ATTACHMENT 5 to ENCLOSURE
(SUPERCEDES ATTACHMENT 12 to LAR)

LRA Analysis titled, "GEN-PI-083, Locked Rotor Accident (LRA) Analysis Using AST," Revision 1

132 Pages Follow

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Document Information

NSPM Calculation (Doc) No: GEN-PI-083	Revision: 1
Title: Locked Rotor Accident (LRA) Analysis Using AST	
Facility: ☐ MT ☒ PI	Unit: ☒ 1 ☒ 2
Safety Class: ☒ SR ☐ Aug Q ☐ Non SR	
Special Codes: ☐ Safeguards ☐ Proprietary	
Type: **Calc** Sub-Type:	

NOTE:	Print **and** sign name in signature blocks, as required.

Major Revisions

EC Number: 13720	☐ Vendor Calc
Vendor Name or Code:	Vendor Doc No:
Description of Revision: The TDAFW pump exhaust steam release path is re-evaluated as Unit 2 Group 1 and Group 2 PORV release paths	
Prepared by: Gopal J. Patel	Date: 07/15/2010
Reviewed by: Thomas J. Mscisz	Date: 07/10/2010
Type of Review: ☒ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☒ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date: 7/13/10

Minor Revisions

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

(continued on next page)

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Calculation Signature Sheet

EC No:	☐ Vendor Calc:
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Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

Record Retention: Retain this form with the associated calculation for the life of the plant.

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NOTE:	This reference table is used for data entry into the PassPort Controlled Documents Module, reference tables (C012 Panel). It may also be used as the reference section of the calculation. The input documents, output documents and other references should all be listed here. Add additional lines as needed.

Reference Documents (PassPort C012 Panel from C020)

#	Controlled* Doc? + Type	Document Name	Document Number	Doc Rev	Ref Type** (if known)
1	☐ RG	Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors	1.183	July 2000	☒Input ☐Output
2	☐ DOC	A Simplified Model for Radionuclide Transport and Removal and Dose Estimation	NUREG/CR-6604	Dec 1997	☒Input ☐Output
3	☒ TRNS	LR Input Parameters	DIT No. 13720-09	0	☒Input ☐Output
4	☒ TRNS	Control Room Input Parameters	DIT No. 13720-07	1	☒Input ☐Output
5	☒ TRNS	Meteorological Input Parameters	DIT No. 13720-03	0	☒Input ☐Output
6	☒ STD	Accident Source Term	10 CFR 50.67		☒Input ☐Output
7	☒ CALC	Prairie Island Atmospheric Dispersion Factors (χ/Qs) – AST Additional Releases	GEN-PI-080	1	☒Input ☐Output
8	☒ Tech Spec	PINGP Units 1 & 2, Definition of Rated Thermal Power	1.1	U1/U2 Amendment 158/149	☒Input ☐Output
9	☒ Tech Spec	PINGP Units 1 & 2, Definition of Dose Equivalent I-131	1.1	U1/U2 Amendment 158/149	☒Input ☐Output
10	☒ Tech Spec	PINGP Units 1 & 2, Definition of E-bar Average Disintegration Energy	1.1	U1/U2 Amendment 177/167	☒Input ☐Output
11	☒ Tech Spec	PINGP Units 1 & 2 LCO for Secondary Specific Activity	3.7.14	U1/U2 Amendment 158/149	☒Input ☐Output

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Calculation Signature Sheet

#	Controlled* Doc? + Type	Document Name	Document Number	Doc Rev	Ref Type** (if known)
12	☒ Tech Spec	PINGP Units 1 & 2 LCO for RCS Specific Activity	3.4.17	U1/U2 Amendment 167/157	☒Input ☐Output
13	☒ Tech Spec	PINGP Units 1 & 2 LCO for Control Room Special Ventilation System (CRSVS)	3.7.10	U1/U2 Amendment 158/149	☒Input ☐Output
14	☒ Tech Spec	PINGP Units 1 & 2 LCO for RCS Operational Leakage	3.4.14	U1/U2 Amendment 158/149	☒Input ☐Output
15	☒ Tech Spec	PINGP Units 1 & 2 Specification for Ventilation Filter Testing Program (VFTP)	5.5.9	U1/U2 Amendment 186/176	☒Input ☐Output
16	☒ Tech Spec	PINGP Units 1 & 2 LCO for Control Room Special Ventilation System (CRSVS) Actuation Instrumentation	3.3.6	U1/U2 Amendment 158/149	☒Input ☐Output
17	☐ FGR	Federal Guidance Report 11	EPA-520/1-88-020		☒Input ☐Output
18	☐ FGR	Federal Guidance Report 12	EPA-402-R-93-081		☒Input ☐Output
19	☒ LTR	Westinghouse Letter - Nuclear Management Company Prairie Island Units 1 & 2, MUR Power Uprate Program, Core Activity Inventory and Coolant Activity Concentrations	NSP-07-59 LTR-PEP-07-26	11/02/2007	☒Input ☐Output
20	☐ STD	Laboratory Testing of Nuclear-Grade Activated Charcoal	GL 99-02	6/3/99	☒Input ☐Output
21	☐ DOC	ASME Steam Tables		Sixth Edition	☒Input ☐Output
22	☐ SRP	NUREG-0800, Standard Review Plan, "Radiological Consequence Analyses Using Alternative Source Terms"	15.0.1	0	☒Input ☐Output
23	☒ CALC	Post-LOCA EAB, LPZ, and CR Doses - AST	GEN-PI-079	0	☒Input ☐Output
24	☒ USAR	Steam Generator Design Data	Table 4.1-5	27	☒Input ☐Output
25	☒ CALC	Locked Rotor Accident Dose Consequences	12400604-UR(B)-002	0	☐Input ☒Output

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Calculation Signature Sheet

#	Controlled* Doc? + Type	Document Name	Document Number	Doc Rev	Ref Type** (if known)
26	☐ STD	Deletion of E Bar Definition and Revision to RCS Specific Activity Tech Spec	TSTF-490	0	☒Input ☐Output
27	☒ PROC	Natural Circulation Cooldown With CRDM Fans	1ES-0.3A	14	☒Input ☐Output
28	☒ PROC	Natural Circulation Cooldown Without CRDM Fans	1ES-0.3B	11	☒Input ☐Output
29	☒ DRAW	Admin Bldg, Screen House, & Control RM Flow Diagram	NF-39603-1, Rev 76, Including T-Mod EC 14090	76	☒Input ☐Output
30	☒ LAR	LAR to Revise the Loss of Coolant Accident (LOCA) and Main Steam Line Break Accident (MSLB) Dose Consequences Analyses and Affected Technical Specifications (TS)	L-PI-08-052	06/26/2008	☒Input ☐Output
31	☒ USAR	PINGP USAR Appendix D - Activity In Fuel Gap	Section D.2	27	☒Input ☐Output
32	☒ CALC	FHA Fission Product Inventories for AST Assessments	GEN-PI-047	0, Add 1	☒Input ☐Output
33	☒ LA	PINGP Amendment Nos. 166 and 156 to Operating License Nos. DPR-42 and DPR-60, respectively, Selective Implementation Of Alternate Source Term For Fuel Handling Accidents	LA # 166 & 156		☒Input ☐Output
34	☒ USAR	Steam Generators	Section 4.3.2.1.1	29	☒Input ☐Output
35		Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants	1.52	2	☒Input ☐Output
36	☒ PROC	PINGP Emergency Plan Implementing Procedure, Determination of Radioactive Release Concentrations	F3-20	22	☒Input ☐Output
37	☒ TRNS	Steam Release Pathway Inputs for Main Steam Line Break (MSLB), Steam Generator Tube Rupture (SGTR), Locked Rotor Accident (LRA) and Control Rod Ejection Accident (CREA)	DIT No. 13720-16	0	☒Input ☐Output

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Calculation Signature Sheet

#	Controlled* Doc? + Type	Document Name	Document Number	Doc Rev	Ref Type** (if known)
38	☒ PROC	PINGP Operating Procedure, Unit 1 Shutdown Unit 2 Shutdown	1C1.3 2C1.3	68 67	☒Input ☐Output
39	☒ CALC	Shaw Stone & Webster Calculation - ARCON96 Atmospheric Dispersion Factors (χ/Qs) for Post-LOCA Gaseous Radiological Releases from Units 1 and 2	12400604-WM(B)-001	0	☒Input ☐Output

*Controlled Doc checkmark means the reference can be entered on the C012 panel in black. Unchecked lines will be yellow. If checked, also list the Doc Type, e.g., CALC, DRAW, VTM, PROC, etc.)

**Corresponds to these PassPort "Ref Type" codes: Inputs/Both = ICALC, Outputs = OCALC, Other/Unknown = blank)

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Calculation Signature Sheet

Other Pass Port Data

Associated System (PassPort C011, first three columns) **OR** **Equipment References** (PassPort C025, all five columns):

Facility	Unit	System	Equipment Type	Equipment Number
PI	0	ZN	FILTER	069-241
PI	0	ZN	FILTER	069-242
PI	1	MS	CV	CV-31084
PI	2	MS	CV	CV-31102
PI	1	MS	CV	CV-31089
PI	2	MS	CV	CV-31107
PI	1	MS	CV	CV-31085
PI	1	MS	CV	CV-31086
PI	1	MS	CV	CV-31090
PI	1	MS	CV	CV-31091
PI	2	MS	CV	CV-31103
PI	2	MS	CV	CV-31104
PI	2	MS	CV	CV-31108
PI	2	MS	CV	CV-31109
PI	1	MS	RFV	RS-21-1
PI	1	MS	RFV	RS-21-2
PI	1	MS	RFV	RS-21-3
PI	1	MS	RFV	RS-21-4
PI	1	MS	RFV	RS-21-5
PI	1	MS	RFV	RS-21-6
PI	1	MS	RFV	RS-21-7
PI	1	MS	RFV	RS-21-8
PI	1	MS	RFV	RS-21-9
PI	1	MS	RFV	RS-21-10
PI	2	MS	RFV	RS-21-11
PI	2	MS	RFV	RS-21-12
PI	2	MS	RFV	RS-21-13
PI	2	MS	RFV	RS-21-14

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Calculation Signature Sheet

Facility	Unit	System	Equipment Type	Equipment Number
PI	2	MS	RFV	RS-21-15
PI	2	MS	RFV	RS-21-16
PI	2	MS	RFV	RS-21-17
PI	2	MS	RFV	RS-21-18
PI	2	MS	RFV	RS-21-19
PI	2	MS	RFV	RS-21-20
PI	0	RD	RM	RM-23
PI	0	RD	RM	RM-24
PI	1	SG	GEN	134-011
PI	1	SG	GEN	134-012
PI	2	SG	GEN	234-011
PI	2	SG	GEN	234-012

Superseded Calculations (PassPort C019):

Facility	Calc Document Number	Title

Description Codes - Optional (PassPort C018):

Code	Description (optional)	Code	Description (optional)

Notes (Nts) - Optional (PassPort X293 from C020):

Topic Notes	Text
☐ Calc Introduction	☒ Copy directly from the calculation Intro Paragraph **or** ☐ See write-up below
The purpose of this calculation is to determine the Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and Control Room (CR) doses due to a Locked Rotor Accident (LRA) using the Alternative Source Term (AST) methodology, the total effective dose equivalent (TEDE) dose criteria, and the plant-specific bounding design information applicable to the PINGP Units 1 & 2 steam generators (SGs). The dose consequences are representative of an LRA occurring in either Unit 1 or Unit 2.	
☐ (Specify)	

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Design Review Comment Form

Sheet ___ of ___

DOCUMENT NUMBER/ TITLE: GEN-PI-083/ Locked Rotor Accident (LRA) Analysis Using AST

REVISION: 0 DATE: _____

ITEM #	REVIEWER'S COMMENTS	PREPARER'S RESOLUTION	REVIEWER'S DISPOSITION
1	Minor editorial comments made in document text.	Incorporated.	Accepted 07/22/09
2	Section 2.1 states that the Prairie Island fuel management program can result in some fuel assemblies being exposed to a maximum LHGR that exceeds 6.3 kw/hr at fuel burnups between 54 and 62 GWD/MTU. There should be a statement of what the calculated LHGR is, and how many assemblies are affect ted. This will potentially eliminate RAI questions.	The comparison of the plant-specific GAP fraction with the RG 1.183, gap fraction in Table 3 indicates that the calculated gap fraction for the most limiting I-131 is at least two times lower than that in RG 1.183, Table 3. Therefore, the tacking of number of assemblies exceeding LHGR of 6.3 kw/hr is essential because it provides a large margin for the same.	Accepted 07/22/09
3	Section 2.1 makes reference to the normalized default nuclide inventory file (NIF) "Pwr_def.nif", which is modified based on the PINGP plant-specific isotopic core inventory. It also states that there are two modified NIF files "PILRA_Iodin_def.txt" and "PILRA_Liq_def.txt" are used in the analysis. However none of these files are included in the calculation. All .nif, .rft, and any modified .inp files should be included.	Since the NIF and RFT files are reproduced by the RADTRAD code in the output files, therefore, they are not provided in the attachment. The modified DCF is added.	Accepted 07/22/09
4	Design Input Table item 5.3.1: There should be something that says that 1683 MWt includes the 102% as used in section 5.3.5.	Incorporated.	Accepted 07/22/09
5	Section 7.3.2 (CRSVS HEPA Filter Efficiency) states that Generic Letter 99-02 requires a safety factor of at least 2 to be used to determine the filter efficiencies to be credited in the design basis accident. Although this true for charcoal laboratory testing, RG 1.52 states that if the in-place filter penetration and bypass test results are less than or equal to 0.05%, then an efficiency of 99% can be assigned.	The PINGP Ventilation Filter Testing Program, Section 5.5.9.a, shows that the inplace DOP test for the HEPA shows a penetration and system bypass < 0.05%, Therefore, a safety factor of 2 is conservatively applied. The word "system bypass" is added for completeness.	Accepted 07/22/09
6	Tables 8 & 9 should have the names of the .NIF files that are associated with them for clarity.	Incorporated.	Accepted 07/22/09

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Design Review Comment Form

Sheet ___ of ___

DOCUMENT NUMBER/ TITLE: GEN-PI-083/ Locked Rotor Accident (LRA) Analysis Using AST

REVISION: 0 DATE: _____

ITEM #	REVIEWER'S COMMENTS	PREPARER'S RESOLUTION	REVIEWER'S DISPOSITION
7	Tables 12 & 13 should have some tie-in to the RADTRAD inputs. It is difficult to follow the RADTRAD input file to see where the values came from.	Section 5.5.17 is added to establish a link for the X/Qs used in the analysis	Accepted 07/22/09
END			
Reviewer: Thomas Mscisz Date: 05/17/2009		Preparer: Gopal J. Patel Date: 07/15/2009	

REVISION HISTORY

Revision	Description
0	Initial issue
1	The TDAFW pump exhaust steam release is re-evaluated as Unit 2 Groups 1 and 2 PORV release paths

SHEET REVISION INDEX

SHEET	REV	SHEET	REV
1	1	31	1
2	1	32	1
3	1	33	1
4	1	34	1
5	1	35	1
6	1	36	1
7	1	37	1
8	1	38	1
9	1	39	1
10	1	40	1
11	1	41	1
12	1	42	1
13	1	43	1
14	1	44	1
15	1	45	1
16	1	46	1
17	1	47	1
18	1	48	1
19	1	49	1
20	1	50	1
21	1	51	1
22	1	Attachment 13.1	1
23	1	Attachment 13.2	1
24	1	Attachment 13.3	1
25	1	Attachment 13.4	1
26	1		
27	1		
28	1		
29	1		
30	1		

TABLE OF CONTENTS

Section	Sheet No.
Cover Sheet	1
Revision History	11
Sheet Revision Index	12
Table of Contents	13
1.0 Purpose And Summary Report	14
2.0 Methodology	14
3.0 Acceptance Criteria	20
4.0 Assumptions	21
5.0 Design Inputs	27
6.0 Computer Codes & Compliance With Regulatory Requirements	33
7.0 Calculations	34
8.0 Results Summary And Conclusions	38
9.0 References	39
10.0 Tables	41
11.0 Figures	49
12.0 Affected Documents	51
13.0 Attachment	51
13.1 RADTRAD Output File PLRINID02.o0	52
13.2 RADTRAD Output File PLRAING02.o0	74
13.3 RADTRAD Output File PLRAINLQ02.o0	94
13.4 Modified RADTRAD Dose Conversion File PINGP_fg11&12.txt	115

1.0 PURPOSE AND SUMMARY REPORT:

1.1 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 a Locked Rotor Accident (LRA) using the Alternative Source Term (AST) methodology, the total effective dose equivalent (TEDE) dose criteria, and the plant-specific bounding design information applicable to the PINGP Units 1 & 2 steam generators (SGs). The dose consequences are representative of an LRA occurring in either Unit 1 or Unit 2.

1.2 Summary Report

The resulting post-LRA doses are shown in Section 8.0. These doses comply with the applicable regulatory allowable dose limits.

2.0 METHODOLOGY:

The PINGP operating licenses are proposed to amend to implement the full scope AST methodology in lieu of the TID-14844 source term methodology. The TEDE offsite dose acceptance criteria specified in Table 6 of Regulatory Guide 1.183 (Ref. 9.1) is implemented in lieu of the whole body and thyroid dose guidelines provided in 10 CFR 100.11. In addition, the 5 rem TEDE control room dose acceptance criterion specified in 10 CFR 50.67 (Ref. 9.4) is implemented in lieu of the 5 rem whole body and equivalent organ dose guidelines provided in 10 CFR 50 Appendix A GDC 19.

The design basis locked rotor accident is analyzed using a conservative set of assumptions and as-built design inputs. The numeric values of the critical design inputs are conservatively selected to assure an appropriate prudent safety margin against unpredicted events in the course of an accident and compensate for large uncertainties in facility parameters, accident progression, radioactive material transport, and atmospheric dispersion. The LRA analysis is performed using the guidance in Regulatory Guide 1.183 and its Appendix G (Ref. 9.1).

This analysis uses Version 3.02 of the RADTRAD computer code (Ref. 9.2) to calculate the potential radiological consequences of the LRA. The validation and verification (V&V) of the RADTRAD code is addressed in Section 6.

The LRA dose consequences are determined by summing together the results from the primary-to-secondary (P-T-S) leakage iodine activity release, the P-T-S leakage noble gas activity release, and the secondary liquid iodine release.

2.1 Failed Fuel Gap Inventory

The principal radiation source term for the LRA is the fuel gap activity in the failed fuel caused by the transient of the accident. The PINGP plant-specific LRA analysis predicted that no more than 20% of the fuel in the core will fail (Ref. 9.3.1, Item #3). Consistent with the guidance in Regulatory Guide 1.183 (Ref. 9.1, Appendix G, Section 3), the failed fuel rod gap activity is assumed to be released instantaneously and homogenously through the primary coolant (i.e., reactor coolant system [RCS]) at the start of the event.

The fuel gap isotopic activity release fractions are in accordance with RG 1.183 (Ref. 9.1, Table 3). Footnote 11 to Table 3 of RG 1.183 requires that the maximum linear heat generation (LHGR) does not

exceed 6.3 kw/ft peak rod average power for burnups exceeding 54 GWD/MTU. The Prairie Island fuel management program can result in some fuel assemblies being exposed to a maximum LHGR that exceeds 6.3 kw/hr at fuel burnups between 54 and 62 GWD/MTU (Ref. 9.20). To account for the higher LHGR a site-specific analysis was performed in Reference 9.21 and a computer code, "GAP" was developed and qualified using methodology presented in ANSI/ANS-5.4-1982 to perform the site-specific gap fraction analysis. The NRC reviewed the GAP code during approval of the PINGP license amendment for implementing selective implementation of AST for FHA (Ref. 9.22, Section 3.2) and determined that the analytical approach is consistent with the ANSI/ANS-5.4-1982 model, and that the GAP code is acceptable for analyzing the gap release fraction. The plant-specific gap fractions are compared with the RG 1.183 gap fractions in Table 1A, which indicates that the gap fractions in Table 3 of RG 1.183 are bounding for the PINGP fuel assemblies exceeding the maximum LHGR of 6.3 kw/ft.

The exclusion of iodine spiking is consistent with the guidance presented in RG 1.183 (Ref. 9.1, Appendix E, Footnote 2), which states that the activity assumed in the analysis should be based on the activity associated with the projected fuel damage <u>or</u> the maximum technical specification values, whichever maximizes the radiological consequences. Since the RCS activity associated with 20% failed fuel is greater than that of an iodine spike, the iodine spike is not included with the failed fuel activity release.

Per Regulatory Guide 1.183 (Ref. 9.1, Section 3.2), for non-LOCA events (such as an LRA), the fractions of the core inventory assumed to be in the fuel rod gap space for the various radionuclides are given in RG 1.183 Table 3. Per RG 1.183 Table 3, the isotopes present in the gap are noble gases, iodine and alkali metals. Per RG 1.183 Section 3.4 and Table 5, noble gases are Xenon and Krypton isotopes, halogens are Iodine and Bromine isotopes, and alkali metals are Cesium and Rubidium isotopes.

The alkali metals (Cs, Rb) present in the source term are omitted from the RADTRAD analysis since they have a negligible impact on the analysis results, primarily because the dose contribution from alkali metals is insignificant compared to the dose contribution from noble gases which are released directly to the environment without hold-up.

In an intact steam generator in which the tubes are covered by liquid for the event duration, the release of alkali metals is facilitated solely by steam generator moisture carryover of no more than 0.25% (Ref. 9.23) (i.e., a factor of 400 less than the noble gas release rate). In addition, the alkali metals introduced into both intact SGs are diluted within the SG space of approximately 3400 cubic feet (per Section 7.1.2), and then gradually released as this SG liquid volume is steamed to the environment at a rate of no more than 40 cfm (per Section 7.2.2, without consideration of iodine PC of 100). This release rate of approximately 0.012 SG volumes per minute (= 40 cfm / 3400 cf) is 85 times lower than the noble gas release rate to the environment. Combining the moisture carryover and hold-up effect indicates that the alkali metal release rate is approximately 34,000 times (= 400 x 85) lower than the noble gas release rate to the environment. This hold-up of the alkali metal within the intact SG significantly reduces the alkali metal activity released to the environment in comparison to the noble gas activity released to the environment.

In addition, the control room dose contribution from alkali metals is further minimized by their removal via the 99% efficient control room HEPA recirculation filter (Ref. 9.3.2, Item #14), which would reduce the alkali metal CR dose contribution by an additional factor of 100.

The activity released during the vent contributes to the external dose (whole body gamma – DDE) and internal dose (inhaled – CEDE). All alkali isotopes including the daughters are naturally beta emitters; therefore, they do not contribute to any external dose. The inhaled dose conversion factors for the rubidium and cesium isotopes are calculated in Table 14, which shows that the alkali isotopes are

inherently low thyroid inhalation dose contributors. These dose characteristics combined with the extremely low fractional release of less than 1/34,000 will result in inconsequential CR and offsite doses, which will be eliminated as being less than the significant figure rounding error.

Westinghouse Letter NSP-07-59, LTR-PEP-07-26 (Ref. 9.9, Table 2-1) presents the PINGP Units 1 and 2 core inventory at a core thermal power level of 1683 MWt at reactor shutdown. This core inventory is bounding for the 422V+ (Heavy Bundle or HB) core and OFA core (Ref. 9.9, Section 2.0). The core activity is based on a core thermal power of 1,683 MW_t (= 1,650 MW_t x 1.02) including the 2% power level measuring instrument uncertainty, fuel enrichment of 5.0%, and cycle burnup of 25,000 MWD/MTU (Ref. 9.9, Table 6-1). For conservatism and to bound possible core inventory increases associated with a 10% Power Uprate, the Table 1 core inventory is used in this analysis with the core thermal power level of 1,852 MWt (= 1.10 × 1,683 MWt).

NUREG/CR-6604 (Ref. 9.2, Section 1.4.3.2 and Table 1.4.3.2-2) provides the normalized default nuclide inventory file (NIF) "Pwr_def.nif", which is modified based on the PINGP plant-specific isotopic core inventory. Modified NIF files "PILRA_Iodin_def.txt" and "PILRA_Liq_def.txt" are used in the analysis.

The design basis core iodine and noble gas activity releases from the 20% failed fuel are calculated in Table 1 using the gap release fractions in RG 1.183, Table 3. Consistent with RG 1.183 (Appendix G, Section 3), the activity released from the failed fuel is assumed to be instantaneously and homogeneously mixed through the primary coolant.

2.2 RCS Iodine Inventory

Westinghouse Letter NSP-07-59, LTR-PEP-07-26 (Ref. 9.9, Table 2-2, HB × 1.04 scenario) provides the PINGP Units 1 and 2 RCS iodine activity concentrations based on a 1% fuel defect level. Table 4 converts the iodine activity concentration profile based on this 1% fuel defect level into its corresponding Dose Equivalent Iodine-131 (DE I-131) activity concentration using the thyroid inhalation dose conversion factors listed in Table 2. Technical Specification 1.1 defines Dose Equivalent I-131 as that concentration of I-131 that alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134 and I-135 actually present. Technical Specification 1.1 defines Dose Equivalent I-131 in terms of the thyroid dose conversion factors listed in Table III of TID-14844. In this calculation, consistent with RG 1.183 methodology (Ref. 9.1, Section 4.1.2), DE I-131 is defined in terms of the committed effective dose equivalent (CEDE) iodine inhalation dose conversion factors of FGR-11 (Ref. 9.7). The revision to use of FGR dose conversion factors in the Technical Specification 1.1 definition for DE I-131 will be included in the AST license amendment request. The iodine inhalation dose conversion factors are calculated in Table 2 and used in Table 3 to establish a scaling factor based on 0.50 μCi/gram DE I-131 to calculate Tech Spec iodine concentration in Table 4. The total isotopic iodine activities are conservatively calculated using the 1% failed fuel iodine concentration instead of 0.50 μCi/gram DE I-131 concentration and RCS mass (per Section 7.1.1) in Table 5.

2.3 Noble Gas Inventory

Per Technical Specification LCO 3.4.17 (Ref. 9.6.5), the maximum permitted equilibrium RCS non-iodine concentration is 100/E-BAR. The parameter E-BAR is defined in Technical Specification Section 1.1 (Ref. 9.6.3) as the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per

disintegration (in MeV) for isotopes, other than iodines, with half lives greater than 15 minutes, making up at least 95% of the total non-iodine activity in the coolant.

The PINGP licensing proposes the deletion of the E-BAR definition and revision of the RCS Specific Activity Tech Specification to utilize a new indicator, Dose Equivalent Xenon-133, instead of the current indicator known as E-BAR. The current limits on primary coolant gross specific activity will be replaced with limits on primary coolant noble gas activity. The noble gas activity would be based on DOSE EQUIVALENT XE-133 and would take into account only the noble gas activity in the primary coolant. The determination of Dose Equivalent Xe-133 will be performed in a similar manner to that currently used in determining DE I-131, except that the calculation of Dose Equivalent Xe-133 is based on the acute dose to the whole body and considers the noble gases which are significant in terms of contribution to whole body dose. Some noble gas isotopes are not included due to low concentration, short half-life, or small dose conversion factor.

Per TSTF-490 traveler (Ref. 9.16), the DOSE EQUIVALENT XE-133 shall be that concentration of Xe-133 (μCi/g) that alone would produce the same acute dose to the whole body as the combined activities of noble gas nuclides [Kr-85m, Kr-85, Kr-87, Kr-88, Xe-131m, Xe-133m. Xe-133, Xe-135m, Xe-135, and Xe-138] actually present. The determination of DOSE EQUIVALENT XE-133 shall be performed using effective dose conversion factors for air submersion listed in Table III.1 of EPA Federal Guidance Report No. 12, 1993. "External Exposure to Radionuclides in Air, Water, and Soil" or the average gamma disintegration energies as provided in ICRP Publication 38, "Radionuclide Transformations" or similar source.

The XE-133 Dose Equivalent concentration is established in Table 6 as defined in the TSTF-490 design specification using effective dose conversion factors for air submersion listed in Table III.1 of EPA Federal Guidance Report No. 12 (Ref. 9.8) and 1% failed fuel noble gas isotopic concentrations in Reference 9.9, Table 2-2 for HB x 1.04. The proposed XE-133 Dose Equivalent concentration limit for noble gas activity is calculated to be 580 μCi/g XE-133 DE (Table 6), and is used in this analysis with the noble gas isotopic concentrations in Table 7.

2.4 RCS Alkali Metal Inventory

Westinghouse Letter NSP-07-59, LTR-PEP-07-26 (Ref. 9.9, Table 2-2) presents the PINGP Units 1 and 2 RCS non-iodine activity concentrations based on a 1% fuel defect level. As discussed in Section 2.1, all alkali metals are omitted from the RADTRAD analysis. This analysis considers only the iodine and noble gas isotopes present in the modified Nuclide Inventory Files "PILRA_Iodin_def.txt" and "PILRA_Liq_def.txt" that are described in Section 2.1.

Table 8 determines the post-LRA total iodine and noble gas activity initially present in the RCS by summing the RCS activity introduced by the 20% fuel failure from Table 1 with the initial RCS activity at the 1 percent fuel defect level from Tables 5 and 7. This RCS activity inventory is input into RADTRAD Nuclide Inventory File "PILRA_Iodin_def.txt.

2.5 Secondary Coolant Liquid Iodine Inventory

Per Technical Specification LCO 3.7.14 (Ref. 9.6.4) the secondary coolant iodine concentration is limited to 0.1 μCi/gram DE I-131. This is one-fifth of the proposed Specification LCO 3.4.17 RCS iodine concentration limit of 0.50 μCi/gram DE I-131. In Table 9, the RCS iodine concentration profile at the 1% fuel defect level (which is conservatively greater than 0.50 μCi/gm DE I-131) is multiplied by the secondary to primary limits (0.1/0.5) to determine the secondary coolant iodine concentration profile. Table 9 scales this secondary coolant iodine activity concentration profile by the coolant mass in both intact steam generators (per Section 7.1.2) to calculate the total secondary coolant iodine

inventory. This secondary coolant iodine activity inventory is input into RADTRAD Nuclide Inventory File "PILRA_Liq_def.txt".

2.6 Post-LRA Releases

2.6.1 Primary to Secondary (P-T-S) Leakage Rate

This analysis models the RCS operational leakage limit of 150 gallons/day of primary to secondary (P-T-S) leakage through each steam generator (SG) at 70°F (i.e., 300 gpd through both SGs) as specified in Technical Specification LCO 3.4.14 (Ref. 9.6.7).

Consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 5.3) the primary-to-secondary leakage is assumed to continue until the primary system pressure is less than the secondary system pressure, or until the temperature of the leakage is less than 212°F, and the release of radioactivity is assumed to continue until shutdown cooling is in operation and releases from the steam generator have terminated. In this analysis the RCS is assumed to leak into the SGs for 45.5 hours at which time the Residual Heat Removal (RHR) system is initialized (Ref. 9.3.1, Item #25).

2.6.2 RCS Iodine Release Trough P-T-S Leakage

The SG tubes are expected to be submerged in the intact SGs coolant during the LRA, with no tube uncovery (Ref. 9.3.1, Item #22). The iodine activity in the P-T-S leakage is assumed to mix with SG coolant without flashing during period of submergence (Ref. 9.1, Appendix E, Section 5.5.1) and iodine partition coefficient of 100 is assumed (Ref. 9.1, Appendix E, Section 5.5.1 and Ref. 9.3.1, Item #22). The RCS iodine release continues until the RHR system is initialized at 45.5 hours (Ref. 9.3.1, Item #25).

The doses from the LRA RCS iodine release are summarized in Section 8.1.

2.6.3 RCS Noble Gas Release Trough P-T-S Leakage

Noble gases present in the P-T-S leakage are released directly to the environment without dilution or retention in the intact SGs. The RCS noble gas release continues until the RHR system is initialized at 45.5 hours (Ref. 9.3.1, Item #25).

The doses from the LRA RCS noble gas release are summarized in Section 8.1.

2.6.4 Secondary Liquid Iodine Release to the Environment

The iodine activity in the bulk water in the SG is assumed to become vapor and is directly released to the environment in proportion to the steam release rate, with credit taken for iodine partitioning in the SG liquid. For the secondary liquid iodine release from the SGs, an iodine partition coefficient of 100 is assumed as recommended in Regulatory Guide 1.183 (Ref. 9.1, Appendix G, Section 5.6 and Appendix E, Section 5.5.4).

The secondary coolant iodine release continues until the RHR system is initialized at 45.5 hours (Ref. 9.3.1, Item #25).

The doses from the LRA secondary liquid iodine release are summarized in Section 8.1.

2.7 Steam Release Atmospheric Dispersion to the Control Room

In Revision 0 of this calculation, the post-LRA long-term release was postulated to be through the turbine driven auxiliary feed water pump (TDAFWP) exhaust. In actuality, the steam is released through the TDAFW pump exhaust momentarily when offsite power is lost, until such time that the diesel generator completes its load sharing sequence and onsite power is available to safety related equipment including the motor driven AFW pump (MDAFWP). Plant operating procedures provide guidance such that the operators would preferentially use the MDAFWP in lieu of the TDAFWP. Per shutdown procedure C1.3 (Ref. 9.26), only one AFW pump is running when one pump is able to maintain SG levels (Step 5.4.13). The MDAFW Pump is preferable to the TDAFW Pump (implied from Steps 5.4.5 and 5.4.6). In addition, speed of the TDAFWP is affected by the steam pressure in the SG. At lower steam pressures in the SG, the TDAFWP would slow down and provide inadequate FW inventory to cover the SG tube. Furthermore, the activity levels released from the TDAFWP steam exhaust are not accurately estimated during an event – see procedure F3-20, Step 5.1 (Ref. 9.25). In order to provide adequate SG tube coverage and more accurate estimates of releases, the MDAFW pump is obviously used.

There will be a steam release through the TDAFWP exhaust momentarily (less than a few minutes) until the onsite power is available through the diesel generator. The apportioned steam mass from the intact SG is conservatively postulated to release from the Unit 2 Groups 1 & 2 PORVs, which have less atmospheric dispersion (i.e., higher χ/Qs) than a release from the TDAFWP exhaust (Ref. 9.5, Table 8-5). Thus, use of the Unit 2 Groups 1 & 2 PORVs χ/Qs conservatively bound the momentary steam release from the TDAFWP exhaust.

The locations of the Units 1 and 2 PORVs with respect to the locations of the Units 1 & 2 CR air intakes are such that the Unit 2 PORVs are located closer to the Unit 2 CR air intake, and thereby provide less atmospheric dispersion, than any other combination of PORV release points and CR air intakes (Ref. 9.27, Section 6). Therefore, the post-LRA activity is postulated to release from the intact SGs via Unit 2 PORVs to maximize the CR dose.

The location of the Unit 2 Group 1 PORV is located closer to the Unit 2 CR air intake, and provides less atmospheric dispersion, than the Unit 2 Group 2 PORV (Ref. 9.5, Sections 2.4 & 2.5). Conservatively, 60 percent of the steam release is assumed from the Unit 2 Group 1 PORV, and the remaining 40 percent of the steam release is assumed from the Unit 2 Group 2 PORV (Refs. 9.3.1 and 9.3.4).

Following the event the intact SGs are used to cooldown the RCS. The mass of the steam released and the release location during the cooldown are important considerations due to the total 300 gpd P-T-S leakage assumed for the intact SGs (maximum allowed by Technical Specification 3.4.14) (Ref. 9.6.7). Assuming a loss of off-site power, the unit would be cooled down using procedure ES-0.3A or ES-0.3B (Ref. 9.17) for cooling down using natural circulation. Per either procedure, the preferred means to release steam for the cooldown is by dumping steam to the condenser. If this path is not available, then the SG PORV is used (Ref. 9.17.1, Step 8 and Ref. 9.17.2, Step 7). The time dependent steaming rates through the intact SGs are shown in Section 5.4.3 and obtained from 9.3.4, Attachment C. The apportioned P-T-S leakage rates used in this analysis are based on the steam mass flow rate distribution through the intact SGs as shown in Table 10.

The post-LRA activity transport and CR response models are shown in Figures 1 and 2, which are used to determine the post-LRA radiological consequences using the plant-specific as-built design inputs and assumptions listed in Sections 4 & 5.

2.8 CR Intake Monitor Response

Post-LRA Xe-133 activity in the CR @ 0.0833 hr (5 minutes)

= 0.58225 Ci (RADTRAD Run PLRAING01.o0)

Control room volume 61,315 ft^3 (Section 5.5.1) = 61,315 ft^3 / $(3.28\ ft/m)^3$ = 1,737.58 m^3

Xe-133 activity concentration in the CR @ 0.0036 hr (0.22 minute)

= 0.58225 Ci / 1,737.58 m^3 = 3.351E-04 Ci/m^3 = 3.351E-04 μCi/cc, which exceeds CR monitor setpoint of 1E-05 μCi/cc for Xe-133 (Section 5.5.19).

Since the Xe-133 activity in the CR is circulated by the CR recirculation flow through the CR air supply duct (Ref. 9.19), the monitor setpoint is instantly exceeded. Therefore, the CR actuation delay of 5 minutes following a LRA is considered extremely conservative, and does not require any further justification.

3.0 ACCEPTANCE CRITERIA:

The following NRC regulatory requirement and guidance documents are applicable to this PINGP Alternative Source Term LRA Calculation:

- Regulatory Guide 1.183 (Ref. 9.1)
- 10 CFR 50.67 (Ref. 9.4)
- Standard Review Plan section 15.0.1 (Ref. 9.12)

Dose Acceptance Criteria are:

Regulatory Dose Limits

Dose Type	Control Room (rem)	EAB and LPZ (rem)
TEDE Dose	5	2.5

4.0 ASSUMPTIONS:

Regulatory Guide 1.183 (Ref. 9.1) provides guidance on modeling assumptions that are acceptable to the NRC staff for the evaluation of the radiological consequences of a LRA. The following sections address the applicability of these modeling assumptions to the PINGP Units 1 and 2 LRA analysis. These assumptions are incorporated as design inputs in Sections 5.3 through 5.6. There are no unverified assumptions used in this analysis.

The radioactivity material releases and radiation levels used in the control room dose analysis are determined using the same source term, transport, and release assumptions used for determining the exclusion area boundary (EAB) and the low population zone (LPZ) TEDE values (Ref 9.1, Section 4.2.2).

4.1 Source Term

For conservatism and to bound possible fuel failure increases associated with a Power Uprate, this analysis assumes that 20% of the fuel in the core has failed (Ref. 9.3.1, Item #3). Per RG 1.183 (Ref. 9.1, Appendix G, Section 2), since fuel damage is postulated for the limiting event, a radiological analysis is required.

4.1.1 Core Inventory

It is assumed that the inventory of fission products in the reactor core is based on the maximum power level of 1,852 MWt corresponding to 110% of 1,683 MWt. The power level of 1,683 MWt is 1.02 times the PINGP current licensed rated thermal power of 1,650 MW_t (Ref. 9.6.1).

4.1.2 Activity Release from the Fuel into the Primary Coolant

It is assumed consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 3), that the activity released from the fuel is assumed to be released instantaneously and homogeneously through the primary coolant (i.e., the Reactor Coolant System).

4.1.3 Iodine Chemical Form

It is assumed consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 4), that the chemical form of iodine releases from the steam generators to the environment is 97% elemental and 3% organic. These fractions apply to iodine releases from the primary-to-secondary (P-T-S) leakage and the secondary liquid.

4.2 Transport

4.2.1 Primary-to-Secondary Leak Rates

This analysis assumes the primary-to-secondary (P-T-S) leakage is at the RCS operational leakage limit of 150 gallons/day through any one SG (i.e., 300 gpd through both SGs) as specified in Technical Specification LCO 3.4.14 (Ref. 9.6.7).

4.2.2 Primary-to-Secondary Leak Primary Coolant Density

It is assumed consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 5.2), that the primary coolant (i.e., RCS) density used in converting the volumetric primary-to-secondary leak rates (e.g., gpm) to mass leak rates (e.g., lb/hr) is 1.0 gm/cc (62.4 lb/ft^3).

4.2.3 Primary-to-Secondary Leak Duration

It is assumed consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 5.3), that the primary-to-secondary leakage continues until the primary system pressure is less than the secondary system pressure, or until the temperature of the leakage is less than 212°F, and the release of radioactivity is assumed to continue until shutdown cooling is in operation and releases from the steam generator have terminated. In this analysis RCS is conservatively assumed to leak into the SGs for 45.5 hours until the RHR system is initialized (Ref. 9.3.1, Item #25).

4.2.4 Release of Fission Products

It is assumed consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 5.4), that the release of fission products from the secondary system is evaluated with the assumption of a coincident loss of offsite power (LOOP). The offsite power is assumed to be lost so that the main steam condensers are not available for removal of the decay heat.

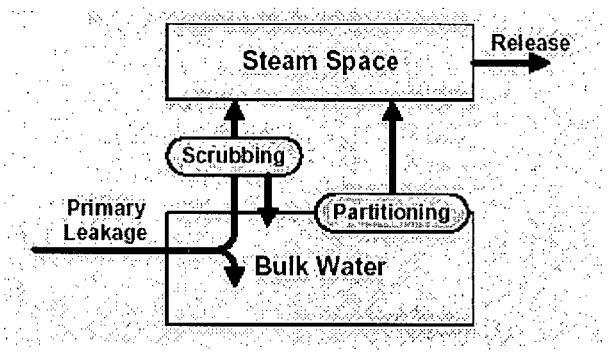
4.2.5 Noble Gas Releases to the Environment

It is assumed consistent with RG 1.183 (Ref. 9.1, Appendix G, Section 5.5), that all noble gas radionuclides released from the primary system (via the primary-to-secondary leak) are released to environment without reduction or mitigation.

4.2.6 Transport Model

RG 1.183 (Ref. 9.1, Appendix G, Section 5.6) states that the main steam line break (MSLB) accident transport model of RG 1.183, Appendix E, Sections 5.5 and 5.6 should be utilized for iodine and particulates. RG 1.183 Appendix E Sections 5.5 and 5.6 present the following transport model for use in evaluating releases from steam generators:

STEAM GENERATOR TRANSPORT MODEL



In this analysis, no credit is taken for iodine scrubbing, only for iodine partitioning. It is assumed consistent with RG 1.183 (Appendix E, Section 5.5.4), that the iodine activity in the bulk water of the two intact steam generators (consisting of the initial secondary coolant iodine activity and the iodine activity introduced via primary-to-secondary leakage) becomes vapor at a rate that is a function of the steaming rate and assumed iodine partition coefficient of 100.

For the primary-to-secondary leakage iodine release from the SGs, the SG tubes are expected to be submerged in the SGs liquid during the event, and consequently iodine introduced into the two intact SGs via the P-T-S leakage is assumed to be released to the environment with an iodine partitioning coefficient of 100 as recommended in RG 1.183 (Ref. 9.1, Appendix G, Section 5.6 and Appendix E, Section 5.5.4 and Ref. 9.3.1, Item #22).

For the secondary liquid iodine release from the SGs, an iodine partition coefficient of 100 is assumed (Ref. 9.3.1, Item #22), consistent with the value of 100 recommended in Regulatory Guide 1.183 (Ref. 9.1, Appendix G, Section 5.6 and Appendix E, Section 5.5.4).

4.3 Offsite Dose Consequences

Regulatory Guide 1.183 (Ref. 9.1, Section 4.1) provides guidance to be used in determining the total effective dose equivalent (TEDE) for persons located at the exclusion area boundary (EAB) and at the outer boundary of the low population zone (LPZ). The following sections address the applicability of this guidance to the PINGP Units 1 and 2 LRA analyses. These assumptions are incorporated as design inputs in Section 5.6.

4.3.1 Modeling of Parent and Daughter Isotopes

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.1.1), that the dose calculation determines the TEDE, which is the sum of the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent (DDE) from external exposure. It is assumed that the CEDE and DDE components of the TEDE consider all radionuclides, including progeny from the decay of parent radionuclides that are significant with regard to dose consequences and the released radioactivity. These isotopes are listed in Section 5.3.

4.3.2 CEDE (Inhalation) Dose Conversion Factors

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.1.2), that the exposure-to-CEDE factors for inhalation of radioactive material are derived from the data provided in ICRP Publication 30, "Limits for Intakes of Radionuclides by Workers". This calculation models the CEDE dose conversion factors (DCFs) in the column headed "effective" yield doses in Table 2.1 of Federal Guidance Report 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" (Ref. 9.7).

4.3.3 Offsite Breathing Rates

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.1.3), that for the first 8 hours, the breathing rate of persons offsite is assumed to be 3.5×10^{-4} cubic meters per second. From 8 to 24 hours following the accident, the breathing rate is assumed to be 1.8×10^{-4} cubic meters per second. After that and until the end of the accident, the rate is assumed to be 2.3×10^{-4} cubic meters per second. These offsite breathing rates are listed in Section 5.6.

4.3.4 DDE (Immersion) Dose Conversion Factors

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.1.4), that the deep dose equivalent (DDE) is calculated assuming submergence in semi-infinite cloud assumptions with appropriate credit for attenuation by body tissue. The DDE is nominally equivalent to the effective dose equivalent (EDE) from external exposure if the whole body is irradiated uniformly. Since this is a reasonable assumption for submergence exposure

situations, EDE is used in lieu of DDE in determining the contribution of external dose to the TEDE. This calculation models the EDE dose conversion factors in the column headed "effective" in Table III.1 of Federal Guidance Report 12, "External Exposure to Radionuclides in Air, Water, and Soil" (Ref. 9.8).

4.3.5 Exclusion Area Boundary Dose Acceptance Criteria

It is assumed for the LRA that the postulated EAB dose should not exceed 2.5 Rem TEDE (per Section 3.2). Per RG 1.183 Table 6, the LRA event release duration is until cold shutdown is established. In this analysis, the LRA event ends when shutdown cooling is placed into operation at 45.5 hours (Ref. 9.3.1, Item #25).

The RADTRAD Code (Ref. 9.2) used in this analysis determines the maximum two-hour TEDE by calculating the postulated dose for a series of small time increments and performing a "sliding" sum over the increments for successive two-hour periods. The time increments appropriately reflect the progression of the accident to capture the peak dose interval between the start of the event and the end of radioactivity release.

4.3.6 Low Population Zone Outer Boundary Dose Acceptance Criteria

It is assumed for the LRA that the postulated LPZ dose should not exceed 2.5 Rem TEDE (per Section 3.3). Per RG 1.183 Table 6, the LRA event release duration is until cold shutdown is established. In this analysis, the LRA event ends when shutdown cooling is placed into operation at 45.5 hours (Ref. 9.3.1, Item #25).

4.3.7 Effluent Plume Depletion

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.1.7), that no correction is made for depletion of the effluent plume by deposition on the ground.

4.4 Control Room Dose Consequences

Regulatory Guide 1.183 (Ref. 9.1, Section 4.2) provides guidance to be used in determining the total effective dose equivalent (TEDE) for persons located in the control room (CR). The following sections address the applicability of this guidance to the PINGP Units 1 and 2 LRA analyses. These assumptions are incorporated as design inputs in Section 5.5.

4.4.1 Control Room Operator Dose Contributors

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.1), the CR TEDE analysis considers the following sources of radiation that will cause exposure to control room personnel:

- Contamination of the control room atmosphere by the filtered CR ventilation inflow through the CR air intake and by unfiltered inleakage of the radioactive material contained in the post-accident radioactive plume released from the facility,
- Contamination of the control room atmosphere by filtered CR ventilation inflow via the CR air intake and by unfiltered inleakage of airborne radioactive material from areas and structures adjacent to the control room envelope,
- * Radiation shine from the external radioactive plume released from the facility (i.e., external airborne cloud shine dose),

- Radiation shine from radioactive material in the reactor containment (i.e., containment shine dose). This form of radiation shine is not applicable to a LRA in which the activity is not released into the containment air space, and
- * Radiation shine from radioactive material in systems and components inside or external to the control room envelope (e.g., radioactive material buildup in CR intake and recirculation filters [i.e., CR filter shine dose]).

* Note: The external airborne cloud shine dose and the CR filter shine dose due to a LRA are expected to be less than those due to a LOCA as a result of source term differences (i.e., the LOCA releases significantly more activity from failed fuel than does the LRA event per RG 1.183 [Ref. 9.1, Table 2 for LOCA compared to Ref. 9.1, Table 3 for LRA]). Therefore, the post-LOCA external airborne cloud and CR filter shine doses are conservatively applied to the LRA in Section 8.1.

4.4.2 Control Room Source Term

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.2), that the radioactive material releases and radiation levels used in the control room dose analysis are determined using the same source term, transport, and release assumptions used for determining the EAB and the LPZ TEDE values. The parameters assumed for determining the EAB and LPZ TEDE values also result in conservative dose projections to the control room personnel.

4.4.3 Control Room Transport

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.3), that the models used to transport radioactive material into and through the control room, and the shielding models used to determine radiation dose rates from external sources, are structured to provide suitably conservative estimates of the exposure to control room personnel. These conservative assumptions include conservative values for unfiltered inleakage, minimum clean-up air flow rates, and minimum filter efficiencies. The shielding models are not developed to determine radiation dose rates from external sources because their dose contributions are insignificant compared to those from a LOCA (Section 4.4.1).

4.4.4 Control Room Response

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.4), that engineered safety features (ESF) are credited in mitigating airborne radioactive material within the control room. Such features include control room recirculation filtration. The CR isolation is actuated by radiation monitors (RMs). The Xe-133 concentration at the CR air intake instantaneously exceeds CR monitor setpoint of 1.0E-05 μCi/ml following a LRA (see Section 2.8). Therefore, a delay of 5 minutes for the CR isolation to be fully operational is considered to be conservative and no further sensitivity of delay time is required.

4.4.5 Control Room Operator Use of Dose Mitigating Devices

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.5), that credit is not taken for the use of personal protective equipment (e.g., protective beta radiation resistant clothing, eye protection, or self-contained breathing apparatus) or prophylactic drugs (i.e., potassium iodide [KI] pills).

4.4.6 Control Room Occupancy Factors and Breathing Rates

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.6), that the CR dose receptor for these analyses is the hypothetical maximum exposed individual who is present in the control room for 100% of the time during the first 24 hours after the event, 60% of the time between 1 and 4 days, and 40% of the time from 4 days to 30 days. For the duration of the event, the breathing rate of this individual should be assumed to be 3.5×10^{-4} cubic meters per second. These assumptions are incorporated as design inputs in Section 5.5.

4.4.7 Control Room Dose Conversion Factors

It is assumed consistent with RG 1.183 (Ref. 9.1, Section 4.2.7), that the control room doses are calculated using the offsite dose analysis dose conversion factors identified in RG 1.183 Regulatory Position 4.1 (see preceding Sections 4.3.2 & 4.3.4). The deep dose equivalent (DDE) from photons is corrected for the difference between finite cloud geometry in the control room and the semi-infinite cloud assumption used in calculating the dose conversion factors. The RADTRAD Code (Ref. 9.2) used in this analysis uses the following expression to correct the semi-infinite cloud dose, DDE_{∞}, to a finite cloud dose, DDE_{finite}, where the control room is modeled as a hemisphere that has a volume, V, in cubic feet, equivalent to that of the control room:

$$DDE_{finite} = (DDE_{\infty} \times V^{0.338}) / 1173$$

4.4.8 Control Room Operator Dose Acceptance Criteria

It is assumed that for the LRA the postulated CR dose should not exceed 5 Rem TEDE (per Section 3.1).

5.0 DESIGN INPUTS:

5.1 General Considerations

5.1.1 Applicability of Prior Licensing Basis

As discussed in RG 1.183 (Ref. 9.1, Section 5.1.4), the implementation of an AST is a significant change to the design basis of the facility and assumptions and design inputs used in the analyses. The characteristics of the AST and the revised TEDE dose calculation methodology may be incompatible with many of the analysis assumptions and methods currently used in the facility's design basis analyses. The PINGP specific design inputs and assumptions used in the TID-14844 analyses were assessed for their validity to represent the as-built condition of the plant and evaluated for their compatibility to meet the AST characteristics and TEDE methodology. The analysis in this calculation ensures that analysis assumptions, design inputs, and methods are compatible with the requirements of the AST and the TEDE criteria. There are no unvalidated assumptions used in this calculation.

5.1.2 Credit for Engineered Safety Features

Credit is taken only for those 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 dose mitigation features of the Control Room Special Ventilation System (CRSVS) are credited in the analysis. This system is safety related and operable by Technical Specification LCO 3.7.10 (Ref. 9.6.6). The CRSVS HEPA particulate removal filtration efficiency, and the CRSVS charcoal iodine removal filtration efficiencies used in the analysis are verified by the Ventilation Filter Testing Program in Technical Specification 5.5.9 (Ref. 9.6.8), which comply with Generic Letter (GL) 99-02 (Ref. 9.10) as demonstrated in Section 7.3. The CRSVS air intake monitors are required to be operable by TS 3.3.6 and Table 3.3.6-1 (Ref. 9.6.9) in Modes 1, 2, 3, & 4 and during movement of irradiated fuel assemblies. The CRSVS actuation during the LRA is credited in the analysis with a 5-minute system response delay.

5.1.3 Assignment of Numeric Input Values

The numeric values chosen as inputs to this analysis are compatible to AST and TEDE dose criteria and selected with the objective of maximizing the postulated dose. The loss of offsite power for the entire duration of the event disabling the condenser, the 60/40 split of Groups 1 & 2 PORV steam releases, use of more than measured CR unfiltered inleakage, 5 minutes delay for CRSVS actuation and a 10% lower CR recirculation flow rate are conservatively used to maximize the resulting doses.

5.1.4 Meteorology Considerations

The control room atmospheric dispersion factors (χ/Qs) are developed in Reference 9.5 using the NRC sponsored ARCON96 computer code. The release points for activity released to the environment are the Unit 2 Groups 1 & 2 PORV release locations (Section 2.7).

Per the AST LOCA Calculation GEN-PI-079 (Ref. 9.13, Sections 2.4.1 & 2.4.2), the use of the CR air intake χ/Qs are conservative for the CR unfiltered inleakage and are modeled for both the CR makeup flow during 0 to 5 minutes and the unfiltered inleakage for greater than 5 minutes.

The EAB and LPZ χ/Qs used in this analysis were originally developed for the plant operating license and were accepted by the staff in the previous licensing proceedings.

5.2 Accident-Specific Design Inputs/Assumptions

The design inputs and assumptions utilized in this EAB, LPZ, and CR dose consequence analysis are listed in the following sections. The design inputs are compatible with the requirements of the AST characteristics and TEDE dose criteria and the assumptions are consistent with those identified in Section 4 and Appendix G 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
Locked Rotor Accident Parameters		
5.3 Source Terms		
5.3.1 Licensed reactor core thermal power level	1,650 MW_t 1,683 MW_t (= 102% of 1,650 MW_t) 1,852 MW_t (= 110% of 1,683 MW_t)	9.6.1 10% EPU Power Level Used in the analysis
5.3.2 Proposed LCO for RCS iodine specific activity	1.0 μCi/gm DE Iodine-131 Modeled as 0.50 μCi/gm DE I-131 per Ref. 9.18	9.6.2, 9.6.5, & 9.18
5.3.3 Reactor Coolant System (non-iodine) specific activity in the Technical Specifications	100 / E-bar 580 μCi/gm DE of Xe-133	9.6.3 Proposed limit is used in the analysis Section 2.3, Tables 6 & 7, Used in the analysis
5.3.4 Secondary coolant (iodine) specific activity in the Technical Specifications	0.1 μCi/gm DE Iodine-131	9.6.2 & 9.6.4

5.3.5 Core activity inventory at 1683 MWt — 9.9, Table 2-1

Isotope	Activity (Ci)	Isotope	Activity (Ci)	Isotope	Activity (Ci)
I-131	4.50E+07	Kr-85	7.15E+05	Xe-133M	2.86E+06
I-132	6.51E+07	Kr-85M	1.08E+07	Xe-135	2.07E+07
I-133	9.13E+07	Kr-87	2.12E+07	Xe-135M	1.95E+07
I-134	1.02E+08	Kr-88	2.82E+07	Xe-138	7.72E+07
I-135	8.72E+07	Xe-131M	5.06E+05		
Kr-83M	0.00E+00	Xe-133	9.15E+07		

5.3.6 RCS iodine activity concentration based on 1% fuel defects — 9.9, Table 2-2 for HB x 1.04

Isotope	Activity (μCi/gm)	Isotope	Activity (μCi/gm)	Isotope	Activity (μCi/gm)
I-131	2.55E+00	I-134	5.82E-01		
I-132	2.80E+00	I-135	2.20E+00		
I-133	3.88E+00				

5.3.7 RCS noble gas activity concentration based on 1% fuel defects — 9.9, Table 2-2 for HB x 1.04

Isotope	Activity (μCi/gm)	Isotope	Activity (μCi/gm)	Isotope	Activity (μCi/gm)
Kr-83M	3.92E-01	Kr-88	2.89E+00	Xe-135	8.24E+00
Kr-85	1.09E+01	Xe-131M	2.05E+00	Xe-135M	5.02E-01
Kr-85M	1.59E+00	Xe-133	2.60E+02	Xe-138	6.09E-01
Kr-87	1.03E+00	Xe-133M	3.65E+00		

5.3.8 Post-LRA failed fuel	20%	9.3.1, Item #3
5.3.9 Fission product inventory in Fuel Rod Gap: I-131 Other Iodines (I & Br) Kr-85 Other Noble Gases (Kr & Xe)	 0.08 0.05 0.10 0.05	Section 2.1

Design Input Parameter	Value Assigned	Reference
5.3.10 Radionuclide Composition		9.1, Table 5
Group	**Elements**	
Noble Gases	Xe, Kr	
Iodines	I, Br	
Alkali Metals	Cs, Rb	
Tellurium Group	Te, Sb, Se, Ba, Sr	
Noble Metals	Ru, Rh, Pd, Mo, Tc, Co	
Lanthanides	La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y, Cm, Am	
Cerium	Ce, Pu, Np	
5.4 Activity Transport Models (Figure 1)		
5.4.1 RCS operational leakage through any one SG	150 gpd – one intact SG 300 gpd – two intact SGs	9.6.7 Used in the analysis
5.4.2 Primary-to-Secondary leak duration	45.5 hours	9.3.1, Item #25
5.4.3 Steam mass released from intact SGs to the environment 0 – 2 hr 2 – 8 hr 8 – 24 hr 24 – 45.5 hr	 226,414 lbm 406,952 lbm 796,899 lbm 863,053 lbm	9.3.4, Attachment C
5.4.4 Deleted		
5.4.5 Nominal Reactor Coolant System volume	5,290 ft^3	9.9, Table 6-1
5.4.6 Steam generator dilution mass: U1 Framatome ANP Model 56/19 U2 Westinghouse Model 51	 107,100 lb @ Full Power 107,420 lb @ Full Power	9.3.1, Item #10
5.4.7 SG liquid iodine partition coefficient for SG liquid iodine release	100	9.1, Appendix E, Section 5.5.4 & 9.3.1, Item #22
5.4.8 SG liquid iodine partition coefficient for P-T-S leakage	100	9.1, Appendix E, Section 5.5.4 & 9.3.1, Item #22
5.4.9 Chemical Form of Iodine In SG Releases Elemental Organic	 97% 3%	9.1, Appendix G, Section 4
5.4.10 Steam condition at full load	519.2^0F and 806.8 psia – Unit 1 510.8^0F and 750 psia – Unit 2	9.14, page 1 of 2
5.4.11 Steam generator moisture carryover: Unit 1 Unit 2	 ≤ 0.10 % ≤ 0.25 %	9.23

Design Input Parameter	Value Assigned	Reference
5.5 Control Room Model Parameters (Figure 2)		
5.5.1 CR Volume	61,315 ft^3	9.3.2, Item #6
5.5.2 CRSVS Normal Flow Rate	1,818 cfm ± 10% 2,000 cfm < 5 minutes	9.3.2, Item #10 Used in the analysis
5.5.3 CRSVS Makeup Rate	0 cfm > 5 minutes	9.3.2, Item #4 (CR operates in a recirculation mode)
5.5.4 CRSVS Recirc Flow Rate	4,000 cfm ± 10% 3,600 cfm > 5 minutes	9.3.2, Item #13
5.5.5 CRSVS Charcoal Filter Efficiencies	95% for elemental iodine 95% for organic iodide	Section 7.3.1
5.5.6 CRSVS HEPA Filter Efficiency	99%	Section 7.3.2
5.5.7 CR Unfiltered Inleakage Determined By Tracer Gas Testing	300 cfm (includes 10 cfm for ingress and egress) (nominal value including uncertainty)	9.3.2, Item #11
5.5.8 CR Breathing Rate	3.5E-04 m^3/sec	9.1, Section 4.2.6
5.5.9 CR Allowable Dose Limit	5 rem TEDE for the event duration	9.4
5.5.10 CR occupancy factors		
Time (Hr)	**%**	9.1, Section 4.2.6
0-24	100	
24-96	60	
96-720	40	
5.5.11 Unit 2 CR air intake χ/Qs for Unit 2 Group 1 PORV Release – Intact SG		
Time (Hr)	**X/Q (sec/m^3)**	
0-2	3.07E-02	9.5, Table 8-5
2-8	2.49E-02	
8-24	1.12E-02	
24-96	7.78E-03	
96-720	6.17E-03	
5.5.12 Unit 2 CR air intake χ/Qs for Unit 2 Group 2 PORV Release – Intact SG		
Time (Hr)	**X/Q (sec/m^3)**	
0-2	2.20E-03	9.5, Table 8-5
2-8	1.81E-03	
8-24	7.97E-04	
24-96	5.16E-04	
96-720	4.00E-04	
5.5.13 PORV Mass Release Distribution	60% from the Group 1 PORVs 40% from the Group 2 PORVs	9.3.1 and 9.3.4 Attachment C
5.5.14 CR Monitor Setpoint	1.0E-05 μCi/ml for Xe-133	9.3.2, Item # 9
5.6 Site Boundary Release Model Parameters		
5.6.1 EAB Atmospheric Dispersion Factor (χ/Q)	6.50E-04 sec/m^3	9.3.3, Item #2
5.6.2 EAB Breathing Rate (m^3/sec)	3.50E-04	9.1, Section 4.1.3
5.6.3 LPZ Distance	2,414 m	9.3.3, Item #3

Design Input Parameter	Value Assigned	Reference
5.6.4 LPZ atmospheric dispersion factors (χ/Qs)		
Time (Hr)	**χ/Q (sec/m^3)**	9.3.3, Item #3
0-8	1.77E-04	
8-24	3.99E-05	
24-96	7.12E-06	
96-720	1.04E-06	
5.6.5 LPZ breathing rates (m^3/sec)		
Time (Hr)	**BR (m^3/sec)**	9.1, Section 4.1.3
0-8	3.5E-04	
8-24	1.8E-04	
24-720	2.3E-04	
5.6.6 EAB allowable dose limit	2.5 rem TEDE	9.1, Table 6
5.6.7 LPZ allowable dose limit	2.5 rem TEDE	9.1, Table 6

6. COMPUTER CODES & COMPLIANCE WITH REGULATORY REQUIREMENTS

6.1 COMPUTER CODES:

RADTRAD 3.03 (Ref. 9.2) 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 the 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.

Calculation GEN-PI-079 (Ref. 9.13, Sections 2.6 & 8.2) documents a V&V of the RADTRAD3.03 code. Suitable acceptance test cases for the PWR radiological analysis were incrementally selected, initially defining simplified cases that could verified against analytical solutions, then adding complexity (typically a control room) and comparing the results against the RADTRAD3.03 and HABIT code analyses, adding more complexity (e.g., removal by decay chain) and comparing the results with the RADTRAD3.03 and HABIT codes again. The selected PWR code cases cover all essential characteristics of an LRA AST analysis, including transportation of activity within the compartment and in the atmosphere. All radiological features of the RADTRAD3.03 code were verified and validated by running the selected PWR code cases in the Microsoft Window XP environment. The results of V&V code cases were summarized in Calculation GEN-PI-079, Section 8.2, and compared with the RADTRAD3.03 and HABIT code results, which showed an excellent agreement.

Therefore, the RADTRAD code is considered validated for use in this PINGP AST analysis.

6.2 COMPLIANCE WITH REGULATORY REQUIREMENTS:

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 G.

7.0 CALCULATIONS:

The LRA dose consequences are determined by summing together the results from a set of three RADTRAD code analyses that separately calculate the dose contributions from the primary-to-secondary (P-T-S) leakage iodine activity release, the P-T-S leakage noble gas activity release, and the secondary liquid iodine release.

RADTRAD Nuclide Inventory File (NIF) "PILRA_iodin_def.txt" models the RCS nuclide inventory of Table 8. This inventory includes iodine and noble gas activity initially present in the RCS, including the RCS activity introduced by the 20% fuel failure from Table 1, and the initial RCS activity from Tables 5 and 7. RADTRAD NIF "PILRA_Liq_def.txt" models the secondary coolant iodine inventory of Table 9.

RADTRAD Release Fraction Timing (RFT) File "PINGP_Iodine_RFT.txt" is used for iodine release by setting the iodine release fraction to 1.0 and all other release fractions to zero. RADTRAD RFT File "PILRA_NG_RFT.txt" is used for noble gas release by setting the noble gas release fraction to 1.0 and all other release fractions to zero.

All three RADTRAD runs use Dose Conversion File (DCF) "PINGP_fg11&12.txt", which uses CEDE inhalation DCFs from FGR-11 (Ref. 9.7), and EDE immersion DCFs from FGR-12 (Ref. 9.8).

7.1 Reactor Coolant & Steam Generator Coolant Mass

7.1.1 RCS Mass:

RCS water volume = 5,290 ft^3 @ 560°F and 2235 psia (Ref. 9.9, Table 6-1 & Ref. 9.3.1, Item #24)

RCS specific volume at 560°F and 2235 psia = 0.02165 ft^3/lb (Ref. 9.11, page 281)

RCS density at 560°F and 2235 psia = 1 / (0.02165 ft^3/lb) = 46.19 lb/ft^3

RCS water density at cooled liquid conditions = 62.4 lb/ft^3 (Ref. 9.1, Appendix G, Section 5.2)

The RCS mass at cooled liquid conditions is:

RCS Mass = 5,290 ft^3 × 62.4 lb/ft^3 × 453.6 gm/lb = 1.497E+08 gm [used in Tables 5 and 7] (a larger mass yields a greater RCS activity inventory available for leakage)

7.1.2 SG Liquid Volume and Mass:

The steam generator (SG) tubes are expected to be submerged in the intact SGs coolant during the LRA event, with no tube uncovery (Ref. 9.3.1, Item #22). The iodine activity in the P-T-S leakage is assumed to mix with SG coolant without flashing during period of submergence (Ref. 9.1, Appendix G, Section 5.6 and Appendix E, Section 5.5.1).

The Unit 1 SGs are Framatome ANP Model 56/19 with a full power liquid mass of 107,100 lb (Ref. 9.3.1, Item #10). The Unit 2 SGs are Westinghouse Model 51 with a full power liquid mass of 107,420 lb (Ref. 9.3.1, Item #10). The total intact SG liquid volume is minimized by assuming that the secondary liquid mass is at cooled liquid conditions. Minimizing the intact SGs dilution volume will maximize the intact SGs liquid activity concentrations due to P-T-S leakage. Maximizing the intact SGs liquid activity concentration will conservatively maximize the intact SGs steaming activity releases to the environment.

Total intact SG liquid mass = 107,100 lb + 107,420 lb = 214,520 lb x 453.6 gm/lb = 9.731E+07 gm

Total intact SG liquid volume = 214,520 lb / 62.4 lb/ft^3 = 3,438 ft^3

7.2 Post-LRA Release Rates

7.2.1 P-T-S Leakage Iodine and Noble Gas Release Rate

Per Design Input 5.4.1, the primary to secondary leakage through any one SG is 150 gpd.

P-T-S volumetric leakage rate into intact SGs = 0.208 gpm (= [2 SGs × 150 gpd/SG] / [24 hr/day x 60 min/hr])

P-T-S volumetric leakage rate into intact SGs = (0.208 gal/min) × (0.13368 ft^3/gal) = 0.02781 cfm

Per Regulatory Guide 1.183 (Ref. 9.1, Appendix G, Section 5.2), the density of this P-T-S leakage at the time of surveillance test measurement is assumed to be 1.0 gm/cc (62.4 lb/ft^3). Therefore, the P-T-S mass leakage rate into the intact SGs at measured conditions is:

P-T-S mass leakage rate at measured conditions = (0.02781 ft^3/min) × (62.4 lb/ft^3) = 1.735 lb/min

Per Section 7.1.1, at the time of the LRA the RCS is operating at 560°F and 2235 psia with an RCS specific volume of 0.02165 ft^3/lb. Therefore, the iodine and noble gas P-T-S volumetric leakage rate into the intact SGs at conditions present during the LRA is:

0-45.5 hr P-T-S volumetric leakage rate during the LRA = (1.735 lb/min) × (0.02165 ft^3/lb)

0-45.5 hr P-T-S volumetric leakage rate during the LRA = 0.0376 cfm of RCS liquid

0-45.5 hr iodine and noble gas P-T-S leakage rate from RCS to the intact SGs = 0.0376 cfm

7.2.2 Intact SGs PORVs Steaming Rates (P-T-S Leakage):

Unit 1 steam temperature @ full power = 519.2^{0}F and 806.8 psia (Ref. 9.14)

Unit 1 liquid specific volume @ full power = 0.02089 ft^3/lbm (Ref. 9.11, page 182)

Unit 2 steam temperature @ full power = 510.8^{0}F and 750 psia (Ref. 9.14)

Unit 2 liquid specific volume @ full power = 0.02069 ft^3/lbm (Ref. 9.11, page 182)

Unit 1 liquid specific volume of 0.02089 ft^3/lbm is conservatively used in the following section to maximize the volumetric steaming rates:

The intact SGs tubes remain covered during the LRA, the iodine partition factor of 100 (Ref. 9.1, Appendix G, Section 5.6 and Appendix E, Section 5.5.4) is credited in calculating the steaming rate from the intact SGs :

Total mass of steam released from intact SG to the environment (0 – 2 hr) = 226,414 lb (Ref. 9.3.4, Attachment C)

Intact SG steaming rate (0 – 2 hr) = $\frac{226{,}414 \text{ lb} \times 0.02089 \text{ ft}^3/\text{lb}}{120 \text{ minutes}}$ x (1/100) = 0.3942 cfm of Intact SG liquid

Total mass of steam released from intact SG to the environment (2 – 8 hr) = 406,952 (Ref. 9.3.4, Attachment C)

Intact SG steaming rate (2 – 8 hr) = $\frac{406{,}952 \text{ lb} \times 0.02089 \text{ ft}^3/\text{lb}}{360 \text{ minutes}}$ x (1/100) = 0.2361 cfm of Intact SG liquid

Total mass of steam released from intact SG to the environment (8 – 24 hrs) = 796,899 lb (Ref. 9.3.4, Attachment C)

Intact SG steaming rate (8 – 24 hr) = $\frac{796{,}899 \text{ lb} \times 0.02089 \text{ ft}^3/\text{lb}}{960 \text{ minutes}}$ x (1/100) = 0.1734 cfm of Intact SG liquid

Total mass of steam released from intact SG to the environment (24 – 45.5 hrs) = 863,053 lb (Ref. 9.3.4, Attachment C)

Intact SG steaming rate (24 – 45.5 hr) = $\frac{863{,}053 \text{ lb} \times 0.02089 \text{ ft}^3/\text{lb}}{1290 \text{ minutes}}$ x (1/100) = 0.1398 cfm of Intact SG liquid

0 - 2 hr iodine P-T-S leakage release from intact SG to the environment = 0.3942 cfm of Intact SG liquid

2 - 8 hr iodine P-T-S leakage release from intact SG to the environment = 0.2361 cfm of Intact SG liquid

8 - 24 hr iodine P-T-S leakage release from intact SG to the environment = 0.1734 cfm of Intact SG liquid

24 - 45.5 hr iodine P-T-S leakage release from intact SG to the environment = 0.1398 cfm of Intact SG liquid

7.2.3 Intact SGs – Iodine Release Rate – Secondary Liquid

The steaming rates for the secondary liquid iodine releases from the intact steam generators are the same as the intact SGs iodine release rates calculated in Section 7.2.2.

0 - 2 hr iodine secondary liquid release from intact SG to the environment = 0.3942 cfm of Intact SG liquid

2 - 8 hr iodine secondary liquid release from intact SG to the environment = 0.2361 cfm of Intact SG liquid

8 - 24 hr iodine secondary liquid release from intact SG to the environment = 0.1734 cfm of Intact SG liquid

24 - 45.5 hr iodine secondary liquid release from intact SG to the environment = 0.1398 cfm of Intact SG liquid

7.3 CRSVS Charcoal / HEPA Filter Efficiencies

The Control Room Special Ventilation System (CRSVS) charcoal and HEPA filter efficiencies are modeled per the following table, based on the calculations performed in the following subsections.

Safety Grade Filter	Filter Efficiency Credited (%)		
	Aerosol	Elemental	Organic
CRSVS	99	95	95

7.3.1 CRSVS Charcoal Filter Efficiency

Laboratory penetration testing acceptance criteria for the safety related Charcoal filters are as follows:

CRSVS Charcoal Filter – in-laboratory testing methyl iodide penetration < 2.5% (Ref. 9.6.8 Section 5.5.9.c)

Generic Letter 99-02 (Ref. 9.10) requires a safety factor of at least 2 to be used to determine the filter efficiencies to be credited in the design basis accident.

Testing methyl iodide penetration (%) = (100% - η)/safety factor = (100% - η)/2

Where η = charcoal filter efficiency to be credited in the analysis

CRSVS Charcoal Filter:

2.5% = (100% - η)/2

5% = (100% - η)

η = 100% - 5% = 95%

7.3.2 CRSVS HEPA Filter Efficiency

CRSVS HEPA Filter – in-place DOP penetration and bypass < 0.05% (Ref. 9.6.8 Section 5.5.9.a)

Generic Letter 99-02 (Ref. 9.10) requires a safety factor of at least 2 to be used to determine the filter efficiencies to be credited in the design basis accident.

Testing DOP penetration (%) = (100% - η)/safety factor = (100% - η)/2

Where η = HEPA filter efficiency to be credited in the analysis

CRSVS HEPA Filter:

0.05% = (100% - η)/2

0.10% = (100% - η)

η = 100% - 0.10% = 99.9%

Regulatory Guide 1.52 (Ref. 9.24, Regulatory Position C.5.c) states that if the in-place penetration and bypass testing results are <0.05%, the condition can be considered to warrant a 99% removal efficiency for particulates in accident dose evaluations. Therefore, a HEPA filter efficiency of 99% is used in the analysis.

Safety Grade Filter	Filter Efficiency Credited (%)		
	Aerosol	Elemental	Organic
CRSVS	99	95	95

8.0 RESULTS SUMMARY/CONCLUSIONS:

8.1 Result Summary

The post-LRA EAB, LPZ, and CR doses are summarized in the following table:

Post-LRA Activity Release Path	Post-LRA TEDE Dose (Rem)		
	Receptor Location		
	Control Room	EAB	LPZ
P-T-S Iodine Release ISG PLRINID02.o0	4.12E+00	3.90E-01 (occurs @ 24 hrs)	2.14E-01
P-T-S Noble Gas Release ISG PLRAING02.o0	1.32E-01	9.57E-02 (occurs @ 0.0 hrs)	5.59E-02
Liquid Iodine Release ISG PLRAINLQ02.o0	1.07E-02	1.17E-03 (occurs @ 0.0 hrs)	9.66E-04
External Cloud*	4.51E-02	0.00E+00	0.00E+00
CR Filter Shine*	2.33E-02	0.00E+00	0.00E+00
Total	**4.33E+00**	**4.87E-01**	**2.71E-01**
Allowable TEDE Limit	**5.00E+00**	**2.50E+00**	**2.50E+00**

ISG = Intact SG

* Post-LOCA External Cloud & CR Filter Shine Doses Used From Reference 9.13, Section 8.1

8.2 Conclusions

The results of analysis in Section 8.1 indicate that the EAB, LPZ, and CR doses are within allowable limits for an LRA. The calculated doses have adequate margins over the allowable dose limits for future safe operation of the plant.

The proposed new LCO 3.4.17 for Reactor Coolant System Specific Activity is 580 μCi/g DE of XE-133 based on the primary coolant noble gas activity corresponding to 1% failed fuel with the following changes:

- Delete the definition of "E-Bar," AVERAGE DISINTEGRATION ENERGY
- Add a new definition for DOSE EQUIVALENT XE-133
- Revise definition for DOSE EQUIVALENT I-131 to refer to FGR-11 thyroid inhalation dose conversion factors
- Revise LCO 3.4.17, "RCS Specific Activity, to delete references to gross specific activity
- Reference limit on DOSE EQUIVALENT XE-133
- Revise SR 3.4.16.1 to verify the limit for DOSE EQUIVALENT XE-133

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., "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation," NUREG/CR-6604, USNRC, December 1997
3. Design Input Transmittal Nos.
   - 3.1 DIT No. 13720-09, Rev. 0, LR Input Parameters
   - 3.2 DIT No. 13720-07, Rev. 1, Control Room Input Parameters
   - 3.3 DIT No. 13720-03, Rev. 0, Meteorological Input Parameters
   - 3.4 DIT No. 13720-16, Rev. 0, Steam Release Pathway Inputs for Main Steam Line Break (MSLB), Steam Generator Tube Rupture (SGTR), Locked Rotor Accident (LRA) and Control Rod Ejection Accident (CREA)
4. 10 CFR 50.67, "Accident Source Term"
5. PINGP Calculation No. GEN-PI-080, Rev 1, Prairie Island Atmospheric Dispersion Factors (χ/Qs) – AST Additional Releases
6. PINGP Units 1 & 2 Technical Specifications (TS):
   - 6.1 Specification 1.1, PINGP Units 1 & 2, Rated Thermal Power
   - 6.2 Specification 1.1, PINGP Units 1 & 2, Dose Equivalent I-131
   - 6.3 Specification 1.1, PINGP Units 1 & 2, E-bar Average Disintegration Energy
   - 6.4 Specification 3.7.14, PINGP Units 1 & 2 Limiting Condition for Operation (LCO) for Secondary Specific Activity
   - 6.5 Specification 3.4.17, PINGP Units 1 & 2 LCO for RCS Specific Activity
   - 6.6 Specification 3.7.10, PINGP Units 1 & 2 LCO for Control Room Special Ventilation System (CRSVS)
   - 6.7 Specification 3.4.14, PINGP Units 1 & 2 LCO FOR RCS Operational Leakage
   - 6.8 Specification 5.5.9, PINGP Units 1 & 2 Ventilation Filter Testing Program (VFTP)
   - 6.9 Specification 3.3.6, PINGP Units 1 & 2 LCO for Control Room Special Ventilation System (CRSVS) Actuation Instrumentation and Table 3.3.6-1, PINGP Unit 1/Unit 2 LCO for Radiation Monitoring Instrumentation
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. Westinghouse Letter NSP-07-59, LTR-PEP-07-26, Nuclear Management Company, Prairie Island Units 1 & 2, MUR Power Uprate Program, Core Activity Inventory and Coolant Activity Concentration, November 2, 2007.
10. USNRC Generic Letter 99-02, "Laboratory Testing of Nuclear-Grade Activated Charcoal", June 3, 1999
11. ASME Steam Tables, Sixth Edition
12. NUREG-0800, Standard Review Plan, "Radiological Consequence Analyses Using Alternative Source Terms," SRP 15.0.1, Rev. 0, July 2000

13. PINGP Calculation No. GEN-PI-079, Rev 0, Post-LOCA EAB, LPZ, and CR Doses - AST

14. PINGP USAR Table 4.1-5, Rev 27, Steam Generator Design Data

15. PINGP Calculation No.12400604-UR(B)-002, Rev 0, Locked Rotor Accident Dose Consequences

16. Technical Specification Task Force Improved Standard Technical Specifications Change Traveler TSTF-490, Rev 0, "Deletion of E Bar Definition and Revision to RCS Specific Activity Tech Spec"

17. PINGP Procedure Nos:

    17.1 1ES-0.3A, Rev 14, Natural Circulation Cooldown With CRDM Fans

    17.2 1ES-0.3B, Rev 11, Natural Circulation Cooldown Without CRDM Fans

18. PINGP License Amendment Request (LAR) L-PI-08-052, LAR to Revise the Loss of Coolant Accident (LOCA) and Main Steam Line Break Accident (MSLB) Dose Consequences Analyses and Affected Technical Specifications (TS), June 26, 2008

19. PINGP Flow Diagram No. NF-39603-1, Rev 76, Including T-Mod EC 14090, Admin Bldg, Screen House, & Control RM Flow Diagram

20. PINGP USAR Appendix D Section D.2, Rev 27, Activity In Fuel Gap

21. PINGP Calculation No. GEN-PI-047, Rev 0, Addendum 1, FHA Fission Product Inventories for AST Assessments

22. Prairie Island Nuclear Generating Plant Amendment Nos. 166 and 156 to Operating License Nos. DPR-42 and DPR-60, respectively, Selective Implementation Of Alternate Source Term For Fuel Handling Accidents (TAC Nos. MC1843 and MC1844), September 10, 2004, NRC ADAMS Accession Number ML042430504

23. PINGP USAR Section 4.3.2.1.1, Rev 28, Steam Generators

24. U.S. NRC Regulatory Guide 1.52, Revision 2, "Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants", March 1978

25. PINGP Emergency Plan Implementing Procedure No. F3-20, Rev 22, Determination of Radioactive Release Concentrations

26. PINGP Operating Procedure Nos.

    26.1 1C1.3, Rev 68, Unit 1 Shutdown

    26.2 2C1.3, Rev 67, Unit 2 Shutdown

27. PINGP Calculation No. 12400604-UR(B)-001, Rev 0, ARCON96 Atmospheric Dispersion Factors (χ/Qs) for Post-LOCA Gaseous Releases

10.0 TABLES:

Table 1
Post-LRA Design Basis Failed Fuel Gap Activity Release

Isotope	Isotopic Core Inventory at 1683 MWt (Ci) A	Fraction of Fission Product Inventory In Gap B	Fraction Failed Fuel C	Failed Fuel Gap Activity Release (Ci) D = A x B x C
I-131	4.50E+07	**0.08**	0.20	7.20E+05
I-132	6.51E+07	0.05	0.20	6.51E+05
I-133	9.13E+07	0.05	0.20	9.13E+05
I-134	1.02E+08	0.05	0.20	1.02E+06
I-135	8.72E+07	0.05	0.20	8.72E+05
KR-83M	0.00E+00	0.05	0.20	0.00E+00
KR-85	7.15E+05	**0.10**	0.20	1.43E+04
KR-85M	1.08E+07	0.05	0.20	1.08E+05
KR-87	2.12E+07	0.05	0.20	2.12E+05
KR-88	2.82E+07	0.05	0.20	2.82E+05
XE-131M	5.06E+05	0.05	0.20	5.06E+03
XE-133	9.15E+07	0.05	0.20	9.15E+05
XE-133M	2.86E+06	0.05	0.20	2.86E+04
XE-135	2.07E+07	0.05	0.20	2.07E+05
XE-135M	1.95E+07	0.05	0.20	1.95E+05
XE-138	7.72E+07	0.05	0.20	7.72E+05

A From Reference 9.9, Table 2-1, based on 1683 MWt per Reference 9.9, Section 1.2
B From Regulatory Guide 1.183 (Ref. 9.1, Table 3)
C From Reference 9.3.1, Item # 3

Table 1A
Comparison of Gap Fractional Releases for Prairies Island Fuel Rod To RG 1.183, Table 3

Radionuclide Or Radionuclide Group	Fractional Release	
	Bounding Prairie Island Result A	RG 1.183 Table 3 B
I-131	0.036	0.08
Kr-85	0.056	0.10
Other Noble Gases	0.024	0.05
Other Halogens	0.013	0.05
Alkali Metals	0.072	0.12

A From Reference 9.20
B From Regulatory Guide 1.183 (Ref. 9.1, Table 3)

Table 2
Iodine Isotopic Dose Conversion Factors

Isotope	Thyroid Inhalation Dose Conversion Factor (Sv/Bq) A	Radiation Units Conversion Factors [1 Sv = 100 Rem] [3.7E10 Bq = 1 Ci] (rem/Ci per Sv/Bq) B	Thyroid Inhalation Dose Conversion Factor (rem/Ci) C=AxB
I-131	2.92E-07	3.70E+12	1.08E+06
I-132	1.74E-09	3.70E+12	6.44E+03
I-133	4.86E-08	3.70E+12	1.80E+05
I-134	2.88E-10	3.70E+12	1.07E+03
I-135	8.46E-09	3.70E+12	3.13E+04

(A) From Reference 9.7, Page 136

Table 3
Iodine Scaling Factor for I-131 Dose Equivalent

Isotope	1% Fuel Defect Iodine Activity Concentration (µCi/gm) A	Thyroid Inhalation Dose Conversion Factor (rem/Ci) B	Product (µCi.rem / Ci.gm) (A x B)
I-131	2.55E+00	1.08E+06	2.76E+06
I-132	2.80E+00	6.44E+03	1.80E+04
I-133	3.88E+00	1.80E+05	6.98E+05
I-134	5.82E-01	1.07E+03	6.20E+02
I-135	2.20E+00	3.13E+04	6.89E+04
Total			3.54E+06

I-131 DE Based on 1% FF Iodine Concentration (µCi/gm); (C)	3.28E+00
Iodine Scaling Factor Based on 0.50 µCi/gm DE I-131; (D)	1.526E-01

(A) From Reference 9.9, Table 2-2 for HB x 1.04, based on 1683 MWt per Reference 9.9, Table 6-1

(C) = Total / Iodine-131 Thyroid Inhalation Dose Conversion Factor

(D) = 0.50 µCi/gm DE I-131 / C

Table 4
RCS 0.50 μCi/gm DE I-131 Iodine Concentration

Isotope	1% Failed Fuel Iodine Activity Concentration (μCi/gm) A	Iodine Scaling Factor 0.50 μCi/gm DE I-131 B	0.50 μCi/g DE I-131 Iodine Concentration (μCi/gm) C = A x B
I-131	2.55E+00	1.526E-01	3.891E-01
I-132	2.80E+00	1.526E-01	4.272E-01
I-133	3.88E+00	1.526E-01	5.920E-01
I-134	5.82E-01	1.526E-01	8.880E-02
I-135	2.20E+00	1.526E-01	3.357E-01

A From Reference 9.9, Table 2-2 for HB x 1.04, based on 1683 MWt per Reference 9.9, Table 6-1
B From Table 3

Table 5
1% Failed Fuel RCS Iodine Activity

Isotope	1% Fuel Defect RCS Iodine Activity Concentration (μCi/gm) A	Reactor Coolant Mass (gm) B	Total Pre-Accident RCS Iodine Activity (Ci) C = (A x B) / 1E6
I-131	2.55E+00	1.497E+08	3.817E+02
I-132	2.80E+00	1.497E+08	4.192E+02
I-133	3.88E+00	1.497E+08	5.808E+02
I-134	5.82E-01	1.497E+08	8.713E+01
I-135	2.20E+00	1.497E+08	3.293E+02

(A) From Reference 9.9, Table 2-2 for HB x 1.04, based on 1683 MWt per Reference 9.9, Table 6-1
(B) Reactor coolant mass from Section 7.1.1

Table 6
Dose Equivalent of Xenon-133

Noble Gas Nuclide	1% Failed Fuel RCS Activity (µCi/gm) A	Submersion Dose Coefficient (Sv m^3/ Bq s) B	Product (µCi/gm * Sv m^3/ Bq s) C = A x B
KR-85	1.09E+01	1.19E-16	1.297E-15
KR-85M	1.59E+00	7.48E-15	1.189E-14
KR-87	1.03E+00	4.12E-14	4.244E-14
KR-88	2.89E+00	1.02E-13	2.948E-13
XE-131M	2.05E+00	3.89E-16	7.975E-16
XE-133	2.60E+02	1.56E-15	4.056E-13
XE-133M	3.65E+00	1.37E-15	5.001E-15
XE-135	8.24E+00	1.19E-14	9.806E-14
XE-135M	5.02E-01	2.04E-14	1.024E-14
Xe-138	6.09E-01	5.77E-14	3.514E-14
Total (µCi/gm * Sv / Bq s m3)			**9.052E-13**
Xe-133 DE Based on 1% FF NG Concentration (µCi/gm)			**580**

A From Reference 9.9, Table 2-2 for HB x 1.04, based on 1683 MWt per Reference 9.9, Table 6-1 (Kr-83M omitted per definition of Dose Equivalent XE-133)

B From FGR 12, Table III.1

Table 7
Total RCS Noble Gas Activity

Isotope	1% Fuel Defect RCS Noble Gas Activity Concentration (µCi/gm) A	Reactor Coolant Mass (gm) B	Total Pre-Accident RCS Noble Gas Activity (Ci) C = (A x B) / 1E6
KR-83M	3.92E-01	1.497E+08	5.868E+01
KR-85	1.09E+01	1.497E+08	1.632E+03
KR-85M	1.59E+00	1.497E+08	2.380E+02
KR-87	1.03E+00	1.497E+08	1.542E+02
KR-88	2.89E+00	1.497E+08	4.326E+02
XE-131M	2.05E+00	1.497E+08	3.069E+02
XE-133	2.60E+02	1.497E+08	3.892E+04
XE-133M	3.65E+00	1.497E+08	5.464E+02
XE-135	8.24E+00	1.497E+08	1.234E+03
XE-135M	5.02E-01	1.497E+08	7.515E+01
Xe-138	6.09E-01	1.497E+08	9.117E+01

(A) From Reference 9.9, Table 2-2 for HB x 1.04, based on 1683 MWt per Reference 9.9, Table 6-1

(B) Reactor coolant mass from Section 7.1.1

Table 8
Total LRA Activity Initially Present in the RCS

Isotope	Failed Fuel Gap Activity Release (Ci) A	Total RCS Iodine & NG Activity (Ci) B	Total Post-LRA Activity In RCS (Ci) C = A + B	Core Thermal Power Level (MW_t) D	RADTRAD Nuclide Inventory File PLRA_iodin_def.txt (Ci/MW_t) E
I-131	7.200E+05	3.817E+02	7.204E+05	1683	.4280E+03
I-132	6.510E+05	4.192E+02	6.514E+05	1683	.3871E+03
I-133	9.130E+05	5.808E+02	9.136E+05	1683	.5428E+03
I-134	1.020E+06	8.713E+01	1.020E+06	1683	.6061E+03
I-135	8.720E+05	3.293E+02	8.723E+05	1683	.5183E+03
KR-83M	0.000E+00	5.868E+01	5.868E+01	1683	.3487E-01
KR-85	1.430E+04	1.632E+03	1.593E+04	1683	.9466E+01
KR-85M	1.080E+05	2.380E+02	1.082E+05	1683	.6431E+02
KR-87	2.120E+05	1.542E+02	2.122E+05	1683	.1261E+03
KR-88	2.820E+05	4.326E+02	2.824E+05	1683	.1678E+03
XE-131M	5.060E+03	3.069E+02	5.367E+03	1683	.3189E+01
XE-133	9.150E+05	3.892E+04	9.539E+05	1683	.5668E+03
XE-133M	2.860E+04	5.464E+02	2.915E+04	1683	.1732E+02
XE-135	2.070E+05	1.234E+03	2.082E+05	1683	.1237E+03
XE-135M	1.950E+05	7.515E+01	1.951E+05	1683	.1159E+03
Xe-138	7.720E+05	9.117E+01	7.721E+05	1683	.4588E+03

A, D From Table 1, based on 1683 MWt per Reference 9.9, Section 1.2 and Table 2-1
B, D From Tables 5 and 7, based on 1683 MWt per Reference 9.9, Table 6-1

Table 9
Total LRA Iodine Activity Initially Present in the Secondary Coolant

Isotope	0.50 μCi/g DE I-131 Iodine Concentration (μCi/gm) A	Tech Spec Secondary Coolant Specific Activity Limit (unitless) B	Coolant Mass In Both Intact Steam Generators (gm) C	Total Pre-Accident Secondary Coolant Iodine Activity (μCi) D=(AxBxC)/0.50	RADTRAD Nuclide Inventory File PILRA_liq_def (Ci/MW_t) E = D /(1683 x 1E6)
I-131	3.891E-01	0.10	9.731E+07	7.573E+06	.4500E-02
I-132	4.272E-01	0.10	9.731E+07	8.315E+06	.4940E-02
I-133	5.920E-01	0.10	9.731E+07	1.152E+07	.6846E-02
I-134	8.880E-02	0.10	9.731E+07	1.728E+06	.1027E-02
I-135	3.357E-01	0.10	9.731E+07	6.533E+06	.3882E-02

A, E From Table 4, based on 1683 MWt per Reference 9.9, Table 6-1
B From Reference 9.6.4
C From Section 7.1.2

Table 10
Post-LRA Intact SG Release

Release Category	P-T-S Leakage To Intact SG (cfm) A	Intact SG Release Iodine, Noble gas, & SG Liquid Iodine Release (cfm) B	(cfm) C	(cfm) D	(cfm) E
Iodine Release	0.0376 0-45.5 hr	0.3942 0-2 hr	0.2361 2-8 hr	0.1734 8-24 hr	0.1398 24-45.5 hr
Noble Gas Release	0.0376 0-45.5 hr	0.0376 0-45.5 hr			
SG Liquid Iodine Release	N/A	0.3942 0-2 hr	0.2361 2-8 hr	0.1734 8-24 hr	0.1398 24-45.5 hr
Release Point	Unit 2 Groups 1 & 2 PORV Release Points				

A For Iodine Release From Section 7.2.1
A For Noble Gas Release From Section 7.2.1
B Through E For Iodine & Noble Gas Releases From 7.2.2
B Through E For SG Liquid Iodine Release From 7.3.3

Table 11
Unit 2 CR Atmospheric Dispersion Factor (χ/Q)
Intact Steam Release via Unit 2 PORVs

Time Interval (hr)	Unit 2		
	Group 1 PORV χ/Qs (s/m^3) A	Group 2 PORV χ/Qs (s/m^3) B	Effective PORV χ/Qs (s/m^3) D = 0.6A + 0.4B
0-2	3.07E-02	2.20E-03	1.93E-02
2-8	2.49E-02	1.81E-03	1.57E-02
8-24	1.12E-02	7.97E-04	7.04E-03
24 - 96	7.78E-03	5.16E-04	4.87E-03
96 - 720	6.17E-03	4.00E-04	3.86E-03

A & B from Reference 9.5, Table 8-5

Table 12
Alkali Inhaled Isotopic Dose Conversion Factors

Isotope	Isotopic Dose Conversion Factor (Sv/Bq) A	Conversion Factor (rem/Ci/Sv/Bq) B	Iodine Dose Conversion Factor (rem/Ci) C=AxB	Fractional Iodine Dose Conversion Factor D=C/1.08E+06
I-131	**2.92E-07**	**3.70E+12**	**1.08E+06**	**1.00E+00**
Rb-86	1.33E-09	3.70E+12	4.92E+03	4.56E-03
Rb-88	1.37E-12	3.70E+12	5.07E+00	4.69E-06
Rb-89	1.61E-12	3.70E+12	5.96E+00	5.52E-06
Cs-134	1.11E-08	3.70E+12	4.11E+04	3.80E-02
Cs-136	1.73E-09	3.70E+12	6.40E+03	5.93E-03
Cs-137	7.93E-09	3.70E+12	2.93E+04	2.72E-02
Cs-138	3.57E-12	3.70E+12	1.32E+01	1.22E-05

A From Reference 9.7, Table 2.1

11.0 FIGURES:

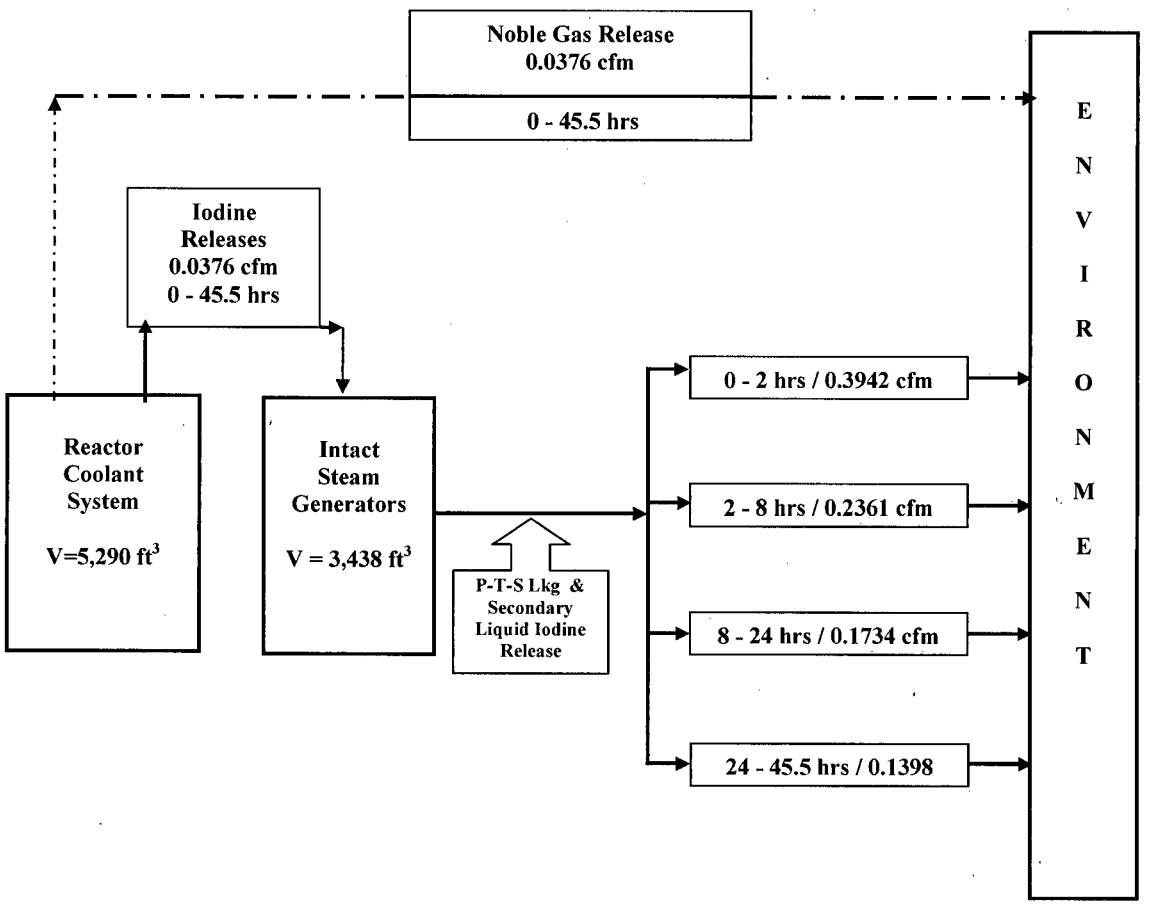


Figure 1: RADTRAD Nodalization For Post-LRA Iodine & Noble Gas Releases

——— P-T-S Leakage and Intact SG Secondary Liquid Iodine Release
—·- P-T-S Leakage Noble Gas Release

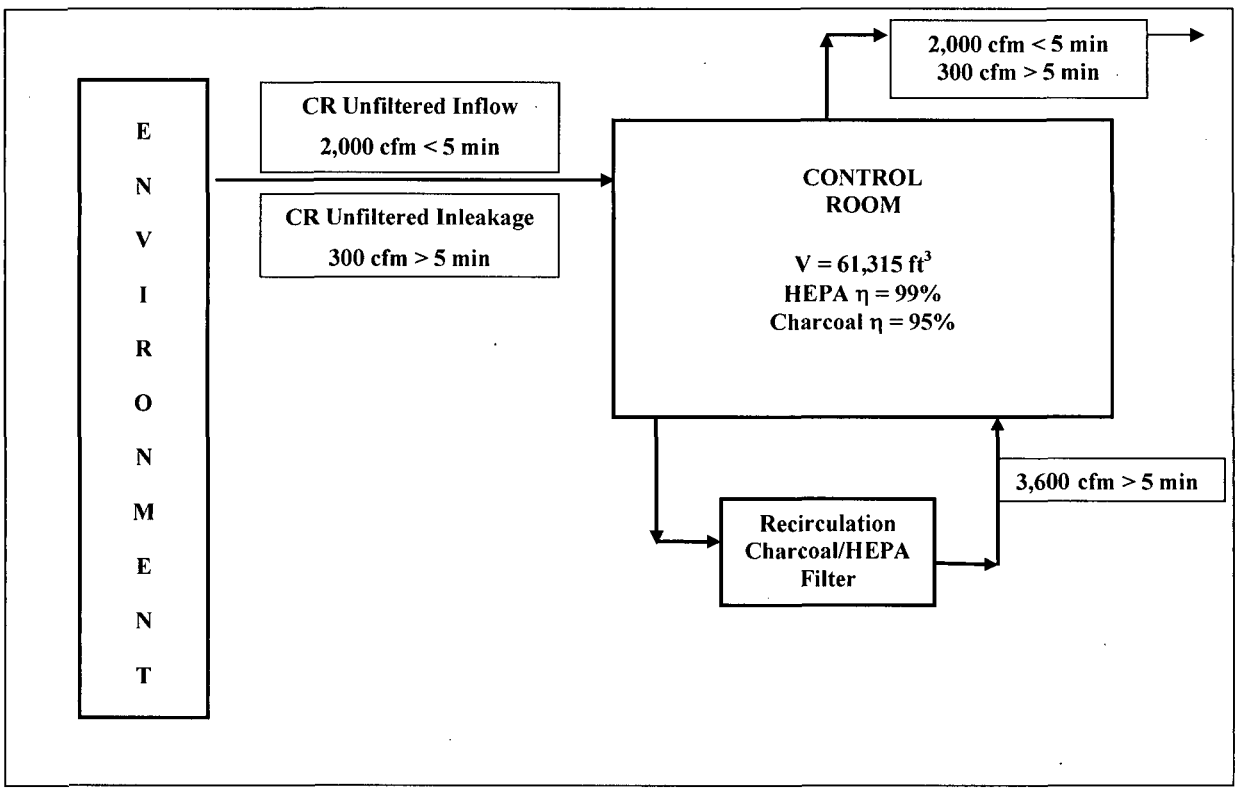


Figure 2 – RADTRAD Nodalization For Control Room Response

12.0 AFFECTED DOCUMENTS:

Upon approval of the AST Licensing Change Request, the following documents will be revised or superseded:

12.1 PINGP Calculation No. 12400604-UR(B)-002, Rev 0, Locked Rotor Accident Dose Consequences

13.0 ATTACHMENTS:

Attachment 13.1 – RADTRAD Output File PLRINID02.o0

Attachment 13.2 – RADTRAD Output File PLRAING02.o0

Attachment 13.3 – RADTRAD Output File PLRAINLQ02.o0

Attachment 13.4 – Modified RADTRAD Dose Conversion File PINGP_fg11&12.txt

Attachment 13.1

RADTRAD Output File PLRINID02.o0

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:46:31
#######################################################################

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

Plant file           = G:\Radtrad 3.03\Input\PI\GEN-PI-083 R1\PLRINID02.psf
Inventory file       = g:\radtrad 3.03\defaults\pilra_iodin_def.txt
Release file         = g:\radtrad 3.03\defaults\pingp_iodine_rft.txt
Dose Conversion file = g:\radtrad 3.03\defaults\pingp_fg11&12.txt


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


Radtrad 3.03 4/15/2001
PINGP 1 & 2 Locked Rotor Accident AST Analysis - P-T-S Leakage Iodine Release From
Intact SG
Nuclide Inventory File:
g:\radtrad 3.03\defaults\pilra_iodin_def.txt
Plant Power Level:
 1.8520E+03
Compartments:
  4
Compartment 1:
RCS
  3
 5.2900E+03
  0
  0
  0
  0
  0
Compartment 2:
Environment
  2
 0.0000E+00
  0
  0
  0
```

```
  0
  0
Compartment 3:
Control Room
  1
 6.1315E+04
  0
  0
  1
  0
  0
Compartment 4:
Intact SG
  3
 3.4380E+03
  0
  0
  0
  0
  0
Pathways:
  4
Pathway 1:
RCS to Intact SG
  1
  4
  2
Pathway 2:
Environment to Control Room
  2
  3
  2
Pathway 3:
Control Room to Environment
  3
  2
  2
Pathway 4:
Intact SG to Environment
  4
  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\pingp_fg11&12.txt
g:\radtrad 3.03\defaults\pingp_iodine_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:
  4
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  1
  1
  0
  0
  0
  0
  1
  3.6000E+03
  3
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   9.9000E+01   9.5000E+01   9.5000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Compartment 4:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Pathways:
  4
Pathway 1:
  0
  0
```

```
  0
  0
  0
  1
  2
  0.0000E+00   3.7600E-02   0.0000E+00   0.0000E+00   0.0000E+00
  4.5500E+01   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
  3
  0.0000E+00   2.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   3.0000E+02   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 3:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   3.0000E+02   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 4:
  0
  0
  0
  0
  0
  1
  5
  0.0000E+00   3.9420E-01   0.0000E+00   0.0000E+00   0.0000E+00
  2.0000E+00   2.3610E-01   0.0000E+00   0.0000E+00   0.0000E+00
```

```
  8.0000E+00   1.7340E-01   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   1.3980E-01   0.0000E+00   0.0000E+00   0.0000E+00
  4.5500E+01   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   6.4900E-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
  5
  0.0000E+00   1.7700E-04
  8.0000E+00   3.9900E-05
  2.4000E+01   7.1200E-06
  9.6000E+01   1.0400E-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   1.9300E-02
  2.0000E+00   1.5700E-02
  8.0000E+00   7.0400E-03
  2.4000E+01   4.8700E-03
  9.6000E+01   3.8600E-03
  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   4.0000E+00
  7.2000E+02   0.0000E+00
Output Filename:
G:\Radtrad 3.o11
  1
  1
  1
  0
  0
End of Scenario File
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:46:31
#######################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.8520E+03 MWth

Number of compartments    =   4

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: RCS
Compartment volume =   5.2900E+03 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  1
   Exit Pathway Number    1: RCS to Intact SG

Compartment number  2
Name: Environment
Compartment type is Environment
Pathways into and out of compartment  2
   Inlet Pathway Number   3: Control Room to Environment
   Inlet Pathway Number   4: Intact SG to Environment
   Exit Pathway Number    2: Environment to Control Room

Compartment number  3
Name: Control Room
Compartment volume =   6.1315E+04 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Environment to Control Room
   Exit Pathway Number    3: Control Room to Environment

Compartment number  4
Name: Intact SG
Compartment volume =   3.4380E+03 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  4
   Inlet Pathway Number   1: RCS to Intact SG
   Exit Pathway Number    4: Intact SG to Environment

Total number of pathways =   4
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:46:31
#######################################################################

#######################################################################
                      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	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
IODINE	1.0000E+00	0.0000E+00	0.0000E+00	7.666E+00
CESIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
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 = 1852. 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)
I-131	2	4.280E+02	6.947E+05	1.820E-14	2.920E-07	8.890E-09
I-132	2	3.871E+02	8.280E+03	1.120E-13	1.740E-09	1.030E-10
I-133	2	5.428E+02	7.488E+04	2.940E-14	4.860E-08	1.580E-09
I-134	2	6.061E+02	3.156E+03	1.300E-13	2.880E-10	3.550E-11
I-135	2	5.183E+02	2.380E+04	8.294E-14	8.460E-09	3.320E-10

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

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

COMPARTMENT DATA

Compartment number 1: RCS

Compartment number 2: Environment

Compartment number 3: Control Room

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	3.6000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.6000E+03	9.9000E+01	9.5000E+01	9.5000E+01
7.2000E+02	3.6000E+03	0.0000E+00	0.0000E+00	0.0000E+00

Compartment number 4: Intact SG

PATHWAY DATA

Pathway number 1: RCS to Intact SG

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	3.7600E-02	0.0000E+00	0.0000E+00	0.0000E+00
4.5500E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.0000E+02	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 3: Control Room to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.0000E+02	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 4: Intact SG to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	3.9420E-01	0.0000E+00	0.0000E+00	0.0000E+00
2.0000E+00	2.3610E-01	0.0000E+00	0.0000E+00	0.0000E+00
8.0000E+00	1.7340E-01	0.0000E+00	0.0000E+00	0.0000E+00
2.4000E+01	1.3980E-01	0.0000E+00	0.0000E+00	0.0000E+00
4.5500E+01	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           6.4900E-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           1.7700E-04
  8.0000E+00           3.9900E-05
  2.4000E+01           7.1200E-06
  9.6000E+01           1.0400E-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           1.9300E-02
  2.0000E+00           1.5700E-02
  8.0000E+00           7.0400E-03
  2.4000E+01           4.8700E-03
  9.6000E+01           3.8600E-03
  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       4.0000E+00
 7.2000E+02       0.0000E+00
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:46:31
#######################################################################


     ####   #    #  #####  #####   #    #  #####
    #    #  #    #    #    #    #  #    #    #
    #    #  #    #    #    #    #  #    #    #
    #    #  #    #    #    #####   #    #    #
    #    #  #    #    #    #       #    #.   #
    #    #  #    #    #    #       #    #    #
     ####    ####     #    #        ####     #

#######################################################################
            Dose, Detailed model and Detailed Inventory Output
#######################################################################

Exclusion Area Boundary Doses:

Time (h) =    0.0036    Whole Body   Thyroid       TEDE
Delta dose (rem)         5.3209E-09  1.5446E-06  5.3614E-08
Accumulated dose (rem)   5.3209E-09  1.5446E-06  5.3614E-08

Low Population Zone Doses:

Time (h) =    0.0036    Whole Body   Thyroid       TEDE
Delta dose (rem)         1.4511E-09  4.2125E-07  1.4622E-08
Accumulated dose (rem)   1.4511E-09  4.2125E-07  1.4622E-08

Control Room Doses:

Time (h) =    0.0036    Whole Body   Thyroid       TEDE
Delta dose (rem)         1.4127E-11  1.1588E-07  3.6372E-09
Accumulated dose (rem)   1.4127E-11  1.1588E-07  3.6372E-09

Control Room Compartment Nuclide Inventory:

Time (h) =    0.0036       Ci           kg          Atoms       Decay
I-131                  9.1346E-08  7.3682E-16  3.3872E+09  3.0507E+04
I-132                  8.2529E-08  7.9953E-18  3.6476E+07  2.7573E+04
I-133                  1.1584E-07  1.0225E-16  4.6300E+08  3.8687E+04
I-134                  1.2899E-07  4.8354E-18  2.1731E+07  4.3122E+04
I-135                  1.1058E-07  3.1487E-17  1.4046E+08  3.6935E+04
Xe-133                 1.9058E-12  1.0182E-20  4.6102E+04  1.2196E-01
Xe-135                 2.2085E-11  8.6481E-21  3.8578E+04  1.4131E+00

Control Room Transport Group Inventory:
Time (h) =    0.0036    Atmosphere     Sump
Noble gases (atoms)     9.3267E+04  0.0000E+00
Elemental I (atoms)     3.9274E+09  0.0000E+00
Organic I (atoms)       1.2147E+08  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00
Dose Effective (Ci/cc) I-131 (Thyroid)          6.5917E-17
Dose Effective (Ci/cc) I-131 (ICRP2 Thyroid)    7.8724E-17
Total I (Ci)                                    5.2928E-07

                        Deposition Recirculating
```

Time (h) = 0.0036	Surfaces	Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 0.0036	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	1.7387E+04
Elemental I (atoms)	0.0000E+00	3.9345E+09
Organic I (atoms)	0.0000E+00	1.2168E+08
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 0.0036	Pathway Filtered	Transported
Noble gases (atoms)	3.7053E+01	0.0000E+00
Elemental I (atoms)	7.4486E+06	0.0000E+00
Organic I (atoms)	2.3037E+05	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 0.0833	Whole Body	Thyroid	TEDE
Delta dose (rem)	8.1673E-06	2.3732E-03	8.2367E-05
Accumulated dose (rem)	8.1726E-06	2.3747E-03	8.2421E-05

Low Population Zone Doses:

Time (h) = 0.0833	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.2274E-06	6.4723E-04	2.2464E-05
Accumulated dose (rem)	2.2289E-06	6.4765E-04	2.2478E-05

Control Room Doses:

Time (h) = 0.0833	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.3694E-07	5.2296E-03	1.6415E-04
Accumulated dose (rem)	6.3696E-07	5.2297E-03	1.6415E-04

Control Room Compartment Nuclide Inventory:

Time (h) = 0.0833	Ci	kg	Atoms	Decay
I-131	1.3346E-04	1.0765E-12	4.9488E+12	1.4171E+09
I-132	1.1775E-04	1.1408E-14	5.2044E+10	1.2652E+09
I-133	1.6884E-04	1.4905E-13	6.7487E+11	1.7948E+09
I-134	1.7700E-04	6.6352E-15	2.9819E+10	1.9396E+09
I-135	1.6026E-04	4.5635E-14	2.0357E+11	1.7085E+09
Xe-131m	2.9383E-10	3.5079E-18	1.6126E+07	1.0420E+02
Xe-133	7.4460E-08	3.9779E-16	1.8012E+09	2.6435E+04
Xe-133m	5.3363E-09	1.1893E-17	5.3849E+07	1.8939E+03
Xe-135	8.6103E-07	3.3717E-16	1.5040E+09	3.0543E+05
Xe-135m	5.3793E-06	5.9053E-17	2.6343E+08	1.7324E+06

Control Room Transport Group Inventory:

Time (h) = 0.0833	Atmosphere	Sump	
Noble gases (atoms)	3.6386E+09	0.0000E+00	
Elemental I (atoms)	5.7319E+12	0.0000E+00	
Organic I (atoms)	1.7727E+11	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		9.6232E-14
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		1.1472E-13
Total I (Ci)			7.5732E-04

Time (h) = 0.0833	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 0.0833	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	1.2839E+08
Elemental I (atoms)	0.0000E+00	6.0490E+12
Organic I (atoms)	0.0000E+00	1.8708E+11
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 0.0833	Pathway Filtered	Transported
Noble gases (atoms)	6.5005E+06	0.0000E+00
Elemental I (atoms)	3.0562E+11	0.0000E+00
Organic I (atoms)	9.4523E+09	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.1860E-03	1.3953E+00	4.6622E-02
Accumulated dose (rem)	3.1941E-03	1.3977E+00	4.6704E-02

Low Population Zone Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	8.6890E-04	3.8053E-01	1.2715E-02
Accumulated dose (rem)	8.7113E-04	3.8118E-01	1.2737E-02

Control Room Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.0886E-04	2.5875E+00	8.0745E-02
Accumulated dose (rem)	2.0950E-04	2.5927E+00	8.0909E-02

Control Room Compartment Nuclide Inventory:

Time (h) = 2.0000	Ci	kg	Atoms	Decay
I-131	2.9684E-03	2.3944E-11	1.1007E+14	3.7544E+11
I-132	1.4800E-03	1.4338E-13	6.5414E+11	2.2799E+11

I-133	3.5473E-03	3.1314E-12	1.4179E+13	4.5718E+11
I-134	8.7094E-04	3.2648E-14	1.4672E+11	1.9393E+11
I-135	2.9356E-03	8.3592E-13	3.7289E+12	3.9619E+11
Xe-131m	4.3774E-07	5.2260E-15	2.4024E+10	3.2846E+07
Xe-133	1.0800E-04	5.7695E-13	2.6124E+12	8.1512E+09
Xe-133m	7.6706E-06	1.7095E-14	7.7405E+10	5.8015E+08
Xe-135	1.2602E-03	4.9348E-13	2.2013E+12	9.6619E+10
Xe-135m	9.3584E-04	1.0273E-14	4.5828E+10	1.0827E+11

Control Room Transport Group Inventory:

Time (h) = 2.0000	Atmosphere	Sump	
Noble gases (atoms)	4.9610E+12	0.0000E+00	
Elemental I (atoms)	1.2492E+14	0.0000E+00	
Organic I (atoms)	3.8634E+12	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		2.1043E-12
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		2.4357E-12
Total I (Ci)			1.1802E-02

Time (h) = 2.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	3.7767E+14
Organic I (atoms)	0.0000E+00	1.1681E+13
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 2.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	4.9847E+12
Elemental I (atoms)	0.0000E+00	5.3764E+14
Organic I (atoms)	0.0000E+00	1.6628E+13
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 2.0000	Pathway Filtered	Transported
Noble gases (atoms)	7.7593E+11	0.0000E+00
Elemental I (atoms)	3.3435E+13	0.0000E+00
Organic I (atoms)	1.0341E+12	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.3740E-02	1.1902E+01	3.8190E-01
Accumulated dose (rem)	1.6934E-02	1.3299E+01	4.2860E-01

Low Population Zone Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.7472E-03	3.2459E+00	1.0415E-01
Accumulated dose (rem)	4.6184E-03	3.6270E+00	1.1689E-01

Control Room Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.0456E-03	2.2351E+01	6.9248E-01
Accumulated dose (rem)	1.2551E-03	2.4944E+01	7.7339E-01

Control Room Compartment Nuclide Inventory:

Time (h) = 8.0000	Ci	kg	Atoms	Decay
I-131	6.2676E-03	5.0556E-11	2.3241E+14	3.5591E+12
I-132	5.2348E-04	5.0715E-14	2.3137E+11	8.5124E+11
I-133	6.2661E-03	5.5315E-12	2.5046E+13	3.8832E+12
I-134	1.6355E-05	6.1307E-16	2.7552E+09	3.2742E+11
I-135	3.3759E-03	9.6128E-13	4.2881E+12	2.6221E+12
Xe-131m	8.5814E-06	1.0245E-13	4.7097E+11	2.6956E+09
Xe-133	1.9487E-03	1.0411E-11	4.7140E+13	6.2832E+11
Xe-133m	1.3448E-04	2.9971E-13	1.3570E+12	4.3746E+10
Xe-135	1.5111E-02	5.9173E-12	2.6396E+13	5.5819E+12
Xe-135m	1.1803E-03	1.2958E-14	5.7802E+10	8.8973E+11

Control Room Transport Group Inventory:

Time (h) = 8.0000	Atmosphere	Sump	
Noble gases (atoms)	7.5422E+13	0.0000E+00	
Elemental I (atoms)	2.5412E+14	0.0000E+00	
Organic I (atoms)	7.8593E+12	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		4.2687E-12
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		4.7473E-12
Total I (Ci)			1.6449E-02

Time (h) = 8.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	3.6424E+15
Organic I (atoms)	0.0000E+00	1.1265E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 8.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	1.3048E+14
Elemental I (atoms)	0.0000E+00	4.2273E+15
Organic I (atoms)	0.0000E+00	1.3074E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 8.0000	Pathway Filtered	Transported
Noble gases (atoms)	5.5385E+13	0.0000E+00
Elemental I (atoms)	3.1981E+14	0.0000E+00
Organic I (atoms)	9.8911E+12	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE

Delta dose (rem)	3.9363E-02	6.6538E+01	2.0845E+00
Accumulated dose (rem)	5.6297E-02	7.9837E+01	2.5131E+00

Low Population Zone Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.4200E-03	2.1038E+00	6.7083E-02
Accumulated dose (rem)	7.0383E-03	5.7308E+00	1.8397E-01

Control Room Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.9652E-03	5.8299E+01	1.7940E+00
Accumulated dose (rem)	3.2203E-03	8.3243E+01	2.5674E+00

Control Room Compartment Nuclide Inventory:

Time (h) = 24.0000	Ci	kg	Atoms	Decay
I-131	5.8428E-03	4.7129E-11	2.1665E+14	1.2422E+13
I-132	4.1616E-06	4.0317E-16	1.8393E+09	9.6874E+11
I-133	3.6301E-03	3.2045E-12	1.4510E+13	1.0697E+13
I-135	6.2259E-04	1.7728E-13	7.9082E+11	4.7284E+12
Xe-131m	3.5932E-05	4.2898E-13	1.9720E+12	4.1366E+10
Xe-133	6.5119E-03	3.4789E-11	1.5752E+14	8.2384E+12
Xe-133m	4.1654E-04	9.2832E-13	4.2034E+12	5.4497E+11
Xe-135	1.6380E-02	6.4143E-12	2.8613E+13	3.6287E+13
Xe-135m	3.5239E-04	3.8685E-15	1.7257E+10	2.0084E+12

Control Room Transport Group Inventory:

Time (h) = 24.0000	Atmosphere	Sump	
Noble gases (atoms)	1.9233E+14	0.0000E+00	
Elemental I (atoms)	2.2500E+14	0.0000E+00	
Organic I (atoms)	6.9587E+12	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		3.7236E-12
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		3.9540E-12
Total I (Ci)			1.0100E-02

Time (h) = 24.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	1.2242E+16
Organic I (atoms)	0.0000E+00	3.7863E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 24.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	8.0113E+14
Elemental I (atoms)	0.0000E+00	1.3570E+16
Organic I (atoms)	0.0000E+00	4.1970E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Pathway

Time (h) = 24.0000	Filtered	Transported
Noble gases (atoms)	5.7980E+14	0.0000E+00
Elemental I (atoms)	1.0742E+15	0.0000E+00
Organic I (atoms)	3.3223E+13	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.6343E-02	1.3549E+02	4.1922E+00
Accumulated dose (rem)	1.0264E-01	2.1532E+02	6.7053E+00

Low Population Zone Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	5.0842E-04	9.7677E-01	3.0397E-02
Accumulated dose (rem)	7.5468E-03	6.7076E+00	2.1437E-01

Control Room Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	9.9497E-04	4.9527E+01	1.5165E+00
Accumulated dose (rem)	4.2153E-03	1.3277E+02	4.0839E+00

Control Room Compartment Nuclide Inventory:

Time (h) = 45.5000	Ci	kg	Atoms	Decay
I-131	5.5999E-03	4.5170E-11	2.0765E+14	2.5424E+13
I-132	6.6128E-09	6.4064E-19	2.9228E+06	9.6993E+11
I-133	1.8359E-03	1.6207E-12	7.3384E+12	1.6505E+13
I-135	6.7633E-05	1.9259E-14	8.5909E+10	5.2441E+12
Xe-131m	7.5255E-05	8.9845E-13	4.1302E+12	1.7996E+11
Xe-133	1.0102E-02	5.3967E-11	2.4436E+14	2.9329E+13
Xe-133m	5.8005E-04	1.2927E-12	5.8533E+12	1.8183E+12
Xe-135	5.5502E-03	2.1734E-12	9.6951E+12	6.1427E+13
Xe-135m	3.7411E-05	4.1070E-16	1.8321E+09	2.3614E+12

Control Room Transport Group Inventory:

Time (h) = 45.5000	Atmosphere	Sump	
Noble gases (atoms)	2.6404E+14	0.0000E+00	
Elemental I (atoms)	2.0862E+14	0.0000E+00	
Organic I (atoms)	6.4522E+12	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		3.4024E-12
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		3.5112E-12
Total I (Ci)			7.5035E-03

Time (h) = 45.5000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	2.4452E+16
Organic I (atoms)	0.0000E+00	7.5624E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Pathway

Time (h) = 45.5000	Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.1699E+15
Elemental I (atoms)	0.0000E+00	2.6927E+16
Organic I (atoms)	0.0000E+00	8.3279E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

	Pathway	
Time (h) = 45.5000	Filtered	Transported
Noble gases (atoms)	1.8370E+15	0.0000E+00
Elemental I (atoms)	2.1452E+15	0.0000E+00
Organic I (atoms)	6.6347E+13	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

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)	1.0264E-01	2.1532E+02	6.7053E+00

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)	7.5468E-03	6.7076E+00	2.1437E-01

Control Room Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.9338E-05	1.0439E+00	3.1945E-02
Accumulated dose (rem)	4.2646E-03	1.3381E+02	4.1158E+00

Control Room Compartment Nuclide Inventory:

Time (h) = 96.0000	Ci	kg	Atoms	Decay
Xe-131m	2.4263E-11	2.8967E-19	1.3316E+06	2.0942E+11
Xe-133	2.8245E-09	1.5090E-17	6.8324E+07	3.3246E+13
Xe-133m	1.0854E-10	2.4189E-19	1.0952E+06	2.0374E+12
Xe-135	4.3013E-11	1.6843E-20	7.5135E+04	6.3167E+13

Control Room Transport Group Inventory:

Time (h) = 96.0000	Atmosphere	Sump	
Noble gases (atoms)	7.0826E+07	0.0000E+00	
Elemental I (atoms)	2.4525E-66	0.0000E+00	
Organic I (atoms)	7.5851E-68	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		3.9439E-92
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		3.9726E-92
Total I (Ci)			7.2600E-83

	Deposition	Recirculating
Time (h) = 96.0000	Surfaces	Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	2.4606E+16
Organic I (atoms)	0.0000E+00	7.6100E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 96.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.1699E+15
Elemental I (atoms)	0.0000E+00	2.6927E+16
Organic I (atoms)	0.0000E+00	8.3279E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 96.0000	Pathway Filtered	Transported
Noble gases (atoms)	2.0953E+15	0.0000E+00
Elemental I (atoms)	2.1587E+15	0.0000E+00
Organic I (atoms)	6.6763E+13	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

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)	1.0264E-01	2.1532E+02	6.7053E+00

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)	7.5468E-03	6.7076E+00	2.1437E-01

Control Room Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.8304E-12	1.1315E-80	1.8304E-12
Accumulated dose (rem)	4.2646E-03	1.3381E+02	4.1158E+00

Control Room Compartment Nuclide Inventory:

Time (h) = 720.0000	Ci	kg	Atoms	Decay

Control Room Transport Group Inventory:

Time (h) = 720.0000	Atmosphere	Sump	
Noble gases (atoms)	7.0911E-74	0.0000E+00	
Elemental I (atoms)	0.0000E+00	0.0000E+00	
Organic I (atoms)	0.0000E+00	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		0.0000E+00
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		0.0000E+00
Total I (Ci)			0.0000E+00

Time (h) = 720.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	2.4606E+16
Organic I (atoms)	0.0000E+00	7.6100E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 720.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.1699E+15
Elemental I (atoms)	0.0000E+00	2.6927E+16
Organic I (atoms)	0.0000E+00	8.3279E+14
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 720.0000	Pathway Filtered	Transported
Noble gases (atoms)	2.0953E+15	0.0000E+00
Elemental I (atoms)	2.1587E+15	0.0000E+00
Organic I (atoms)	6.6763E+13	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

840

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#######################################################################
                              I-131 Summary
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Time (hr)	RCS I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
0.000	1.2232E+05	1.8461E-08	3.3622E-10
0.004	7.9265E+05	5.0231E-06	9.1346E-08
0.083	7.9239E+05	7.7209E-03	1.3346E-04
0.400	7.9138E+05	1.8399E-01	3.6335E-04
0.700	7.9043E+05	5.6483E-01	7.8565E-04
1.000	7.8948E+05	1.1528E+00	1.2714E-03
1.300	7.8853E+05	1.9471E+00	1.7769E-03
1.600	7.8758E+05	2.9467E+00	2.2875E-03
1.900	7.8663E+05	4.1508E+00	2.7984E-03
2.000	7.8631E+05	4.5974E+00	2.9684E-03
2.300	7.8536E+05	5.4814E+00	2.2049E-03
2.600	7.8442E+05	6.4873E+00	2.1139E-03
2.900	7.8347E+05	7.6148E+00	2.2478E-03
3.200	7.8253E+05	8.8635E+00	2.4564E-03
3.500	7.8159E+05	1.0233E+01	2.6894E-03
3.800	7.8064E+05	1.1722E+01	2.9301E-03
4.100	7.7970E+05	1.3332E+01	3.1728E-03
4.400	7.7876E+05	1.5061E+01	3.4156E-03
4.700	7.7783E+05	1.6909E+01	3.6578E-03
5.000	7.7689E+05	1.8875E+01	3.8993E-03
5.300	7.7595E+05	2.0960E+01	4.1399E-03
5.600	7.7502E+05	2.3162E+01	4.3797E-03
5.900	7.7408E+05	2.5482E+01	4.6187E-03
6.200	7.7315E+05	2.7919E+01	4.8568E-03
6.500	7.7222E+05	3.0472E+01	5.0940E-03
6.800	7.7129E+05	3.3141E+01	5.3304E-03
7.100	7.7036E+05	3.5926E+01	5.5660E-03
7.400	7.6943E+05	3.8826E+01	5.8007E-03
7.700	7.6850E+05	4.1840E+01	6.0346E-03
8.000	7.6758E+05	4.4970E+01	6.2676E-03
8.300	7.6665E+05	4.7352E+01	3.5497E-03

8.600	7.6573E+05	4.9819E+01	2.6898E-03
8.900	7.6481E+05	5.2369E+01	2.4525E-03
9.200	7.6389E+05	5.5003E+01	2.4237E-03
9.500	7.6297E+05	5.7721E+01	2.4646E-03
9.800	7.6205E+05	6.0522E+01	2.5286E-03
10.100	7.6113E+05	6.3405E+01	2.6003E-03
10.400	7.6021E+05	6.6371E+01	2.6744E-03
24.000	7.1978E+05	2.8290E+02	5.8428E-03
45.500	6.6020E+05	7.9388E+02	5.5999E-03
96.000	5.5067E+05	7.9388E+02	6.7653E-83
720.000	5.8534E+04	7.9388E+02	0.0000E+00

Time (hr)	Intact SG I-131 (Curies)
0.000	1.4491E-02
0.004	6.0846E-01
0.083	2.7534E+01
0.400	1.3422E+02
0.700	2.3483E+02
1.000	3.3500E+02
1.300	4.3473E+02
1.600	5.3403E+02
1.900	6.3290E+02
2.000	6.6576E+02
2.300	7.6465E+02
2.600	8.6318E+02
2.900	9.6137E+02
3.200	1.0592E+03
3.500	1.1567E+03
3.800	1.2538E+03
4.100	1.3506E+03
4.400	1.4471E+03
4.700	1.5432E+03
5.000	1.6390E+03
5.300	1.7344E+03
5.600	1.8295E+03
5.900	1.9243E+03
6.200	2.0187E+03
6.500	2.1128E+03
6.800	2.2065E+03
7.100	2.2999E+03
7.400	2.3930E+03
7.700	2.4857E+03
8.000	2.5781E+03
8.300	2.6711E+03
8.600	2.7637E+03
8.900	2.8560E+03
9.200	2.9480E+03
9.500	3.0398E+03
9.800	3.1312E+03
10.100	3.2223E+03
10.400	3.3132E+03
24.000	7.1297E+03
45.500	1.2187E+04
96.000	1.0165E+04
720.000	1.0805E+03

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Cumulative Dose Summary

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Time (hr)	Exclusion Area Bounda Thyroid (rem)	TEDE (rem)	Low Population Zone Thyroid (rem)	TEDE (rem)	Control Room 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	1.5446E-06	5.3614E-08	4.2125E-07	1.4622E-08	1.1588E-07	3.6372E-09
0.083	2.3747E-03	8.2421E-05	6.4765E-04	2.2478E-05	5.2297E-03	1.6415E-04
0.400	5.6476E-02	1.9438E-03	1.5403E-02	5.3012E-04	7.3872E-02	2.3160E-03
0.700	1.7305E-01	5.9139E-03	4.7194E-02	1.6129E-03	2.4013E-01	7.5202E-03
1.000	3.5253E-01	1.1973E-02	9.6145E-02	3.2653E-03	5.4026E-01	1.6903E-02
1.300	5.9434E-01	2.0074E-02	1.6209E-01	5.4746E-03	9.8470E-01	3.0781E-02
1.600	8.9787E-01	3.0176E-02	2.4487E-01	8.2300E-03	1.5760E+00	4.9227E-02
1.900	1.2626E+00	4.2248E-02	3.4434E-01	1.1522E-02	2.3142E+00	7.2233E-02
2.000	1.3977E+00	4.6704E-02	3.8118E-01	1.2737E-02	2.5927E+00	8.0909E-02
2.300	1.6645E+00	5.5482E-02	4.5396E-01	1.5132E-02	3.3179E+00	1.0349E-01
2.600	1.9675E+00	6.5409E-02	5.3660E-01	1.7839E-02	3.9335E+00	1.2264E-01
2.900	2.3064E+00	7.6472E-02	6.2901E-01	2.0856E-02	4.5589E+00	1.4209E-01
3.200	2.6807E+00	8.8658E-02	7.3111E-01	2.4179E-02	5.2338E+00	1.6307E-01
3.500	3.0904E+00	1.0196E-01	8.4284E-01	2.7806E-02	5.9712E+00	1.8597E-01
3.800	3.5351E+00	1.1636E-01	9.6411E-01	3.1734E-02	6.7749E+00	2.1092E-01
4.100	4.0145E+00	1.3185E-01	1.0949E+00	3.5959E-02	7.6459E+00	2.3795E-01
4.400	4.5284E+00	1.4843E-01	1.2350E+00	4.0480E-02	8.5843E+00	2.6706E-01
4.700	5.0766E+00	1.6607E-01	1.3845E+00	4.5293E-02	9.5897E+00	2.9824E-01
5.000	5.6588E+00	1.8479E-01	1.5433E+00	5.0396E-02	1.0662E+01	3.3146E-01
5.300	6.2747E+00	2.0455E-01	1.7113E+00	5.5787E-02	1.1800E+01	3.6673E-01
5.600	6.9242E+00	2.2537E-01	1.8884E+00	6.1464E-02	1.3004E+01	4.0402E-01
5.900	7.6069E+00	2.4722E-01	2.0746E+00	6.7424E-02	1.4273E+01	4.4331E-01
6.200	8.3227E+00	2.7010E-01	2.2698E+00	7.3665E-02	1.5606E+01	4.8460E-01
6.500	9.0714E+00	2.9401E-01	2.4740E+00	8.0184E-02	1.7004E+01	5.2787E-01
6.800	9.8526E+00	3.1893E-01	2.6871E+00	8.6981E-02	1.8466E+01	5.7310E-01
7.100	1.0666E+01	3.4486E-01	2.9090E+00	9.4051E-02	1.9992E+01	6.2028E-01
7.400	1.1512E+01	3.7178E-01	3.1396E+00	1.0139E-01	2.1580E+01	6.6940E-01
7.700	1.2390E+01	3.9970E-01	3.3790E+00	1.0901E-01	2.3231E+01	7.2044E-01
8.000	1.3299E+01	4.2860E-01	3.6270E+00	1.1689E-01	2.4944E+01	7.7339E-01
8.300	1.3990E+01	4.5055E-01	3.6489E+00	1.1760E-01	2.6247E+01	8.1367E-01
8.600	1.4705E+01	4.7322E-01	3.6715E+00	1.1834E-01	2.7093E+01	8.3979E-01
8.900	1.5442E+01	4.9660E-01	3.6948E+00	1.1910E-01	2.7798E+01	8.6159E-01
9.200	1.6203E+01	5.2069E-01	3.7189E+00	1.1988E-01	2.8471E+01	8.8236E-01
9.500	1.6986E+01	5.4549E-01	3.7436E+00	1.2068E-01	2.9145E+01	9.0319E-01
9.800	1.7792E+01	5.7099E-01	3.7691E+00	1.2151E-01	2.9833E+01	9.2444E-01
10.100	1.8621E+01	5.9719E-01	3.7953E+00	1.2235E-01	3.0539E+01	9.4623E-01
10.400	1.9472E+01	6.2407E-01	3.8222E+00	1.2322E-01	3.1264E+01	9.6861E-01
24.000	7.9837E+01	2.5131E+00	5.7308E+00	1.8397E-01	8.3243E+01	2.5674E+00
45.500	2.1532E+02	6.7053E+00	6.7076E+00	2.1437E-01	1.3277E+02	4.0839E+00
96.000	2.1532E+02	6.7053E+00	6.7076E+00	2.1437E-01	1.3381E+02	4.1158E+00
720.000	2.1532E+02	6.7053E+00	6.7076E+00	2.1437E-01	1.3381E+02	4.1158E+00

##

Worst Two-Hour Doses

##

Exclusion Area Boundary

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
24.0	4.3110E-03	1.2603E+01	3.8997E-01

Attachment 13.2

RADTRAD Output File PLRAING02.o0

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:52:51
#######################################################################

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

Plant file           = G:\Radtrad 3.03\Input\PI\GEN-PI-083 R1\PLRAING02.psf
Inventory file       = g:\radtrad 3.03\defaults\pilra_iodin_def.txt
Release file         = g:\radtrad 3.03\defaults\pingp_ng_rft.txt
Dose Conversion file = g:\radtrad 3.03\defaults\pingp_fg11&12.txt



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


Radtrad 3.03 4/15/2001
PINGP 1 & 2 Locked Rotor  Accident AST Analysis - Noble Gas Release From Intact SGs
Nuclide Inventory File:
g:\radtrad 3.03\defaults\pilra_iodin_def.txt
Plant Power Level:
 1.8520E+03
Compartments:
  3
Compartment 1:
RCS
  3
 5.2900E+03
  0
  0
  0
  0
  0
Compartment 2:
Environment
  2
 0.0000E+00
  0
  0
  0
  0
  0
```

```
Compartment 3:
Control Room
  1
 6.1315E+04
  0
  0
  1
  0
  0
Pathways:
  3
Pathway 1:
Environment to Control Room
  2
  3
  2
Pathway 2:
Control Room to Environment
  3
  2
  2
Pathway 3:
RCS 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\pingp_fg11&12.txt
g:\radtrad 3.03\defaults\pingp_ng_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:
  1
  1
  0
  0
  0
  0
  1
  3.6000E+03
  3
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   9.9000E+01   9.5000E+01   9.5000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   3.0000E+02   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
  3
  0.0000E+00   2.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   3.0000E+02   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 3:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   3.7600E-02   0.0000E+00   0.0000E+00   0.0000E+00
  4.5500E+01   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   6.4900E-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
  5
  0.0000E+00   1.7700E-04
  8.0000E+00   3.9900E-05
  2.4000E+01   7.1200E-06
  9.6000E+01   1.0400E-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   1.9300E-02
  2.0000E+00   1.5700E-02
  8.0000E+00   7.0400E-03
  2.4000E+01   4.8700E-03
  9.6000E+01   3.8600E-03
  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   4.0000E+00
  7.2000E+02   0.0000E+00
Output Filename:
G:\Radtrad 3.o12
  1
  1
  1
  0
  0
End of Scenario File
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:52:51
#######################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.8520E+03 MWth

Number of compartments    =   3

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: RCS
Compartment volume =   5.2900E+03 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  1
   Exit Pathway Number    3: RCS to  Environment

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

Compartment number  3
Name: Control Room
Compartment volume =   6.1315E+04 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   1: Environment to Control Room
   Exit Pathway Number    2: Control Room to Environment

Total number of pathways =   3
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:52:51
#######################################################################

#######################################################################
                      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	5.058E+01
IODINE	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
CESIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
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 = 1852. 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	3.487E-02	6.588E+03	1.500E-18	0.000E+00	0.000E+00
Kr-85	1	9.466E+00	3.383E+08	1.190E-16	0.000E+00	0.000E+00
Kr-85m	1	6.431E+01	1.613E+04	7.480E-15	0.000E+00	0.000E+00
Kr-87	1	1.261E+02	4.578E+03	4.120E-14	0.000E+00	0.000E+00
Kr-88	1	1.678E+02	1.022E+04	1.020E-13	0.000E+00	0.000E+00
Xe-131m	1	3.189E+00	1.028E+06	3.890E-16	0.000E+00	0.000E+00
Xe-133	1	5.668E+02	4.532E+05	1.560E-15	0.000E+00	0.000E+00
Xe-133m	1	1.732E+01	1.890E+05	1.370E-15	0.000E+00	0.000E+00
Xe-135	1	1.237E+02	3.272E+04	1.190E-14	0.000E+00	0.000E+00
Xe-135m	1	1.159E+02	9.174E+02	2.040E-14	0.000E+00	0.000E+00
Xe-138	1	4.588E+02	8.502E+02	5.770E-14	0.000E+00	0.000E+00

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

Iodine fractions
Aerosol = 0.0000E+00
Elemental = 9.7000E-01

Organic = 3.0000E-02

COMPARTMENT DATA

Compartment number 1: RCS

Compartment number 2: Environment

Compartment number 3: Control Room

Compartment Filter Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	3.6000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.6000E+03	9.9000E+01	9.5000E+01	9.5000E+01
7.2000E+02	3.6000E+03	0.0000E+00	0.0000E+00	0.0000E+00

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	2.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.0000E+02	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 to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.0000E+02	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 3: RCS to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	3.7600E-02	0.0000E+00	0.0000E+00	0.0000E+00
4.5500E+01	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	6.4900E-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           1.7700E-04
  8.0000E+00           3.9900E-05
  2.4000E+01           7.1200E-06
  9.6000E+01           1.0400E-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           1.9300E-02
  2.0000E+00           1.5700E-02
  8.0000E+00           7.0400E-03
  2.4000E+01           4.8700E-03
  9.6000E+01           3.8600E-03
  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       4.0000E+00
      7.2000E+02       0.0000E+00
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:52:51
#######################################################################
```

```
 ####   #    #  #####  #####   #    #  #####
#    #  #    #    #    #    #  #    #    #
#    #  #    #    #    #    #  #    #    #
#    #  #    #    #    #####   #    #    #
#    #  #    #    #    #       #    #    #
#    #  #    #    #    #       #    #    #
 ####    ####     #    #        ####     #
```

```
#######################################################################
           Dose, Detailed model and Detailed Inventory Output
#######################################################################
```

Exclusion Area Boundary Doses:

Time (h) = 0.0036	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.8407E-04	0.0000E+00	1.8407E-04
Accumulated dose (rem)	1.8407E-04	0.0000E+00	1.8407E-04

Low Population Zone Doses:

Time (h) = 0.0036	Whole Body	Thyroid	TEDE
Delta dose (rem)	5.0201E-05	0.0000E+00	5.0201E-05
Accumulated dose (rem)	5.0201E-05	0.0000E+00	5.0201E-05

Control Room Doses:

Time (h) = 0.0036	Whole Body	Thyroid	TEDE
Delta dose (rem)	5.3061E-07	0.0000E+00	5.3061E-07
Accumulated dose (rem)	5.3061E-07	0.0000E+00	5.3061E-07

Control Room Compartment Nuclide Inventory:

Time (h) = 0.0036	Ci	kg	Atoms	Decay
Kr-83m	8.9974E-07	4.3609E-17	3.1641E+08	3.0637E+05
Kr-85	2.4458E-04	6.2340E-10	4.4167E+15	8.3243E+07
Kr-85m	1.6607E-03	2.0180E-13	1.4297E+12	5.6533E+08
Kr-87	3.2518E-03	1.1480E-13	7.9465E+11	1.1075E+09
Kr-88	4.3318E-03	3.4546E-13	2.3641E+12	1.4748E+09
Xe-131m	8.2397E-05	9.8371E-13	4.5222E+12	2.8044E+07
Xe-133	1.4645E-02	7.8238E-11	3.5426E+14	4.9843E+09
Xe-133m	4.4750E-04	9.9730E-13	4.5157E+12	1.5231E+08
Xe-135	3.1967E-03	1.2518E-12	5.5839E+12	1.0879E+09
Xe-135m	2.9690E-03	3.2594E-14	1.4540E+11	1.0140E+09
Xe-138	1.1730E-02	1.2199E-13	5.3234E+11	4.0073E+09

Control Room Transport Group Inventory:

Time (h) = 0.0036	Atmosphere	Sump

```
Noble gases (atoms)     4.7909E+15  0.0000E+00
Elemental I (atoms)     0.0000E+00  0.0000E+00
Organic I (atoms)       0.0000E+00  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00
Dose Effective (Ci/cc) I-131 (Thyroid)          0.0000E+00
Dose Effective (Ci/cc) I-131 (ICRP2 Thyroid)    0.0000E+00
Total I (Ci)                                    0.0000E+00

                        Deposition Recirculating
Time (h) =   0.0036      Surfaces     Filter
Noble gases (atoms)     0.0000E+00  0.0000E+00
Elemental I (atoms)     0.0000E+00  0.0000E+00
Organic I (atoms)       0.0000E+00  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00

Environment to Control Room Transport Group Inventory:

                         Pathway
Time (h) =   0.0036      Filtered   Transported
Noble gases (atoms)     0.0000E+00  4.8021E+15
Elemental I (atoms)     0.0000E+00  0.0000E+00
Organic I (atoms)       0.0000E+00  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00

Control Room to Environment Transport Group Inventory:

                         Pathway
Time (h) =   0.0036      Filtered   Transported
Noble gases (atoms)     1.1257E+13  0.0000E+00
Elemental I (atoms)     0.0000E+00  0.0000E+00
Organic I (atoms)       0.0000E+00  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00

Exclusion Area Boundary Doses:

Time (h) =   0.0833     Whole Body   Thyroid       TEDE
Delta dose (rem)         8.1153E-03  0.0000E+00  8.1153E-03
Accumulated dose (rem)   8.2994E-03  0.0000E+00  8.2994E-03

Low Population Zone Doses:

Time (h) =   0.0833     Whole Body   Thyroid       TEDE
Delta dose (rem)         2.2133E-03  0.0000E+00  2.2133E-03
Accumulated dose (rem)   2.2635E-03  0.0000E+00  2.2635E-03

Control Room Doses:

Time (h) =   0.0833     Whole Body   Thyroid       TEDE
Delta dose (rem)         6.4460E-04  0.0000E+00  6.4460E-04
Accumulated dose (rem)   6.4513E-04  0.0000E+00  6.4513E-04

Control Room Compartment Nuclide Inventory:

Time (h) =   0.0833        Ci           kg          Atoms       Decay
Kr-83m                  3.6620E-05  1.7749E-15  1.2878E+10  3.9500E+08
Kr-85                   1.0260E-02  2.6151E-08  1.8527E+17  1.0900E+11
Kr-85m                  6.8811E-02  8.3614E-12  5.9240E+13  7.3558E+11
```

Kr-87	1.3061E-01	4.6110E-12	3.1917E+13	1.4182E+12
Kr-88	1.7821E-01	1.4212E-11	9.7260E+13	1.9119E+12
Xe-131m	3.4558E-03	4.1257E-11	1.8966E+14	3.6718E+10
Xe-133	6.1406E-01	3.2806E-09	1.4854E+16	6.5252E+12
Xe-133m	1.8752E-02	4.1791E-11	1.8923E+14	1.9933E+11
Xe-135	1.3397E-01	5.2461E-11	2.3402E+14	1.4204E+12
Xe-135m	1.0031E-01	1.1012E-12	4.9121E+12	1.1901E+12
Xe-138	3.8942E-01	4.0499E-12	1.7673E+13	4.6617E+12

Control Room Transport Group Inventory:

Time (h) = 0.0833	Atmosphere	Sump	
Noble gases (atoms)	2.0095E+17	0.0000E+00	
Elemental I (atoms)	0.0000E+00	0.0000E+00	
Organic I (atoms)	0.0000E+00	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		0.0000E+00
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		0.0000E+00
Total I (Ci)			0.0000E+00

Time (h) = 0.0833	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 0.0833	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.1743E+17
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 0.0833	Pathway Filtered	Transported
Noble gases (atoms)	1.6467E+16	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.8147E-01	0.0000E+00	1.8147E-01
Accumulated dose (rem)	1.8977E-01	0.0000E+00	1.8977E-01

Low Population Zone Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	4.9493E-02	0.0000E+00	4.9493E-02
Accumulated dose (rem)	5.1757E-02	0.0000E+00	5.1757E-02

Control Room Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	9.2841E-02	0.0000E+00	9.2841E-02
Accumulated dose (rem)	9.3486E-02	0.0000E+00	9.3486E-02

Control Room Compartment Nuclide Inventory:

Time (h) = 8.0000	Ci	kg	Atoms	Decay
Kr-83m	9.4164E-06	4.5640E-16	3.3114E+09	3.9449E+10
Kr-85	5.2914E-02	1.3487E-07	9.5554E+17	4.3942E+13
Kr-85m	1.0426E-01	1.2670E-11	8.9762E+13	1.5515E+14
Kr-87	9.0024E-03	3.1782E-13	2.1999E+12	9.2277E+13
Kr-88	1.3312E-01	1.0616E-11	7.2649E+13	2.9163E+14
Xe-131m	1.7484E-02	2.0873E-10	9.5956E+14	1.4640E+13
Xe-133	3.0358E+00	1.6219E-08	7.3437E+16	2.5677E+15
Xe-133m	8.7117E-02	1.9415E-10	8.7911E+14	7.5711E+13
Xe-135	3.8600E-01	1.5115E-10	6.7426E+14	4.2115E+14
Xe-135m	2.3010E-10	2.5260E-21	1.1268E+04	9.2401E+12

Control Room Transport Group Inventory:

Time (h) = 8.0000	Atmosphere	Sump	
Noble gases (atoms)	1.0317E+18	0.0000E+00	
Elemental I (atoms)	0.0000E+00	0.0000E+00	
Organic I (atoms)	0.0000E+00	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		0.0000E+00
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		0.0000E+00
Total I (Ci)			0.0000E+00

Time (h) = 8.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 8.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.9265E+18
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 8.0000	Pathway Filtered	Transported
Noble gases (atoms)	1.8912E+18	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE

Delta dose (rem)	6.0919E-02	0.0000E+00	6.0919E-02
Accumulated dose (rem)	2.5069E-01	0.0000E+00	2.5069E-01

Low Population Zone Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.7452E-03	0.0000E+00	3.7452E-03
Accumulated dose (rem)	5.5502E-02	0.0000E+00	5.5502E-02

Control Room Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.1443E-02	0.0000E+00	3.1443E-02
Accumulated dose (rem)	1.2493E-01	0.0000E+00	1.2493E-01

Control Room Compartment Nuclide Inventory:

Time (h) = 24.0000	Ci	kg	Atoms	Decay
Kr-83m	1.0554E-08	5.1155E-19	3.7116E+06	4.1982E+10
Kr-85	2.5412E-02	6.4770E-08	4.5889E+17	1.0960E+14
Kr-85m	4.2124E-03	5.1187E-13	3.6265E+12	2.1009E+14
Kr-87	7.0523E-07	2.4897E-17	1.7234E+08	9.4062E+13
Kr-88	1.2876E-03	1.0269E-13	7.0273E+11	3.4243E+14
Xe-131m	8.0774E-03	9.6434E-11	4.4331E+14	3.5965E+13
Xe-133	1.3383E+00	7.1497E-09	3.2373E+16	6.1949E+15
Xe-133m	3.3875E-02	7.5496E-11	3.4184E+14	1.7432E+14
Xe-135	5.4730E-02	2.1431E-11	9.5602E+13	7.1774E+14

Control Room Transport Group Inventory:

Time (h) = 24.0000	Atmosphere	Sump	
Noble gases (atoms)	4.9215E+17	0.0000E+00	
Elemental I (atoms)	0.0000E+00	0.0000E+00	
Organic I (atoms)	0.0000E+00	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		0.0000E+00
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		0.0000E+00
Total I (Ci)			0.0000E+00

Time (h) = 24.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 24.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	5.2276E+18
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Pathway

Time (h) = 24.0000	Filtered	Transported
Noble gases (atoms)	4.7277E+18	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.5836E-02	0.0000E+00	3.5836E-02
Accumulated dose (rem)	2.8653E-01	0.0000E+00	2.8653E-01

Low Population Zone Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.9314E-04	0.0000E+00	3.9314E-04
Accumulated dose (rem)	5.5895E-02	0.0000E+00	5.5895E-02

Control Room Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.2009E-03	0.0000E+00	6.2009E-03
Accumulated dose (rem)	1.3113E-01	0.0000E+00	1.3113E-01

Control Room Compartment Nuclide Inventory:

Time (h) = 45.5000	Ci	kg	Atoms	Decay
Kr-85	1.7258E-02	4.3987E-08	3.1164E+17	1.6232E+14
Kr-85m	1.0277E-04	1.2488E-14	8.8477E+10	2.1282E+14
Kr-88	4.6013E-06	3.6696E-16	2.5112E+09	3.4299E+14
Xe-131m	5.2075E-03	6.2171E-11	2.8580E+14	5.2313E+13
Xe-133	8.0976E-01	4.3261E-09	1.9588E+16	8.8235E+15
Xe-133m	1.7324E-02	3.8609E-11	1.7482E+14	2.3588E+14
Xe-135	7.2150E-03	2.8253E-12	1.2603E+13	7.7565E+14

Control Room Transport Group Inventory:

Time (h) = 45.5000	Atmosphere	Sump
Noble gases (atoms)	3.3170E+17	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00
Dose Effective (Ci/cc)	I-131 (Thyroid)	0.0000E+00
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)	0.0000E+00
Total I (Ci)		0.0000E+00

Time (h) = 45.5000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 45.5000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	7.3343E+18

Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 45.5000	Pathway Filtered	Transported
Noble gases (atoms)	6.9921E+18	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

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)	2.8653E-01	0.0000E+00	2.8653E-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)	5.5895E-02	0.0000E+00	5.5895E-02

Control Room Doses:

Time (h) = 96.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	7.4923E-04	0.0000E+00	7.4923E-04
Accumulated dose (rem)	1.3188E-01	0.0000E+00	1.3188E-01

Control Room Compartment Nuclide Inventory:

Time (h) = 96.0000	Ci	kg	Atoms	Decay
Kr-85	6.2859E-09	1.6022E-14	1.1351E+11	1.6913E+14
Xe-131m	1.6786E-09	2.0040E-17	9.2127E+07	5.4351E+13
Xe-133	2.2453E-07	1.1995E-15	5.4315E+09	9.1373E+15
Xe-133m	3.2412E-09	7.2234E-18	3.2707E+07	2.4242E+14
Xe-135	5.5898E-11	2.1889E-20	9.7642E+04	7.7792E+14

Control Room Transport Group Inventory:

Time (h) = 96.0000	Atmosphere	Sump
Noble gases (atoms)	1.1907E+11	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00
Dose Effective (Ci/cc)	I-131 (Thyroid)	0.0000E+00
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)	0.0000E+00
Total I (Ci)		0.0000E+00

Time (h) = 96.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 96.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	7.3343E+18
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 96.0000	Pathway Filtered	Transported
Noble gases (atoms)	7.3234E+18	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

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)	2.8653E-01	0.0000E+00	2.8653E-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)	5.5895E-02	0.0000E+00	5.5895E-02

Control Room Doses:

Time (h) = 720.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.3079E-10	0.0000E+00	1.3079E-10
Accumulated dose (rem)	1.3188E-01	0.0000E+00	1.3188E-01

Control Room Compartment Nuclide Inventory:

Time (h) = 720.0000	Ci	kg	Atoms	Decay

Control Room Transport Group Inventory:

Time (h) = 720.0000	Atmosphere	Sump
Noble gases (atoms)	3.1440E-69	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00
Dose Effective (Ci/cc) I-131 (Thyroid)		0.0000E+00
Dose Effective (Ci/cc) I-131 (ICRP2 Thyroid)		0.0000E+00
Total I (Ci)		0.0000E+00

Time (h) = 720.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 720.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	7.3343E+18
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 720.0000	Pathway Filtered	Transported
Noble gases (atoms)	7.3234E+18	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

840

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#################################################################
                          I-131 Summary
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Time (hr)	RCS I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
0.000	0.0000E+00	0.0000E+00	0.0000E+00
0.004	0.0000E+00	0.0000E+00	0.0000E+00
0.083	0.0000E+00	0.0000E+00	0.0000E+00
0.400	0.0000E+00	0.0000E+00	0.0000E+00
0.700	0.0000E+00	0.0000E+00	0.0000E+00
1.000	0.0000E+00	0.0000E+00	0.0000E+00
1.300	0.0000E+00	0.0000E+00	0.0000E+00
1.600	0.0000E+00	0.0000E+00	0.0000E+00
1.900	0.0000E+00	0.0000E+00	0.0000E+00
2.200	0.0000E+00	0.0000E+00	0.0000E+00
2.500	0.0000E+00	0.0000E+00	0.0000E+00
2.800	0.0000E+00	0.0000E+00	0.0000E+00
3.100	0.0000E+00	0.0000E+00	0.0000E+00
3.400	0.0000E+00	0.0000E+00	0.0000E+00
3.700	0.0000E+00	0.0000E+00	0.0000E+00
4.000	0.0000E+00	0.0000E+00	0.0000E+00
4.300	0.0000E+00	0.0000E+00	0.0000E+00
4.600	0.0000E+00	0.0000E+00	0.0000E+00
4.900	0.0000E+00	0.0000E+00	0.0000E+00
5.200	0.0000E+00	0.0000E+00	0.0000E+00
5.500	0.0000E+00	0.0000E+00	0.0000E+00
5.800	0.0000E+00	0.0000E+00	0.0000E+00
6.100	0.0000E+00	0.0000E+00	0.0000E+00
6.400	0.0000E+00	0.0000E+00	0.0000E+00
6.700	0.0000E+00	0.0000E+00	0.0000E+00
7.000	0.0000E+00	0.0000E+00	0.0000E+00
7.300	0.0000E+00	0.0000E+00	0.0000E+00
7.600	0.0000E+00	0.0000E+00	0.0000E+00
7.900	0.0000E+00	0.0000E+00	0.0000E+00
8.000	0.0000E+00	0.0000E+00	0.0000E+00
8.300	0.0000E+00	0.0000E+00	0.0000E+00

8.600	0.0000E+00	0.0000E+00	0.0000E+00
8.900	0.0000E+00	0.0000E+00	0.0000E+00
9.200	0.0000E+00	0.0000E+00	0.0000E+00
9.500	0.0000E+00	0.0000E+00	0.0000E+00
9.800	0.0000E+00	0.0000E+00	0.0000E+00
10.100	0.0000E+00	0.0000E+00	0.0000E+00
10.400	0.0000E+00	0.0000E+00	0.0000E+00
24.000	0.0000E+00	0.0000E+00	0.0000E+00
45.500	0.0000E+00	0.0000E+00	0.0000E+00
96.000	0.0000E+00	0.0000E+00	0.0000E+00
720.000	0.0000E+00	0.0000E+00	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	0.0000E+00	1.8407E-04	0.0000E+00	5.0201E-05	0.0000E+00	5.3061E-07
0.083	0.0000E+00	8.2994E-03	0.0000E+00	2.2635E-03	0.0000E+00	6.4513E-04
0.400	0.0000E+00	3.2757E-02	0.0000E+00	8.9336E-03	0.0000E+00	5.3681E-03
0.700	0.0000E+00	4.9146E-02	0.0000E+00	1.3403E-02	0.0000E+00	9.7671E-03
1.000	0.0000E+00	6.2269E-02	0.0000E+00	1.6983E-02	0.0000E+00	1.4163E-02
1.300	0.0000E+00	7.3554E-02	0.0000E+00	2.0060E-02	0.0000E+00	1.8628E-02
1.600	0.0000E+00	8.3641E-02	0.0000E+00	2.2811E-02	0.0000E+00	2.3180E-02
1.900	0.0000E+00	9.2836E-02	0.0000E+00	2.5319E-02	0.0000E+00	2.7796E-02
2.200	0.0000E+00	1.0130E-01	0.0000E+00	2.7628E-02	0.0000E+00	3.2409E-02
2.500	0.0000E+00	1.0914E-01	0.0000E+00	2.9766E-02	0.0000E+00	3.6894E-02
2.800	0.0000E+00	1.1642E-01	0.0000E+00	3.1752E-02	0.0000E+00	4.1234E-02
3.100	0.0000E+00	1.2320E-01	0.0000E+00	3.3600E-02	0.0000E+00	4.5423E-02
3.400	0.0000E+00	1.2952E-01	0.0000E+00	3.5324E-02	0.0000E+00	4.9457E-02
3.700	0.0000E+00	1.3542E-01	0.0000E+00	3.6934E-02	0.0000E+00	5.3333E-02
4.000	0.0000E+00	1.4094E-01	0.0000E+00	3.8439E-02	0.0000E+00	5.7051E-02
4.300	0.0000E+00	1.4611E-01	0.0000E+00	3.9849E-02	0.0000E+00	6.0613E-02
4.600	0.0000E+00	1.5096E-01	0.0000E+00	4.1171E-02	0.0000E+00	6.4022E-02
4.900	0.0000E+00	1.5551E-01	0.0000E+00	4.2412E-02	0.0000E+00	6.7281E-02
5.200	0.0000E+00	1.5979E-01	0.0000E+00	4.3579E-02	0.0000E+00	7.0395E-02
5.500	0.0000E+00	1.6381E-01	0.0000E+00	4.4676E-02	0.0000E+00	7.3369E-02
5.800	0.0000E+00	1.6761E-01	0.0000E+00	4.5711E-02	0.0000E+00	7.6209E-02
6.100	0.0000E+00	1.7118E-01	0.0000E+00	4.6686E-02	0.0000E+00	7.8921E-02
6.400	0.0000E+00	1.7456E-01	0.0000E+00	4.7608E-02	0.0000E+00	8.1511E-02
6.700	0.0000E+00	1.7776E-01	0.0000E+00	4.8479E-02	0.0000E+00	8.3983E-02
7.000	0.0000E+00	1.8078E-01	0.0000E+00	4.9303E-02	0.0000E+00	8.6344E-02
7.300	0.0000E+00	1.8364E-01	0.0000E+00	5.0085E-02	0.0000E+00	8.8601E-02
7.600	0.0000E+00	1.8636E-01	0.0000E+00	5.0826E-02	0.0000E+00	9.0757E-02
7.900	0.0000E+00	1.8894E-01	0.0000E+00	5.1530E-02	0.0000E+00	9.2819E-02
8.000	0.0000E+00	1.8977E-01	0.0000E+00	5.1757E-02	0.0000E+00	9.3486E-02
8.300	0.0000E+00	1.9219E-01	0.0000E+00	5.1905E-02	0.0000E+00	9.5381E-02
8.600	0.0000E+00	1.9449E-01	0.0000E+00	5.2046E-02	0.0000E+00	9.7108E-02
8.900	0.0000E+00	1.9668E-01	0.0000E+00	5.2181E-02	0.0000E+00	9.8687E-02
9.200	0.0000E+00	1.9877E-01	0.0000E+00	5.2310E-02	0.0000E+00	1.0013E-01
9.500	0.0000E+00	2.0077E-01	0.0000E+00	5.2432E-02	0.0000E+00	1.0147E-01
9.800	0.0000E+00	2.0268E-01	0.0000E+00	5.2550E-02	0.0000E+00	1.0269E-01
10.100	0.0000E+00	2.0450E-01	0.0000E+00	5.2662E-02	0.0000E+00	1.0383E-01
10.400	0.0000E+00	2.0626E-01	0.0000E+00	5.2770E-02	0.0000E+00	1.0488E-01

```
  24.000 0.0000E+00 2.5069E-01 0.0000E+00 5.5502E-02 0.0000E+00 1.2493E-01
  45.500 0.0000E+00 2.8653E-01 0.0000E+00 5.5895E-02 0.0000E+00 1.3113E-01
  96.000 0.0000E+00 2.8653E-01 0.0000E+00 5.5895E-02 0.0000E+00 1.3188E-01
 720.000 0.0000E+00 2.8653E-01 0.0000E+00 5.5895E-02 0.0000E+00 1.3188E-01

#####################################################################
                        Worst Two-Hour Doses
#####################################################################

Exclusion Area Boundary
   Time    Whole Body     Thyroid         TEDE
   (hr)      (rem)         (rem)          (rem)
    0.0    9.5659E-02    0.0000E+00    9.5659E-02
```

Attachment 13.3

RADTRAD Output File PILRAINLQ02.o0

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:57:07
#######################################################################

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

Plant file           = G:\Radtrad 3.03\Input\PI\GEN-PI-083 R1\PLRAINLQ02.psf
Inventory file       = g:\radtrad 3.03\defaults\pilra_liq_def.txt
Release file         = g:\radtrad 3.03\defaults\pingp_iodine_rft.txt
Dose Conversion file = g:\radtrad 3.03\defaults\pingp_fg11&12.txt



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


Radtrad 3.03 4/15/2001
PINGP 1 & 2 Locked Rotor  Accident AST Analysis - SG Liquid Iodine Released  From
Intact  SGs
Nuclide Inventory File:
g:\radtrad 3.03\defaults\pilra_liq_def.txt
Plant Power Level:
 1.8520E+03
Compartments:
  3
Compartment 1:
Intact SG
  3
 3.4380E+03
  0
  0
  0
  0
  0
Compartment 2:
Environment
  2
 0.0000E+00
  0
  0
  0
  0
```

```
  0
Compartment 3:
Control Room
  1
 6.1315E+04
  0
  0
  1
  0
  0
Pathways:
  3
Pathway 1:
Intact SG to Environment
  1
  2
  2
Pathway 2:
Environment to Control Room
  2
  3
  2
Pathway 3:
Control Room to Environment
  3
  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\pingp_fg11&12.txt
g:\radtrad 3.03\defaults\pingp_iodine_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:
  1
  1
  0
  0
  0
  0
  1
  3.6000E+03
  3
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   9.9000E+01   9.5000E+01   9.5000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Pathways:
  3
Pathway 1:
  0
  0
  0
  0
  0
  1
  5
  0.0000E+00   3.9420E-01   0.0000E+00   0.0000E+00   0.0000E+00
  2.0000E+00   2.3610E-01   0.0000E+00   0.0000E+00   0.0000E+00
  8.0000E+00   1.7340E-01   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   1.3980E-01   0.0000E+00   0.0000E+00   0.0000E+00
  4.5500E+01   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
  3
  0.0000E+00   2.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
```

```
  8.3300E-02   3.0000E+02   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 3:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.0000E+03   0.0000E+00   0.0000E+00   0.0000E+00
  8.3300E-02   3.0000E+02   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
Dose Locations:
  3
Location 1:
Exclusion Area Boundary
  2
  1
  2
  0.0000E+00   6.4900E-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
  5
  0.0000E+00   1.7700E-04
  8.0000E+00   3.9900E-05
  2.4000E+01   7.1200E-06
  9.6000E+01   1.0400E-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   1.9300E-02
  2.0000E+00   1.5700E-02
  8.0000E+00   7.0400E-03
  2.4000E+01   4.8700E-03
  9.6000E+01   3.8600E-03
  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   4.0000E+00
  7.2000E+02   0.0000E+00
Output Filename:
G:\Radtrad 3.o13
  1
  1
  1
  0
  0
End of Scenario File
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:57:07
#######################################################################

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

Number of Nuclides =  60

Inventory Power =   1.0000E+00 MWth
Plant Power Level =   1.8520E+03 MWth

Number of compartments    =   3

Compartment information

Compartment number  1  (Source term fraction =   1.0000E+00
)
Name: Intact SG
Compartment volume =   3.4380E+03 (Cubic feet)
Compartment type is Normal
Pathways into and out of compartment  1
   Exit Pathway Number    1: Intact SG to Environment

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

Compartment number  3
Name: Control Room
Compartment volume =   6.1315E+04 (Cubic feet)
Compartment type is Control Room
Removal devices within compartment:
     Filter(s)
Pathways into and out of compartment  3
   Inlet Pathway Number   2: Environment to Control Room
   Exit Pathway Number    3: Control Room to Environment

Total number of pathways =   3
```

```
#######################################################################
  RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:57:07
#######################################################################

#######################################################################
                    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	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
IODINE	1.0000E+00	0.0000E+00	0.0000E+00	8.142E-05
CESIUM	0.0000E+00	0.0000E+00	0.0000E+00	0.000E+00
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 = 1852. 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)
I-131	2	4.500E-03	6.947E+05	1.820E-14	2.920E-07	8.890E-09
I-132	2	4.940E-03	8.280E+03	1.120E-13	1.740E-09	1.030E-10
I-133	2	6.846E-03	7.488E+04	2.940E-14	4.860E-08	1.580E-09
I-134	2	1.027E-03	3.156E+03	1.300E-13	2.880E-10	3.550E-11
I-135	2	3.882E-03	2.380E+04	8.294E-14	8.460E-09	3.320E-10

Nuclide	Daughter	Fraction	Daughter	Fraction	Daughter	Fraction
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

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

COMPARTMENT DATA

Compartment number 1: Intact SG

Compartment number 2: Environment

Compartment number 3: Control Room

Compartment Filter Data

Time (hr) Flow Rate Filter Efficiencies (%)

	(cfm)	Aerosol	Elemental	Organic
0.0000E+00	3.6000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.6000E+03	9.9000E+01	9.5000E+01	9.5000E+01
7.2000E+02	3.6000E+03	0.0000E+00	0.0000E+00	0.0000E+00

PATHWAY DATA

Pathway number 1: Intact SG to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	3.9420E-01	0.0000E+00	0.0000E+00	0.0000E+00
2.0000E+00	2.3610E-01	0.0000E+00	0.0000E+00	0.0000E+00
8.0000E+00	1.7340E-01	0.0000E+00	0.0000E+00	0.0000E+00
2.4000E+01	1.3980E-01	0.0000E+00	0.0000E+00	0.0000E+00
4.5500E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Pathway number 2: Environment to Control Room

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.0000E+02	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 3: Control Room to Environment

Pathway Filter: Removal Data

Time (hr)	Flow Rate (cfm)	Filter Efficiencies (%) Aerosol	Elemental	Organic
0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	0.0000E+00
8.3300E-02	3.0000E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	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	6.4900E-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	1.7700E-04
8.0000E+00	3.9900E-05

```
  2.4000E+01          7.1200E-06
  9.6000E+01          1.0400E-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          1.9300E-02
  2.0000E+00          1.5700E-02
  8.0000E+00          7.0400E-03
  2.4000E+01          4.8700E-03
  9.6000E+01          3.8600E-03
  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       4.0000E+00
 7.2000E+02       0.0000E+00
```

```
#######################################################################
   RADTRAD Version 3.03 (Spring 2001) run on  6/22/2010  at  1:57:07
#######################################################################


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


#######################################################################
            Dose, Detailed model and Detailed Inventory Output
#######################################################################
```

Exclusion Area Boundary Doses:

Time (h) = 0.0036	Whole Body	Thyroid	TEDE
Delta dose (rem)	7.1130E-08	3.2544E-05	1.0860E-06
Accumulated dose (rem)	7.1130E-08	3.2544E-05	1.0860E-06

Low Population Zone Doses:

Time (h) = 0.0036	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.9399E-08	8.8756E-06	2.9619E-07
Accumulated dose (rem)	1.9399E-08	8.8756E-06	2.9619E-07

Control Room Doses:

Time (h) = 0.0036	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.0506E-10	2.6510E-06	8.2880E-08
Accumulated dose (rem)	2.0506E-10	2.6510E-06	8.2880E-08

Control Room Compartment Nuclide Inventory:

Time (h) = 0.0036	Ci	kg	Atoms	Decay
I-131	1.8756E-06	1.5129E-14	6.9548E+10	6.3836E+05
I-132	2.0568E-06	1.9926E-16	9.0907E+08	7.0029E+05
I-133	2.8531E-06	2.5186E-15	1.1404E+10	9.7109E+05
I-134	4.2684E-07	1.6001E-17	7.1909E+07	1.4542E+05
I-135	1.6174E-06	4.6056E-16	2.0545E+09	5.5056E+05
Xe-133	4.4756E-11	2.3911E-19	1.0827E+06	2.3079E+00
Xe-133m	3.2076E-12	7.1485E-21	3.2368E+04	1.6540E-01
Xe-135	3.0798E-10	1.2060E-19	5.3798E+05	1.5880E+01
Xe-135m	1.9362E-09	2.1255E-20	9.4816E+04	9.9579E+01

Control Room Transport Group Inventory:

Time (h) = 0.0036	Atmosphere	Sump
Noble gases (atoms)	1.7559E+06	0.0000E+00
Elemental I (atoms)	8.1468E+10	0.0000E+00

Organic I (atoms)	2.5196E+09	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		1.3881E-15
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		1.6439E-15
Total I (Ci)			8.8298E-06

Time (h) = 0.0036	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 0.0036	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.2901E+05
Elemental I (atoms)	0.0000E+00	8.1663E+10
Organic I (atoms)	0.0000E+00	2.5256E+09
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 0.0036	Pathway Filtered	Transported
Noble gases (atoms)	8.0504E+02	0.0000E+00
Elemental I (atoms)	1.9142E+08	0.0000E+00
Organic I (atoms)	5.9203E+06	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 0.0833	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.1469E-06	1.4405E-03	4.8070E-05
Accumulated dose (rem)	3.2180E-06	1.4731E-03	4.9156E-05

Low Population Zone Doses:

Time (h) = 0.0833	Whole Body	Thyroid	TEDE
Delta dose (rem)	8.5824E-07	3.9287E-04	1.3110E-05
Accumulated dose (rem)	8.7763E-07	4.0174E-04	1.3406E-05

Control Room Doses:

Time (h) = 0.0833	Whole Body	Thyroid	TEDE
Delta dose (rem)	2.4996E-07	3.2332E-03	1.0108E-04
Accumulated dose (rem)	2.5016E-07	3.2358E-03	1.0116E-04

Control Room Compartment Nuclide Inventory:

Time (h) = 0.0833	Ci	kg	Atoms	Decay
I-131	7.8635E-05	6.3429E-13	2.9158E+12	8.3555E+08
I-132	8.4209E-05	8.1581E-15	3.7219E+10	9.0549E+08
I-133	1.1933E-04	1.0534E-13	4.7699E+11	1.2695E+09
I-134	1.6807E-05	6.3004E-16	2.8315E+09	1.8432E+08
I-135	6.7266E-05	1.9154E-14	8.5443E+10	7.1764E+08

Xe-131m	1.7311E-10	2.0667E-18	9.5010E+06	6.1307E+01
Xe-133	5.2625E-08	2.8114E-16	1.2730E+09	1.8657E+04
Xe-133m	3.7714E-09	8.4051E-18	3.8058E+07	1.3367E+03
Xe-135	3.6138E-07	1.4151E-16	6.3125E+08	1.2801E+05
Xe-135m	2.2577E-06	2.4785E-17	1.1056E+08	7.2607E+05

Control Room Transport Group Inventory:

Time (h) = 0.0833	Atmosphere	Sump	
Noble gases (atoms)	2.0624E+09	0.0000E+00	
Elemental I (atoms)	3.4128E+12	0.0000E+00	
Organic I (atoms)	1.0555E+11	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		5.8151E-14
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		6.8799E-14
Total I (Ci)			3.6625E-04

Time (h) = 0.0833	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	0.0000E+00
Organic I (atoms)	0.0000E+00	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 0.0833	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	7.3077E+07
Elemental I (atoms)	0.0000E+00	3.6964E+12
Organic I (atoms)	0.0000E+00	1.1432E+11
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 0.0833	Pathway Filtered	Transported
Noble gases (atoms)	5.6557E+06	0.0000E+00
Elemental I (atoms)	2.7997E+11	0.0000E+00
Organic I (atoms)	8.6589E+09	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.1929E-05	3.3982E-02	1.1195E-03
Accumulated dose (rem)	6.5147E-05	3.5456E-02	1.1686E-03

Low Population Zone Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.6890E-05	9.2679E-03	3.0531E-04
Accumulated dose (rem)	1.7767E-05	9.6697E-03	3.1872E-04

Control Room Doses:

Time (h) = 2.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.0682E-06	9.1548E-02	2.8555E-03

Accumulated dose (rem) 6.3183E-06 9.4784E-02 2.9566E-03

Control Room Compartment Nuclide Inventory:

Time (h) = 2.0000	Ci	kg	Atoms	Decay
I-131	4.2260E-05	3.4088E-13	1.5670E+12	1.2809E+10
I-132	2.5574E-05	2.4776E-15	1.1303E+10	1.0873E+10
I-133	6.0580E-05	5.3478E-14	2.4214E+11	1.8966E+10
I-134	1.9982E-06	7.4906E-17	3.3664E+08	1.5796E+09
I-135	2.9772E-05	8.4776E-15	3.7817E+10	1.0089E+10
Xe-131m	8.4455E-09	1.0083E-16	4.6352E+08	9.2525E+05
Xe-133	2.5056E-06	1.3386E-14	6.0610E+10	2.7653E+08
Xe-133m	1.7784E-07	3.9633E-16	1.7946E+09	1.9686E+07
Xe-135	1.7433E-05	6.8264E-15	3.0451E+10	1.9638E+09
Xe-135m	1.0500E-05	1.1526E-16	5.1417E+08	2.3630E+09

Control Room Transport Group Inventory:

Time (h) = 2.0000	Atmosphere	Sump	
Noble gases (atoms)	9.3834E+10	0.0000E+00	
Elemental I (atoms)	1.8029E+12	0.0000E+00	
Organic I (atoms)	5.5759E+10	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		3.0733E-14
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		3.5643E-14
Total I (Ci)			1.6018E-04

Time (h) = 2.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	1.3188E+13
Organic I (atoms)	0.0000E+00	4.0788E+11
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 2.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	8.9104E+10
Elemental I (atoms)	0.0000E+00	1.6481E+13
Organic I (atoms)	0.0000E+00	5.0974E+11
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 2.0000	Pathway Filtered	Transported
Noble gases (atoms)	2.2206E+10	0.0000E+00
Elemental I (atoms)	1.4368E+12	0.0000E+00
Organic I (atoms)	4.4438E+10	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.5830E-05	5.9825E-02	1.9181E-03
Accumulated dose (rem)	1.3098E-04	9.5281E-02	3.0867E-03

Low Population Zone Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	1.7954E-05	1.6316E-02	5.2312E-04
Accumulated dose (rem)	3.5721E-05	2.5986E-02	8.4184E-04

Control Room Doses:

Time (h) = 8.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	5.4739E-06	1.2280E-01	3.8080E-03
Accumulated dose (rem)	1.1792E-05	2.1758E-01	6.7646E-03

Control Room Compartment Nuclide Inventory:

Time (h) = 8.0000	Ci	kg	Atoms	Decay
I-131	1.9628E-05	1.5833E-13	7.2783E+11	2.9519E+10
I-132	1.9899E-06	1.9277E-16	8.7948E+08	1.5797E+10
I-133	2.3540E-05	2.0780E-14	9.4092E+10	4.0991E+10
I-134	8.2544E-09	3.0942E-19	1.3906E+06	1.7666E+09
I-135	7.5314E-06	2.1446E-15	9.5666E+09	1.9035E+10
Xe-131m	3.4484E-08	4.1170E-16	1.8926E+09	1.6894E+07
Xe-133	9.4543E-06	5.0509E-14	2.2870E+11	4.7994E+09
Xe-133m	6.5118E-07	1.4513E-15	6.5712E+09	3.3478E+08
Xe-135	4.3561E-05	1.7058E-14	7.6092E+10	2.6736E+10
Xe-135m	2.6948E-06	2.9583E-17	1.3196E+08	5.7300E+09

Control Room Transport Group Inventory:

Time (h) = 8.0000	Atmosphere	Sump	
Noble gases (atoms)	3.1339E+11	0.0000E+00	
Elemental I (atoms)	8.0740E+11	0.0000E+00	
Organic I (atoms)	2.4971E+10	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		1.3694E-14
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		1.5332E-14
Total I (Ci)			5.2698E-05

Time (h) = 8.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	3.0922E+13
Organic I (atoms)	0.0000E+00	9.5635E+11
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 8.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	6.4994E+11
Elemental I (atoms)	0.0000E+00	3.4827E+13
Organic I (atoms)	0.0000E+00	1.0771E+12
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 8.0000	Pathway Filtered	Transported
Noble gases (atoms)	3.6532E+11	0.0000E+00

Elemental I (atoms)	2.9924E+12	0.0000E+00
Organic I (atoms)	9.2549E+10	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.0338E-05	1.0266E-01	3.2199E-03
Accumulated dose (rem)	1.9132E-04	1.9794E-01	6.3066E-03

Low Population Zone Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.7095E-06	3.2459E-03	1.0361E-04
Accumulated dose (rem)	3.9431E-05	2.9232E-02	9.4544E-04

Control Room Doses:

Time (h) = 24.0000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.0810E-06	9.3346E-02	2.8763E-03
Accumulated dose (rem)	1.4873E-05	3.1093E-01	9.6409E-03

Control Room Compartment Nuclide Inventory:

Time (h) = 24.0000	Ci	kg	Atoms	Decay
I-131	5.8129E-06	4.6888E-14	2.1555E+11	4.2972E+10
I-132	5.0253E-09	4.8685E-19	2.2211E+06	1.6119E+10
I-133	4.3323E-06	3.8244E-15	1.7316E+10	5.3977E+10
I-135	4.4124E-07	1.2564E-16	5.6048E+08	2.1698E+10
Xe-131m	4.0431E-08	4.8270E-16	2.2190E+09	8.3379E+07
Xe-133	8.8376E-06	4.7214E-14	2.1378E+11	2.1028E+10
Xe-133m	5.6440E-07	1.2578E-15	5.6954E+09	1.4097E+09
Xe-135	1.3197E-05	5.1678E-15	2.3053E+10	7.1052E+10
Xe-135m	2.5082E-07	2.7534E-18	1.2283E+07	7.0707E+09

Control Room Transport Group Inventory:

Time (h) = 24.0000	Atmosphere	Sump
Noble gases (atoms)	2.4476E+11	0.0000E+00
Elemental I (atoms)	2.2642E+11	0.0000E+00
Organic I (atoms)	7.0027E+09	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00
Dose Effective (Ci/cc)	I-131 (Thyroid)	3.7706E-15
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)	4.0362E-15
Total I (Ci)		1.0591E-05

Time (h) = 24.0000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	4.4561E+13
Organic I (atoms)	0.0000E+00	1.3782E+12
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 24.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	1.6925E+12

Elemental I (atoms)	0.0000E+00	4.9110E+13
Organic I (atoms)	0.0000E+00	1.5189E+12
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 24.0000	Pathway Filtered	Transported
Noble gases (atoms)	1.4317E+12	0.0000E+00
Elemental I (atoms)	4.1888E+12	0.0000E+00
Organic I (atoms)	1.2955E+11	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

Exclusion Area Boundary Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.2882E-05	9.2798E-02	2.8753E-03
Accumulated dose (rem)	2.2420E-04	2.9074E-01	9.1819E-03

Low Population Zone Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	3.6074E-07	6.6901E-04	2.0852E-05
Accumulated dose (rem)	3.9791E-05	2.9901E-02	9.6630E-04

Control Room Doses:

Time (h) = 45.5000	Whole Body	Thyroid	TEDE
Delta dose (rem)	6.8006E-07	3.4434E-02	1.0554E-03
Accumulated dose (rem)	1.5553E-05	3.4536E-01	1.0696E-02

Control Room Compartment Nuclide Inventory:

Time (h) = 45.5000	Ci	kg	Atoms	Decay
I-131	2.8472E-06	2.2966E-14	1.0557E+11	5.1677E+10
I-133	1.1197E-06	9.8847E-16	4.4757E+09	5.8805E+10
I-135	2.4496E-08	6.9753E-18	3.1116E+07	2.1973E+10
Xe-131m	4.1006E-08	4.8956E-16	2.2505E+09	1.8327E+08
Xe-133	6.6219E-06	3.5377E-14	1.6018E+11	3.9693E+10
Xe-133m	3.7995E-07	8.4677E-16	3.8341E+09	2.5427E+09
Xe-135	2.1606E-06	8.4605E-16	3.7741E+09	8.5588E+10
Xe-135m	1.3592E-08	1.4921E-19	6.6559E+05	7.2626E+09

Control Room Transport Group Inventory:

Time (h) = 45.5000	Atmosphere	Sump	
Noble gases (atoms)	1.7004E+11	0.0000E+00	
Elemental I (atoms)	1.0678E+11	0.0000E+00	
Organic I (atoms)	3.3025E+09	0.0000E+00	
Aerosols (kg)	0.0000E+00	0.0000E+00	
Dose Effective (Ci/cc)	I-131 (Thyroid)		1.7476E-15
Dose Effective (Ci/cc)	I-131 (ICRP2 Thyroid)		1.8134E-15
Total I (Ci)			3.9914E-06

Time (h) = 45.5000	Deposition Surfaces	Recirculating Filter
Noble gases (atoms)	0.0000E+00	0.0000E+00
Elemental I (atoms)	0.0000E+00	5.2953E+13

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Organic I (atoms)       0.0000E+00  1.6377E+12
Aerosols (kg)           0.0000E+00  0.0000E+00

Environment to Control Room Transport Group Inventory:

                          Pathway
Time (h) =  45.5000      Filtered   Transported
Noble gases (atoms)     0.0000E+00  2.7459E+12
Elemental I (atoms)     0.0000E+00  5.8207E+13
Organic I (atoms)       0.0000E+00  1.8002E+12
Aerosols (kg)           0.0000E+00  0.0000E+00

Control Room to Environment Transport Group Inventory:

                          Pathway
Time (h) =  45.5000      Filtered   Transported
Noble gases (atoms)     2.5317E+12  0.0000E+00
Elemental I (atoms)     4.9250E+12  0.0000E+00
Organic I (atoms)       1.5232E+11  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00

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)   2.2420E-04  2.9074E-01  9.1819E-03

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)   3.9791E-05  2.9901E-02  9.6630E-04

Control Room Doses:

Time (h) =  96.0000     Whole Body   Thyroid       TEDE
Delta dose (rem)         2.3088E-08  5.3616E-04  1.6416E-05
Accumulated dose (rem)   1.5576E-05  3.4590E-01  1.0713E-02

Control Room Compartment Nuclide Inventory:

Time (h) =  96.0000        Ci           kg          Atoms      Decay
Xe-133                  1.8515E-12  9.8915E-21  4.4788E+04  4.2260E+10

Control Room Transport Group Inventory:
Time (h) =  96.0000     Atmosphere     Sump
Noble gases (atoms)     4.6260E+04  0.0000E+00
Elemental I (atoms)     1.2489E-69  0.0000E+00
Organic I (atoms)       3.8625E-71  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00
Dose Effective (Ci/cc) I-131 (Thyroid)          2.0100E-95
Dose Effective (Ci/cc) I-131 (ICRP2 Thyroid)    2.0275E-95
Total I (Ci)                                    3.7413E-86

                        Deposition Recirculating
Time (h) =  96.0000      Surfaces     Filter
Noble gases (atoms)     0.0000E+00  0.0000E+00
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Elemental I (atoms)     0.0000E+00  5.3032E+13
Organic I (atoms)       0.0000E+00  1.6402E+12
Aerosols (kg)           0.0000E+00  0.0000E+00

Environment to Control Room Transport Group Inventory:

                          Pathway
Time (h) =  96.0000      Filtered   Transported
Noble gases (atoms)     0.0000E+00  2.7459E+12
Elemental I (atoms)     0.0000E+00  5.8207E+13
Organic I (atoms)       0.0000E+00  1.8002E+12
Aerosols (kg)           0.0000E+00  0.0000E+00

Control Room to Environment Transport Group Inventory:

                          Pathway
Time (h) =  96.0000      Filtered   Transported
Noble gases (atoms)     2.6984E+12  0.0000E+00
Elemental I (atoms)     4.9319E+12  0.0000E+00
Organic I (atoms)       1.5253E+11  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00

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)   2.2420E-04  2.9074E-01  9.1819E-03

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)   3.9791E-05  2.9901E-02  9.6630E-04

Control Room Doses:

Time (h) = 720.0000     Whole Body   Thyroid       TEDE
Delta dose (rem)         1.1577E-15  5.7668E-84  1.1577E-15
Accumulated dose (rem)   1.5576E-05  3.4590E-01  1.0713E-02

Control Room Compartment Nuclide Inventory:

Time (h) = 720.0000        Ci           kg          Atoms       Decay

Control Room Transport Group Inventory:
Time (h) = 720.0000     Atmosphere     Sump
Noble gases (atoms)     4.5583E-77  0.0000E+00
Elemental I (atoms)     0.0000E+00  0.0000E+00
Organic I (atoms)       0.0000E+00  0.0000E+00
Aerosols (kg)           0.0000E+00  0.0000E+00
Dose Effective (Ci/cc) I-131 (Thyroid)          0.0000E+00
Dose Effective (Ci/cc) I-131 (ICRP2 Thyroid)    0.0000E+00
Total I (Ci)                                    0.0000E+00

                        Deposition Recirculating
Time (h) = 720.0000      Surfaces     Filter
Noble gases (atoms)     0.0000E+00  0.0000E+00
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Elemental I (atoms)	0.0000E+00	5.3032E+13
Organic I (atoms)	0.0000E+00	1.6402E+12
Aerosols (kg)	0.0000E+00	0.0000E+00

Environment to Control Room Transport Group Inventory:

Time (h) = 720.0000	Pathway Filtered	Transported
Noble gases (atoms)	0.0000E+00	2.7459E+12
Elemental I (atoms)	0.0000E+00	5.8207E+13
Organic I (atoms)	0.0000E+00	1.8002E+12
Aerosols (kg)	0.0000E+00	0.0000E+00

Control Room to Environment Transport Group Inventory:

Time (h) = 720.0000	Pathway Filtered	Transported
Noble gases (atoms)	2.6984E+12	0.0000E+00
Elemental I (atoms)	4.9319E+12	0.0000E+00
Organic I (atoms)	1.5253E+11	0.0000E+00
Aerosols (kg)	0.0000E+00	0.0000E+00

840

##
I-131 Summary
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Time (hr)	Intact SG I-131 (Curies)	Environment I-131 (Curies)	Control Room I-131 (Curies)
0.000	1.2861E+00	2.4577E-06	4.4757E-08
0.004	8.3338E+00	1.0320E-04	1.8756E-06
0.083	8.3268E+00	4.6701E-03	7.8635E-05
0.400	8.2993E+00	2.2779E-02	5.4153E-05
0.700	8.2732E+00	3.9878E-02	4.6564E-05
1.000	8.2473E+00	5.6923E-02	4.3931E-05
1.300	8.2214E+00	7.3914E-02	4.2960E-05
1.600	8.1956E+00	9.0853E-02	4.2546E-05
1.900	8.1699E+00	1.0774E-01	4.2319E-05
2.000	8.1614E+00	1.1335E-01	4.2260E-05
2.300	8.1425E+00	1.2343E-01	2.7784E-05
2.600	8.1237E+00	1.3348E-01	2.2901E-05
2.900	8.1049E+00	1.4351E-01	2.1233E-05
3.200	8.0862E+00	1.5352E-01	2.0643E-05
3.500	8.0675E+00	1.6350E-01	2.0413E-05
3.800	8.0489E+00	1.7346E-01	2.0305E-05
4.100	8.0303E+00	1.8339E-01	2.0238E-05
4.400	8.0117E+00	1.9331E-01	2.0185E-05
4.700	7.9932E+00	2.0320E-01	2.0136E-05
5.000	7.9747E+00	2.1306E-01	2.0088E-05
5.300	7.9563E+00	2.2291E-01	2.0042E-05
5.600	7.9379E+00	2.3273E-01	1.9995E-05
5.900	7.9195E+00	2.4253E-01	1.9949E-05
6.200	7.9012E+00	2.5231E-01	1.9903E-05
6.500	7.8830E+00	2.6206E-01	1.9857E-05
6.800	7.8648E+00	2.7179E-01	1.9811E-05
7.100	7.8466E+00	2.8150E-01	1.9765E-05

7.400	7.8284E+00	2.9119E-01	1.9720E-05
7.700	7.8104E+00	3.0085E-01	1.9674E-05
8.000	7.7923E+00	3.1049E-01	1.9628E-05
8.300	7.7768E+00	3.1756E-01	1.0862E-05
8.600	7.7614E+00	3.2461E-01	7.9156E-06
8.900	7.7460E+00	3.3165E-01	6.9195E-06
9.200	7.7307E+00	3.3867E-01	6.5772E-06
9.500	7.7153E+00	3.4568E-01	6.4541E-06
9.800	7.7000E+00	3.5268E-01	6.4044E-06
10.100	7.6848E+00	3.5966E-01	6.3793E-06
10.400	7.6695E+00	3.6663E-01	6.3625E-06
24.000	7.0093E+00	6.6804E-01	5.8129E-06
45.500	6.1568E+00	1.0123E+00	2.8472E-06
96.000	5.1354E+00	1.0123E+00	3.4397E-86
720.000	5.4587E-01	1.0123E+00	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	3.2544E-05	1.0860E-06	8.8756E-06	2.9619E-07	2.6510E-06	8.2880E-08
0.083	1.4731E-03	4.9156E-05	4.0174E-04	1.3406E-05	3.2358E-03	1.0116E-04
0.400	7.1753E-03	2.3890E-04	1.9569E-03	6.5153E-05	2.3725E-02	7.4137E-04
0.700	1.2544E-02	4.1677E-04	3.4212E-03	1.1366E-04	3.8700E-02	1.2089E-03
1.000	1.7882E-02	5.9291E-04	4.8769E-03	1.6170E-04	5.2219E-02	1.6307E-03
1.300	2.3189E-02	7.6741E-04	6.3243E-03	2.0929E-04	6.5203E-02	2.0354E-03
1.600	2.8466E-02	9.4034E-04	7.7635E-03	2.5646E-04	7.7959E-02	2.4328E-03
1.900	3.3713E-02	1.1118E-03	9.1945E-03	3.0322E-04	9.0593E-02	2.8262E-03
2.000	3.5456E-02	1.1686E-03	9.6697E-03	3.1872E-04	9.4784E-02	2.9566E-03
2.300	3.8576E-02	1.2702E-03	1.0521E-02	3.4643E-04	1.0484E-01	3.2695E-03
2.600	4.1682E-02	1.3711E-03	1.1368E-02	3.7394E-04	1.1223E-01	3.4994E-03
2.900	4.4773E-02	1.4713E-03	1.2211E-02	4.0126E-04	1.1871E-01	3.7008E-03
3.200	4.7851E-02	1.5708E-03	1.3050E-02	4.2840E-04	1.2487E-01	3.8921E-03
3.500	5.0914E-02	1.6697E-03	1.3886E-02	4.5537E-04	1.3090E-01	4.0795E-03
3.800	5.3963E-02	1.7679E-03	1.4717E-02	4.8216E-04	1.3687E-01	4.2649E-03
4.100	5.6998E-02	1.8656E-03	1.5545E-02	5.0880E-04	1.4281E-01	4.4490E-03
4.400	6.0020E-02	1.9626E-03	1.6369E-02	5.3527E-04	1.4871E-01	4.6322E-03
4.700	6.3029E-02	2.0591E-03	1.7190E-02	5.6158E-04	1.5459E-01	4.8144E-03
5.000	6.6024E-02	2.1551E-03	1.8007E-02	5.8775E-04	1.6044E-01	4.9958E-03
5.300	6.9006E-02	2.2505E-03	1.8820E-02	6.1377E-04	1.6626E-01	5.1763E-03
5.600	7.1975E-02	2.3454E-03	1.9630E-02	6.3965E-04	1.7206E-01	5.3560E-03
5.900	7.4932E-02	2.4397E-03	2.0436E-02	6.6538E-04	1.7784E-01	5.5348E-03
6.200	7.7876E-02	2.5336E-03	2.1239E-02	6.9098E-04	1.8359E-01	5.7129E-03
6.500	8.0807E-02	2.6270E-03	2.2038E-02	7.1644E-04	1.8931E-01	5.8901E-03
6.800	8.3726E-02	2.7198E-03	2.2834E-02	7.4177E-04	1.9501E-01	6.0666E-03
7.100	8.6633E-02	2.8123E-03	2.3627E-02	7.6698E-04	2.0069E-01	6.2422E-03
7.400	8.9528E-02	2.9042E-03	2.4417E-02	7.9205E-04	2.0634E-01	6.4171E-03
7.700	9.2410E-02	2.9957E-03	2.5203E-02	8.1701E-04	2.1197E-01	6.5912E-03
8.000	9.5281E-02	3.0867E-03	2.5986E-02	8.4184E-04	2.1758E-01	6.7646E-03
8.300	9.7381E-02	3.1533E-03	2.6052E-02	8.4399E-04	2.2172E-01	6.8928E-03
8.600	9.9473E-02	3.2195E-03	2.6118E-02	8.4614E-04	2.2433E-01	6.9732E-03
8.900	1.0156E-01	3.2855E-03	2.6184E-02	8.4827E-04	2.2641E-01	7.0376E-03
9.200	1.0363E-01	3.3512E-03	2.6250E-02	8.5040E-04	2.2832E-01	7.0965E-03

9.500	1.0570E-01	3.4166E-03	2.6315E-02	8.5251E-04	2.3016E-01	7.1534E-03
9.800	1.0776E-01	3.4817E-03	2.6380E-02	8.5461E-04	2.3197E-01	7.2094E-03
10.100	1.0982E-01	3.5465E-03	2.6445E-02	8.5671E-04	2.3377E-01	7.2651E-03
10.400	1.1186E-01	3.6111E-03	2.6510E-02	8.5879E-04	2.3556E-01	7.3204E-03
24.000	1.9794E-01	6.3066E-03	2.9232E-02	9.4544E-04	3.1093E-01	9.6409E-03
45.500	2.9074E-01	9.1819E-03	2.9901E-02	9.6630E-04	3.4536E-01	1.0696E-02
96.000	2.9074E-01	9.1819E-03	2.9901E-02	9.6630E-04	3.4590E-01	1.0713E-02
720.000	2.9074E-01	9.1819E-03	2.9901E-02	9.6630E-04	3.4590E-01	1.0713E-02

```
#####################################################################
                        Worst Two-Hour Doses
#####################################################################
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Exclusion Area Boundary

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	6.5147E-05	3.5456E-02	1.1686E-03

Attachment 13.4

Modified RADTRAD Dose Conversion File PINGP_fg11&12.txt

```
PINGP_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/10/08/2001
Kr-85
Kr-85m
Kr-87
Kr-88
Rb-86     D
Rb-88           data entered by Gopal J. Patel NUCORE/12/05/2001
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/10/08/2001						
Xe-133								
Xe-133m		data entered by Gopal J. Patel NUCORE/10/08/2001						
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/12/05/2001						
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