596E-11	3.376E-10	5.585E-16-1.000E+00	7.840E-09	1.240E-08
LUNGS	2.649E-14	1.517E-11	3.209E-10	5.309E-16-1.000E+00	8.820E-09	1.270E-08
RED MARR	2.583E-14	1.542E-11	3.260E-10	5.394E-16-1.000E+00	8.300E-09	1.320E-08
BONE SUR	4.382E-14	2.238E-11	4.734E-10	7.832E-16-1.000E+00	7.940E-09	1.260E-08
THYROID	2.725E-14	1.588E-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
Cs-138						
GONADS	1.170E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	3.280E-12	8.000E-12
BREAST	1.330E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	4.020E-12	8.000E-12
LUNGS	1.190E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	1.590E-10	8.530E-12
RED MARR	1.180E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	3.950E-12	7.370E-12
BONE SUR	1.700E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	3.550E-12	6.470E-12
THYROID	1.210E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	3.570E-12	5.730E-12
REMAINDER	1.150E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	2.060E-11	1.570E-10
EFFECTIVE	1.210E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+00	2.740E-11	5.250E-11
SKIN(FGR)	2.170E-13	0.000E+00	0.000E+00	0.000E+00-1.000E+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-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

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

1st Pass Attributes – General Overview

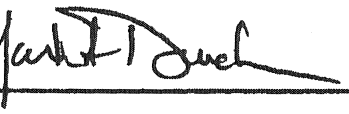
Yes	No	Attribute
☒	☐	The purpose/scope is clear and well defined. You should be able to understand the purpose without resorting to consultation with the preparer. (4.3.2)
☒	☐	The reason or need for the product is clearly discussed. (4.3.2)
☒	☐	You possess the proper knowledge and skill sets needed for the review. If additional expertise is needed, those reviews have been scheduled to ensure that appropriate knowledgeable "experts" are utilized for reviews.
☒	☐	The Methodology is appropriate for the purpose and scope of the document, and is clearly documented.

2nd Pass Attributes – Technical Review

Yes	No	Attribute
☒	☐	Input Parameters are clearly listed, defined with source documentation.
☒	☐	The Inputs are valid and are referenced to a quality documented reference.
☒	☐	Assumptions are reasonable and well documented.
☒	☐	The Methodology is appropriate and Equations Used have been verified-Ensure proper methodology & units
☒	☐	If an Alternate Calculation Tools or Methods was used as the review method, that analysis has been attached to the final document
☒	☐	The Numerical calculations and computations have been verified correct-validate the numbers
☒	☐	The acceptance criteria is consistent with the Design Basis, Design Standards and applicable codes.
☒	☐	Does the analysis consider new potential failure modes and disposition them as appropriate? If none are indicated, is this appropriate?
☒	☐	Does the product consider the most limiting or bounding design basis conditions?
☒	☐	Are the results consistent with actual plant response and do they appear reasonable?
☒	☐	Does the conclusion clearly support the purpose as described?

3rd Pass Attributes – Administrative

Yes	No	Attribute
☒	☐	Check references- are they the correct rev
☒	☐	Check procedures used- are they the correct rev
☒	☐	Assumptions are reasonable and well documented
☒	☐	Check for Spelling Errors, Punctuation and Grammar
☒	☐	Check for simplicity and readability
☒	☐	Are the proper forms included in the document and filled out correctly
☒	☐	Check Page and Attachment Numbering
☒	☐	Right Boxes Checked on Forms
☒	☐	Proper process has been used, Major Rev, Minor Rev, EC/ECR etc.
☒	☐	Appropriate boxes are signed off or marked N/A

Reviewer: Mark Drucker  07/14/2014

Print / Signature Date