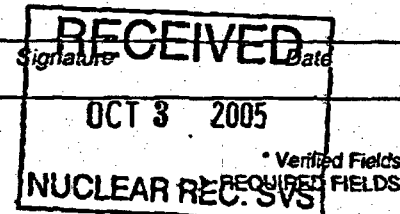


NUCLEAR ENGINEERING CALCULATION COVER SHEET NEPM-QA-0221-1		1. Page 1 of 130 Total Pages 130
>2. TYPE: <u>CALC</u>	>3. NUMBER: <u>EC-RADN-1134</u>	>4. REVISION: <u>0</u>
*>5. UNIT <u>0</u>	*>6. QUALITY CLASS: <u>Q</u>	
>7. DESCRIPTION: <u>Impact Of AST On Current NUREG-0737 Radiological Evaluations That Use</u> <u>TID-14844 DBA-LOCA Releases</u>		
8. SUPERSEDED BY: _____		
9. Alternate Number: _____	10. Cycle: <u>NA</u>	
11. Computer Code/Model used: <u>MICROSHIELD 5.0</u>	12. Discipline: <u>NR 9/30/05</u>	
>13. Are any results of this calculation described in the Licensing Documents?		
<input type="checkbox"/> Yes, Refer to NDAP-QA-0730 and NDAP-QA-0731 <input checked="" type="checkbox"/> No		
>14. Is this calculation changing any method of evaluation described in the FSAR and using the results to support or change the FSAR? (Refer to PPL Resource Manual for Definition of FSAR)		
<input type="checkbox"/> Yes, 50.59 screen or evaluation required. <input checked="" type="checkbox"/> No		
>15. Is this calculation Prepared by an External Organization?		
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
EG771 Qualifications may not be required for individuals from external organizations (see Section 7.4.3).		
>16. Prepared by:	<u>Terrence F. Mackay</u> <small>Print Name(EG771 Qualification Required)</small>	<u>Terrence F. Mackay</u> <small>Signature</small>
>17. Reviewed by:	<u>George M. Kowal</u> <small>Print Name(EG771 Qualification Required)</small>	<u>George M. Kowal</u> <small>Signature</small>
>18. Verified by:	<u>George M. Kowal</u> <small>Print Name(EG771 Qualification Required)</small>	<u>George M. Kowal</u> <small>Signature</small>
>19. Approved by:	<u>Richard L. Doty</u> <small>Print Name(Qualified per NEPM-QA-0241 and comply with Section 7.8 of NEPM-QA-0221)</small>	<u>Richard L. Doty</u> <small>Signature</small>
>20. Accepted by:	<u>Gregory M. Shadle</u> <small>Print Name(EG771 Qualification Required) and comply with Section 7.9 of NEPM-QA-0221</small>	

ADD A NEW COVER PAGE FOR EACH REVISION
FORM NEPM-QA-0221-1, Revision 8, Page 1 of 1, ELECTRONIC FORM



PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	Impact Of AST On Current		
Designed By	T.F.Mackay		
Checked By	NUREG-0737 Radiological	Sh. No.	2
	Evaluations That Use		
	TID14844 DBA-LOCA		
	Releases		

TABLE OF CONTENTS

<u>Description</u>	<u>Page</u>
1.0 OBJECTIVE.....	3
2.0 CONCLUSIONS & RECOMMENDATIONS.....	3
3.0 ASSUMPTIONS/DESIGN INPUTS.....	4
4.0 METHODOLOGY	9
4.1 Evaluation Of AST Sources For NUREG-0737	10
4.2 Evaluation Of AST Doses For Reactor Coolant Liquid Sources	12
4.3 Evaluation Of AST Doses For Reactor Coolant Steam Sources.....	13
4.4 Evaluation Of AST Doses For Suppression Pool Liquid Sources	14
4.5 Evaluation Of Doses For AST - Activity Buildup On SGTS Filter	15
5.0 RESULTS	16
6.0 REFERENCES.....	17

Attachments

- 1 MICROSHIELD Computer Code Outputs, AST Reactor Coolant Liquid

PP&L CALCULATION SHEET

Dept.

Date

Designed By T.F.Mackay

Checked By

PROJECT

Impact Of AST On Current

NUREG-0737 Radiological

Evaluations That Use

TID14844 DBA-LOCA

Releases

Calc. No. EC-RADN-1134

Sh. No. 3

1.0 OBJECTIVE

The purpose of this calculation is to perform an evaluation of the impact of implementation of the USNRC Regulatory Guide 1.183 Alternative Source Term (AST) for Design Basis Accident dose analysis on current NUREG-0737 radiological evaluations. This includes post-accident plant radiation zoning and radiation shielding and vital area access. Current NUREG-0737 radiological evaluations are based on Regulatory Guide 1.3 and DBA-LOCA releases using TID-14844 activity sources.

This analysis is performed by comparing DBA-LOCA doses for TID and AST source terms.

2.0 CONCLUSIONS & RECOMMENDATIONS

The current NUREG-0737 radiological evaluations performed with DBA-LOCA TID-14844 releases are bounding for the DBA-LOCA Alternative Source Term for a reactor core power of 3616 MWt. This includes post-accident plant radiation zoning and radiation shielding and vital area access.

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	Impact Of AST On Current		
Designed By	<u>T.F.Mackay</u>		
Checked By	<u>NUREG-0737 Radiological</u>	Sh. No.	4
	<u>Evaluations That Use</u>		
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

3.0 ASSUMPTIONS/DESIGN INPUTS

The following input data and assumptions are used in this evaluation:

- 3.1 The current NUREG-0737 (Reference 6.1) radiological dose analysis for DBA-LOCA post-accident plant radiation zoning and radiation shielding and vital area access is given in calculation EC-RADN-1034 (Reference 6.2). The basis for this analysis is a reactor power of 3616 MWt and DBA-LOCA activity source terms based on TID-14844 releases as specified in Regulatory Guide 1.3 (Reference 6.3). In order to determine the impact of AST on the current NUREG-0737 radiological dose analyses, an analysis comparing DBA-LOCA doses for AST and TID sources is performed.
- 3.2 NUREG-0737 radiation source terms for a DBA-LOCA are identified in Item II.B.2 and are based on a TID-14844 release. These source terms are as follows:
- a. Liquid Containing Systems: 100% of the core equilibrium noble gas inventory, 50% of the core equilibrium halogen inventory, and 1% of all others are assumed to be mixed in the reactor coolant and liquids recirculated by residual heat removal (RHR), high-pressure coolant injection (HPCI), and low-pressure coolant injection (LPCI), or the equivalent of these systems. In determining the source term for recirculated, repressurized cooling water, you may assume that the water contains no noble gases.
 - b. Gas-Containing systems: 100% of the core equilibrium noble gas inventory and 25% of the core equilibrium halogen activity are assumed to be mixed in the containment atmosphere. For vapor-containing lines connected to the primary system (e.g. BWR steam lines), the concentration of radioactivity is contained in the vapor space in the primary coolant system.

Based on these requirements, the following DBA-LOCA sources are used in EC-RADN-1034 for the NUREG-0737 vital area access and plant radiation shielding dose analysis:

Reactor Coolant Liquid: 100% Noble Gases, 50% Halogens, and 1% Particulates.
Reactor Coolant Steam: 100% Noble Gases, 25% Halogens.
Suppression Pool Water: 50% Halogens, and 1% Particulates.

In addition to these sources, activity buildup on the Standby Gas Treatment System Filter is also included in the EC-RADN-1034 NUREG-0737 dose evaluations.

In addition to these sources, activity buildup on the Standby Gas Treatment System Filter is also included in the EC-RADN-1034 NUREG-0737 dose evaluations.

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	5
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

3.3 The following source volume data is obtained from EC-RADN-1034 and is used for this comparative analysis:

Reactor Coolant Liquid Volume = 13108 ft³ = 3.712E+08 cc
 Total Reactor Coolant System volume = 23492 ft³
 Drywell Volume = 239593 ft³ = 6.785E+09 cc
 Suppression Pool Volume = 1.32E+05 ft³ = 3.743E+09 cc
 Reactor Coolant Steam Volume = 10384 ft³ = 2.94E+08 cc

3.4 The Alternative Source Term (AST) is defined by USNRC Regulatory Guide 1.183 (Reference 6.4).

3.5 AST activity releases for a DBA-LOCA are given in Regulatory Guide 1.183, Sections 3.2 and 3.3 and are as follows:

BWR Core Inventory Fraction Released Into Containment

Group	Gap Release Phase	Early In-vessel Phase	Total
Noble Gases	0.05	0.95	1.0
Halogens	0.05	0.25	0.3
Alkali Metals	0.05	0.20	0.25
Tellurium Metals	0.00	0.05	0.05
Ba, Sr	0.00	0.02	0.02
Noble Metals	0.00	0.0025	0.0025
Cerium Group	0.00	0.0005	0.0005
Lanthanides	0.00	0.0002	0.0002

LOCA Release Phases for BWRs

Phase	Onset	Duration
Gap Release	2 min	0.5 hr
Early In-Vessel	0.5 hr	1.5 hr

Per Regulatory Guide 1.183, the above AST DBA-LOCA core activity release fractions are also applicable for determining reactor coolant and suppression pool liquid post-accident sources.

Per Regulatory Guide 1.183, the above AST DBA-LOCA core activity release fractions are also applicable for determining reactor coolant and suppression pool liquid post-accident sources.

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By	<u>T.F.Mackay</u>		
Checked By	<u>NUREG-0737 Radiological</u>	Sh. No.	6
	<u>Evaluations That Use</u>		
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

3.6 The DBA-LOCA offsite and control room dose analysis using AST is given in calculation EC-RADN-1125. (Reference 6.5). DBA-LOCA AST source terms for containment airborne, suppression pool liquid and activity buildup on the SGTS filter are obtained from Appendix A of EC-RADN-1125, and are given in the following tables:

- Table 1. AST DBA-LOCA Primary Containment Airborne Activity (Curies)
- Table 2. AST DBA-LOCA Suppression Pool Activity (Curies)
- Table 3. Activity Buildup On SGTS Filter For DBA-LOCA – AST
- Table 4. AST DBA-LOCA Suppression Pool Activity Concentration ($\mu\text{Ci/cc}$).
(Table 2 activity divided by suppression pool volume of 132,000 ft^3 .)

It is noted that these sources are based on a core thermal power of 4032 MWt. The activity inventories are obtained from the RADTRAD computer code for the DBA-LOCA dose analysis which also takes into account losses from the source volumes due to leakage or aerosol deposition. For the containment airborne and suppression pool volumes, activity loss due to leakage is negligible for the first 2 hours post-accident. Also, for primary containment airborne activity, aerosol deposition is not applicable for noble gases.

The noble gas activity inventory given in Table 2 for the suppression pool only includes the noble gas activity from the decay of suppression pool parent isotopes. No AST noble gas activity releases from the reactor core are included in the suppression pool activity inventory.

3.7 The MICROSHIELD Version 5.01 computer code is used to evaluate direct radiation dose rates. (Reference 6.6)

3.8 The DBA-LOCA activity source terms used in calculation EC-RADN-1125 are based on 60 dose significant isotopes identified in Reference 6.7 Table 1.4.3.2-3, for use in the RADTRAD computer code. The 60 radionuclides that are contained in the RADTRAD code were selected based upon a study that determined that those 60 radionuclides have the greatest impact on offsite dose. An analysis is given in EC-RADN-1135 (Reference 6.8) which evaluates the use of these same 60 isotopes for direct shine dose calculations. Results of EC-RADN-1135 show that use of the RADTRAD 60 isotope model for direct shine doses require correction factors to account for the isotopes not considered. These correction factors are based on time post-accident and on source material and thickness of radiation shielding material.

PP&L CALCULATION SHEET

Dept.
Date
Designed By T.F.Mackay
Checked By

PROJECT
Impact Of AST On Current
NUREG-0737 Radiological
Evaluations That Use
TID14844 DBA-LOCA
Releases

Calc. No. **EC-RADN-1134**

Sh. No. **7**

The 60 dose significant RADTRAD isotopes are as follows:

RADTRAD DBA-LOCA Activity Source Term 60 Dose Significant Isotopes			
Co-58	Zr-95	Te-131m	La-141
Co-60	Zr-97	Te-132	La-142
Kr-85	Nb-95	I-131	Ce-141
Kr-85m	Mo-99	I-132	Ce-143
Kr-87	Tc-99m	I-133	Ce-144
Kr-88	Ru-103	I-134	Pr-143
Rb-86	Ru-105	I-135	Nd-147
Sr-89	Ru-106	Xe-133	Np-239
Sr-90	Rh-105	Xe-135	Pu-238
Sr-91	Sb-127	Cs-134	Pu-239
Sr-92	Sb-129	Cs-136	Pu-240
Y-90	Te-27	Cs-137	Pu-241
Y-91	Te-127m	Ba-139	Am-241
Y-92	Te-129	Ba-140	Cm-242
Y-93	Te-129m	La-140	Cm-244

Dose correction factors for the RADTRAD 60 isotope source term are obtained from EC-RADN-1135 and are as follows:

PP&L CALCULATION SHEET

Dept.
Date
Designed By T.F.Mackay
Checked By

PROJECT
Impact Of AST On Current
NUREG-0737 Radiological
Evaluations That Use
TID14844 DBA-LOCA
Releases

Calc. No. EC-RADN-1134

Sh. No. 8

AST LIQUID SOURCES — COMPARISON OF DIRECT SHINE DOSE RESULTS FOR 183 ISOTOPE AND 60 ISOTOPE RADTRAD AST SOURCES

Time Post-Accident (hrs)	Direct Shine Dose Correction Factor Ratio Of Dose Rates 183 Isotopes / 60 RADTRAD Isotopes						
	Unshielded	6 In Concrete	1 Ft Concrete	1.5 Ft Concrete	2 Ft Concrete	2.5 Ft Concrete	3 Ft Concrete
1	1.201	1.278	1.387	1.531	1.716	1.964	2.303
2	1.12	1.16	1.2	1.26	1.41	1.51	1.69
4	1.06	1.08	1.09	1.10	1.2	1.26	1.32
8	1.017	1.023	1.033	1.048	1.069	1.096	1.113
16	1.01	1.01	1.01	1.01	1.02	1.03	1.05
24	1.006	1.006	1.006	1.006	1.007	1.008	1.009

AST AIRBORNE SOURCES — COMPARISON OF DIRECT SHINE DOSE RESULTS FOR 183 ISOTOPE AND 60 ISOTOPE RADTRAD AST SOURCES

Time Post-Accident (hrs)	Direct Shine Dose Correction Factor Ratio Of Dose Rates 183 Isotopes / 60 RADTRAD Isotopes						
	Unshielded	6 In Concrete	1 Ft Concrete	1.5 Ft Concrete	2 Ft Concrete	2.5 Ft Concrete	3 Ft Concrete
1	1.185	1.207	1.237	1.271	1.302	1.332	1.364
2	1.13	1.13	1.15	1.16	1.17	1.17	1.25
4	1.07	1.07	1.10	1.11	1.09	1.1	1.15
8	1.040	1.037	1.033	1.034	1.041	1.052	1.065
16	1.02	1.01	1.01	1.01	1.01	1.01	1.02
24	1.016	1.012	1.010	1.008	1.007	1.007	1.008

3.9 The analysis of DBA-LOCA control room doses for DBA-LOCA AST releases is given in SSES Calculation EC-RADN-1129 (6.9).

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	Impact Of AST On Current		
Designed By	T.F.Mackay		
Checked By	NUREG-0737 Radiological	Sh. No.	9
	Evaluations That Use		
	TID14844 DBA-LOCA		
	Releases		

4.0 METHODOLOGY

EC-RADN-1034 contains the current NUREG-0737 dose analysis using TID-14844 releases at the current reactor core design power level of 3616 MWt. Sections 4.3 and 5.3 of EC-RADN-1034 provide a parametric study of doses for reactor coolant liquid, reactor coolant steam, suppression pool liquid and SGTS filter NUREG-0737 sources. A direct comparison of these doses with doses calculated using the Regulatory Guide 1.183 AST releases is used to evaluate the impact of the AST on the current NUREG-0737 DBA-LOCA radiological evaluations. All analyses are performed at the current reactor core design power of 3616 MWt.

In order to obtain a one-on-one comparison, the doses for AST releases are evaluated using the same MICROSHIELD computer code models as given in EC-RADN-1034, Section 4.3. Only the activity source terms are revised to represent AST releases. Based on the models and results given in EC-RADN-1034, the following cases with respect to source type, source geometry, shield material and thickness and distance to receiver are used for this comparative analysis:

Summary Of Cases Analyzed For MICROSHIELD Comparative Dose Analysis		
SOURCE TYPE / SOURCE GEOMETRY	CONCRETE SHIELD THICKNESS (ft)	RECEIVER POINT LOCATION
Reactor Coolant	Unshielded	Unshielded:
2" Sched 80 pipe	0.5	Contact
24 " Nominal 0.375" wall pipe	1.0	10 Feet
Suppression Pool	2.0	30 Feet
3" Sched 40 pipe	3.0	
24" Sched 40 pipe		Shielded:
Reactor Steam		Contact on
4" Sched 80 pipe		shield outside
20" Nominal 0.95" wall pipe		surface
SGTS Filter		
Height = 8'-1½" ; Width = 9'-1½"		
Depth = approximately 5 ft		
Weight of charcoal in the HECA filter		
unit = 6920 lb @ 28 lb/ft		

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	10
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

The TID activity release model conservatively assumes that the activity released from the core following a DBA-LOCA is instantaneous (i.e. at time = 0 post-accident). The NUREG-0737 vital area access doses for TID releases are evaluated at 1 hour post-accident. The AST activity release model (See Section 3.5) assumes that the activity release from the core following a DBA-LOCA occurs over a 2 hour period post-accident. From EC-RADN-1129, the peak AST DBA-LOCA direct shine dose rates for containment and suppression pool sources also occur at 2 hours post-accident. This analysis conservatively compares the peak AST DBA-LOCA dose rates which occur at 2 hours post-accident with the TID-14844 DBA-LOCA dose rates evaluated at 1 hour post-accident.

The AST DBA-LOCA activity sources obtained from EC-RADN-1125 are based on a reactor core thermal power of 4032 MWt. The current NUREG-0737 radiological analyses given in EC-RADN-1034 are based on a reactor core thermal power of 3616 MWt. Therefore, the MICROSHIELD dose results using the AST sources from EC-RADN-1125 are multiplied by a correction factor of $3616 / 4032 = 0.90$ to obtain AST results for 3616 MWt.

Per Section 3.8 of this calculation, an additional dose correction factor is also applied to the AST dose results to account for using the 60 isotope RADTRAD source term. in EC-RADN-1125 for direct shine dose calculations.

4.1 EVALUATION OF AST SOURCES FOR NUREG-0737

Per Regulatory Guide 1.183, the AST DBA-LOCA core activity release fractions given in Section 3.5 of this calculation are applicable to the reactor coolant, containment airborne and the suppression pool. Therefore, the DBA-LOCA activity released from the core for each of these sources is the same for AST. Using this methodology and the AST activity inventories given in Table 1 for airborne releases and Table 2 for liquid releases (See Section 3.6; Note: Table 2 AST liquid source does not contain core noble gas activity released), NUREG-0737 source terms for AST activity releases are evaluated as follows:

Reactor Coolant Liquid:

This source is defined by NUREG-0737 for TID releases as 100% Noble Gases, 50% Halogens, and 1% Particulates. For AST, this source term is equivalent to the AST suppression pool liquid activity plus the noble gas activity released from the core and is calculated as follows:

$$\text{AST Reactor Coolant Liquid } (\mu\text{Ci/cc}) = \frac{\text{AST Activity (Ci)} \times 10^6 (\mu\text{Ci} / \text{Ci})}{\text{Reactor Coolant Liquid Volume (ft}^3\text{)} \times 28316.85 (\text{cc/ft}^3\text{)}}$$

where:

$$\text{AST Reactor Coolant Liquid } (\mu\text{Ci/cc}) = \text{AST Activity (Ci)} \times 10^6 (\mu\text{Ci} / \text{Ci})$$

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	11
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

AST Activity (Ci) = Table 1 + Table 2 activity for noble gases;
 = Table 2 activity for all isotopes except noble gases

Reactor Coolant Liquid Volume = 13108 ft³

Using the above methodology, DBA-LOCA reactor coolant liquid activity concentrations for AST are evaluated in Table 5.

Reactor Coolant Steam:

This source is defined by NUREG-0737 for TID releases as 100% Noble Gases and 25% Halogens and is equivalent to the DBA-LOCA activity released to containment. For AST, this source term is equivalent to the AST containment airborne activity with a source concentration based on the volume of the reactor coolant steam concentration. This source is calculated as follows:

$$\text{AST Reactor Coolant Steam } (\mu\text{Ci/cc}) = \frac{\text{AST Activity (Ci)} \times 10^6 (\mu\text{Ci / Ci})}{\text{Reactor Coolant Steam Volume (ft}^3\text{)} \times 28316.85 (\text{cc/ft}^3\text{)}}$$

where:

AST Activity (Ci) = Table 1 activity
 Reactor Coolant Steam Volume = 10384 ft³

Using the above methodology, DBA-LOCA reactor coolant steam activity concentrations for AST are evaluated in Table 5.

Suppression Pool:

This source is defined by NUREG-0737 for TID releases as 25% Halogens and 1% Particulates. For AST, the suppression pool activity concentration has already been evaluated in EC-RADN-1125 and is given in Table 4.

Standby Gas Treatment System Filter

This source is defined as the post-accident activity buildup on the SGTS filter. For AST, the activity buildup on the SGTS filter has already been evaluated in EC-RADN-1125 and is given in Table 3.

in Table 3.

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	12
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

4.2 EVALUATION OF AST DOSES FOR REACTOR COOLANT LIQUID SOURCES

The MICROSHIELD computer code is used to evaluate DBA-LOCA dose rates for AST sources. In order to do a direct comparison with NUREG-0737 DBA-LOCA TID dose rates, the MICROSHIELD model is the same as given in EC-RADN-1034, Section 4.3.1 for the TID reactor coolant liquid source. AST dose rates are evaluated for both the 2" Schedule 80 and the 24" nominal pipe with a 0.375 wall thickness. The MICROSHIELD models are as follows:

MICROSHIELD MODEL - 2" Schedule 80 Pipe; Reactor Coolant Liquid

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

Radius = 2.46 cm

Wall Clad = 0.554 cm steel

Unshielded:

X = 4.01 cm, 308.81 cm, 918.41 cm (doses at contact, 10 ft, 30 ft)

Shielded:

Transition = 30.48 cm air

Shield Thickness = 15.24 cm, 30.48 cm, 60.96 cm and 91.44 cm

X = 49.73 cm, 64.97 cm, 95.45 cm and 125.93 cm (contact on shield)

Y = Height / 2 = 609.6 cm / 2 = 304.8 cm

Z = 0

Activity Source: Table 5, Column 5

Source Material: water

Buildup: Source Material

MICROSHIELD MODEL - 24" Nominal Pipe; 0.375 wall thickness; Reactor Coolant Liquid

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

Radius = 29.53 cm

Wall Clad = 0.953 cm steel

Unshielded:

X = 31.48 cm, 336.28 cm and 945.88 cm (doses at contact, 10 ft, 30 ft)

Shielded:

Transition = 30.48 cm air

Shield Thickness = 15.24 cm, 30.48 cm, 60.96 cm and 91.44 cm

X = 77.2 cm, 92.44 cm, 122.92 cm, 153.4 cm (contact on shield)

Y = Height / 2 = 609.6 cm / 2 = 304.8 cm

Z = 0

Activity Source: Table 5, Column 5

Source Material: water

Buildup: Source Material

Activity Source: Table 5, Column 5

Source Material: water

PP&L CALCULATION SHEET

Dept.	PROJECT	
Date	<u>Impact Of AST On Current</u>	Calc. No. EC-RADN-1134
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>	
Checked By	<u>Evaluations That Use</u>	Sh. No. 13
	<u>TID14844 DBA-LOCA</u>	
	<u>Releases</u>	

The MICROSHIELD Version 5.01 computer code outputs for AST for the NUREG-0737 reactor coolant liquid source are given in Attachment 1. These dose rates are summarized in Table 6 which includes dose correction for reactor core thermal power and the RADTRAD 60 isotope source term.

4.3 EVALUATION OF AST DOSES FOR REACTOR COOLANT STEAM SOURCES

The MICROSHIELD computer code is used to evaluate DBA-LOCA dose rates for AST sources. In order to do a direct comparison with NUREG-0737 DBA-LOCA TID dose rates, the MICROSHIELD model is the same as given in EC-RADN-1034, Section 4.3.3 for the TID reactor coolant steam source. AST dose rates are evaluated for both the 4" Schedule 80 and the 20" nominal pipe with a 0.95" wall thickness. The MICROSHIELD models are as follows:

MICROSHIELD MODEL - 4" Schedule 80 Pipe; Reactor Coolant Steam

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

Radius = 4.60 cm

Wall Clad = 1.110 cm steel

Unshielded:

X = 6.71 cm, 311.51 cm, and 921.11 cm (doses at contact, 10 ft, 30 ft)

Shielded:

Transition = 30.48 cm air

Shield Thickness = 15.24 cm, 30.48 cm, 60.96 cm and 91.44 cm

X = 52.42 cm, 67.67 cm, 98.15 cm and 128.63 cm (contact on shield)

Y = Height / 2 = 609.6 cm / 2 = 304.8 cm

Z = 0

Activity Source: Table 5, Column 6

Source Material: water @ 0.035 gm/cc

Buildup: Source Material

MICROSHIELD MODEL - 20" Nominal Pipe; 0.95 wall thickness; Reactor Coolant Steam

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

Radius = 24.45 cm

Wall Clad = 0.95 cm steel

Unshielded:

X = 26.4 cm, 331.2 cm and 940.9 cm (doses at contact, 10 ft, 30 ft)

Shielded:

Transition = 30.48 cm air

Shield Thickness = 15.24 cm, 30.48 cm, 60.96 cm and 91.44 cm

X = 72.12 cm, 87.36 cm, 117.84 cm and 148.32 cm (contact on shield)

Shielded:

Transition = 30.48 cm air

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	14
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

$$Y = \text{Height} / 2 = 609.6 \text{ cm} / 2 = 304.8 \text{ cm}$$

$$Z = 0$$

Activity Source: Table 5, Column 5

Source Material: water @ 0.035 gm/cc

Buildup: Source Material

The MICROSHIELD Version 5.01 computer code outputs for AST for the NUREG-0737 reactor coolant steam source are given in Attachment 2. These dose rates are summarized in Table 7 which includes dose correction for reactor core thermal power and the RADTRAD 60 isotope source term.

4.4 EVALUATION OF DOSES FOR SUPPRESSION POOL LIQUID SOURCES

The MICROSHIELD computer code is used to evaluate DBA-LOCA dose rates for AST sources. In order to do a direct comparison with NUREG-0737 DBA-LOCA TID dose rates, the MICROSHIELD model is the same as given in EC-RADN-1034, Section 4.3.2 for the TID suppression pool liquid source. AST dose rates are evaluated for both the 3" Schedule 40 and the 24" Schedule 40 pipe. The MICROSHIELD models are as follows:

MICROSHIELD MODEL - 3" Schedule 40 Pipe: Suppression Pool Liquid

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

Radius = 3.90 cm

Wall Clad = 0.549 cm steel

Unshielded:

X = 5.45 cm, 310.25 cm and 919.85 cm (doses at contact, 10 ft, 30 ft)

Shielded:

Transition = 30.48 cm air

Shield Thickness = 15.24 cm, 30.48 cm, 60.96 cm and 91.44 cm

X = 51.17 cm, 66.41 cm, 96.89 cm and 127.37 cm (contact on shield)

$$Y = \text{Height} / 2 = 609.6 \text{ cm} / 2 = 304.8 \text{ cm}$$

$$Z = 0$$

Activity Source: Table 4

Source Material: water

Buildup: Source Material

MICROSHIELD MODEL - 24" Schedule 40 Pipe: Suppression Pool Liquid

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

Radius = 28.735 cm

Wall Clad = 1.745 cm steel

Geometry 7 - Cylinder Volume - Side Shields

Height = 20 ft = 609.6 cm

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By	<u>T.F.Mackay</u>	Sh. No.	15
Checked By	<u>NUREG-0737 Radiological</u>		
	<u>Evaluations That Use</u>		
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

Unshielded:

X = 31.48 cm, 336.28 cm and 945.88 cm (doses at contact, 10 ft, 30 ft)

Shielded:

Transition = 30.48 cm air

Shield Thickness = 15.24 cm, 30.48 cm, 60.96 cm and 91.44 cm

X = 77.2 cm, 92.44 cm, 122.92 cm, 153.4 cm (contact on shield)

Y = Height / 2 = 609.6 cm / 2 = 304.8 cm

Z = 0

Activity Source: Table 4

Source Material: water

Buildup: Source Material

The MICROSIELD Version 5.01 computer code outputs for AST for the NUREG-0737 suppression pool liquid source are given in Attachment 3. These dose rates are summarized in Table 8 which includes dose correction for reactor core thermal power and the RADTRAD 60 isotope source term.

4.5 EVALUATION OF DOSES FOR AST - ACTIVITY BUILDUP ON SGTS FILTER

The Standby Gas Treatment System filter is located on Elevation 806'-0" of the control structure. A complete analysis of control structure habitability and vital area access for a DBA-LOCA with AST, which includes doses from the SGTS filter, has been completed and is given in calculation EC-RADN-1129 (Reference 6.10). Therefore, a comparative analysis for the SGTS filter to evaluate the impact of AST is not required.

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	16
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

5.0 RESULTS

DBA-LOCA dose rates for the three sources defined by NUREG-0737 are summarized in Tables 6, 7 and 8 for both TID-14844 and AST releases. Based on a direct comparison of these doses, it can be seen that for all sources, the current NUREG-0737 radiological evaluations performed with DBA-LOCA TID-14844 releases are bounding for the DBA-LOCA Alternative Source Term for a reactor core power of 3616 MWt. This includes post-accident plant radiation zoning and radiation shielding and vital area access.

There is one instance where the AST dose is slightly higher than the TID14844 dose. This occurs for the 3" Sched 80 pipe with the suppression pool liquid source (See Table 8). In this case the difference is less than 3% which is not significant and well within the accuracy of the MICROSIELD dose calculation and does not invalidate the conclusion that the TID doses are bounding.

PP&L CALCULATION SHEET

Dept.	PROJECT	Calc. No.	EC-RADN-1134
Date	<u>Impact Of AST On Current</u>		
Designed By <u>T.F.Mackay</u>	<u>NUREG-0737 Radiological</u>		
Checked By	<u>Evaluations That Use</u>	Sh. No.	17
	<u>TID14844 DBA-LOCA</u>		
	<u>Releases</u>		

6.0 REFERENCES

- 6.1 NUREG – 0737, "Clarification of TMI Action Plan Requirements", US NRC, November 1980
- 6.2 EC-RADN-1034, "SSES Chapter 18 Review of Vital Areas With Power Uprate Sources (EWR M50040 Tasks 1, 2, &7)", Revision 0.
- 6.3 USAEC Regulatory Guide 1.3, "Assumptions Used For Evaluating The Potential radiological Consequences Of A Loss Of Coolant Accident For Boiling Water Reactors", Revision 2, June 1974.
- 6.4 USNRC Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors", JULY 2000.
- 6.5 EC-RADN-1125, "CRHE And Off Site Post LOCA Doses - AST", Revision 0, 8/23/05.
- 6.6 SQAP-MICROSHIELD5-001-97079, "Software Quality Assurance Plan (SQAP) for MICROSHIELD Version 5.01", Revision 0, Code Version # 001-97079.
- 6.7 RADTRAD NUREG/CR-6604, RADTRAD: A Simplified Model for RADionuclide Transport and Removal And Dose Estimation, Supplement 1, 6/8/99.
- 6.8 EC-RADN-1135, "Justification Of AST 60 Isotope RADTRAD Source Term For Direct Shine," Rev. 0.
- 6.9 EC-RADN-1129, "Total DBA-LOCA Control Room Dose", Revision 0, 9/6/2005.

TABLE 1. AST DBA-LOCA PRIMARY CONTAINMENT AIRBORNE ACTIVITY

EC-RADN-1134

PAGE 18

AST DBA-LOCA PRIMARY CONTAINMENT AIRBORNE ACTIVITY -- 4032 MWt (CURIES)														
pe	Isotope	Time Post-Accident												
		.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr	480 hr	720 hr
41	Am-241			1.526E+00	3.948E+00	4.669E-01	2.325E-02	2.865E-04	4.483E-06	4.080E-07	3.379E-09	1.917E-15		
39	Ba-139			7.090E+05	1.109E+06	4.794E+04	3.188E+02	7.014E-02	1.959E-05					
40	Ba-140			1.175E+06	3.030E+06	3.566E+05	1.757E+04	2.121E+02	3.249E+00	2.778E-01		7.926E-10		
41	Ce-141			2.700E+04	6.980E+04	8.238E+03	4.083E+02	4.986E+00	7.724E-02	8.826E-03	5.330E-05	2.538E-11		
43	Ce-143			2.455E+04	6.216E+04	7.045E+03	3.220E+02	3.346E+00	4.413E-02	2.408E-03	7.155E-06			
44	Ce-144			2.271E+04	5.871E+04	6.938E+03	3.448E+02	4.235E+00	6.602E-02	5.945E-03	4.821E-05	2.571E-11		
42	Cm-242			3.996E+02	1.033E+03	1.221E+02	6.084E+00	7.444E-02	1.160E-03	1.043E-04	8.423E-07	4.443E-13		
44	Cm-244			2.342E+01	6.057E+01	7.159E+00	3.559E-01	4.375E-03	6.825E-05	6.161E-06	5.019E-08	2.714E-14		
38	Co-58			4.449E+02	1.150E+03	1.358E+02	6.741E+00	8.260E-02	1.284E-03	1.148E-04	9.175E-07	4.682E-13		
30	Co-60			2.395E+02	6.193E+02	7.320E+01	3.639E+00	4.473E-02	6.977E-04	6.296E-05	5.127E-07	2.788E-13		
34	Cs-134	3.598E+05	9.560E+05	2.143E+06	4.107E+06	4.854E+05	2.413E+04	2.965E+02	4.625E+00	4.171E-01	3.393E-03	1.826E-09		
36	Cs-136	1.149E+05	3.049E+05	6.826E+05	1.306E+06	1.537E+05	7.571E+03	9.145E+01	1.402E+00	1.200E-01	8.799E-04	3.466E-10		
37	Cs-137	2.708E+05	7.195E+05	1.613E+06	3.091E+06	3.654E+05	1.816E+04	2.233E+02	3.484E+00	3.145E-01	2.562E-03	1.386E-09		
1	I-131	1.677E+06	4.482E+06	1.166E+07	2.353E+07	4.154E+06	1.680E+06	1.506E+06	1.457E+06	1.330E+06	1.109E+06	6.417E+05	2.579E+05	1.037E+05
2	I-132	2.373E+06	6.059E+06	1.525E+07	2.830E+07	3.154E+06	4.543E+05	4.032E+04	3.635E+03	3.294E+00	3.662E-03	5.528E-10		
3	I-133	3.470E+06	9.180E+06	2.353E+07	4.607E+07	7.662E+06	2.751E+06	1.945E+06	1.483E+06	6.632E+05	1.327E+05	1.081E+03	3.398E-01	1.087E-04
4	I-134	3.375E+06	6.937E+06	1.218E+07	1.118E+07	4.087E+05	7.095E+03	1.172E+01	2.090E-02	1.194E-10				
5	I-135	3.255E+06	8.407E+06	2.079E+07	3.790E+07	5.463E+06	1.473E+06	5.878E+05	2.528E+05	2.031E+04	1.311E+02	3.520E-05		
15	Kr-85	2.487E+04	7.398E+04	5.425E+05	1.479E+06	1.478E+06	1.476E+06	1.471E+06	1.466E+06	1.459E+06	1.444E+06	1.400E+06	1.330E+06	1.264E+06
30m	Kr-85m	4.356E+05	1.241E+06	8.421E+06	1.987E+07	1.442E+07	7.755E+06	2.242E+06	6.481E+05	1.573E+04	9.273E+00	1.898E-09		
17	Kr-87	8.163E+05	2.041E+06	1.140E+07	1.802E+07	6.053E+06	6.830E+05	8.694E+03	1.107E+02	2.294E-04				
18	Kr-88	1.194E+06	3.301E+06	2.142E+07	4.577E+07	2.807E+07	1.056E+07	1.493E+06	2.112E+05	6.007E+02	4.859E-03			
40	La-140			1.835E+04	6.989E+04	2.008E+04	2.107E+03	5.020E+01	1.108E+00	1.634E-01	2.030E-03	8.949E-10		
41	La-141			8.954E+03	1.941E+04	1.612E+03	3.959E+01	1.187E-01	4.517E-04	5.916E-07	1.790E-03			
42	La-142			6.874E+03	1.101E+04	5.295E+02	4.358E+00	1.468E-03	6.279E-07					
39	Mo-99			1.501E+05	3.841E+05	4.446E+04	2.119E+03	2.395E+01	3.436E-01	2.411E-02	1.187E-04	1.415E-11		
35	Nb-95			1.153E+04	2.981E+04	3.524E+03	1.752E+02	2.153E+00	3.359E-02	3.031E-03	2.466E-05	1.322E-11		
47	Nd-147			4.348E+03	1.122E+04	1.319E+03	6.487E+01	7.809E-01	1.193E-02	1.011E-03	7.261E-06	2.690E-12		
39	Np-239			3.146E+05	8.037E+05	9.269E+04	4.388E+03	4.890E+01	6.916E-01	4.651E-02	2.104E-04	1.947E-11		
43	Pr-143			9.674E+03	2.505E+04	2.979E+03	1.497E+02	1.871E+00	2.951E-02	2.687E-03	2.096E-05	8.646E-12		
38	Pu-238			6.843E+01	1.770E+02	2.092E+01	1.040E+00	1.278E-02	1.994E-04	1.801E-05	1.468E-07	7.946E-14		
39	Pu-239			7.267E+00	1.880E+01	2.222E+00	1.105E-01	1.360E-03	2.124E-05	1.922E-06	1.571E-08	8.524E-15		
40	Pu-240			1.169E+01	3.022E+01	3.572E+00	1.776E-01	2.183E-03	3.406E-05	3.075E-06	2.506E-08	1.356E-14		
41	Pu-241			2.882E+03	7.454E+03	8.810E+02	4.380E+01	5.384E-01	8.399E-03	7.581E-04	6.176E-06	3.339E-12		
86	Rb-86	3.396E+03	9.018E+03	2.019E+04	3.865E+04	4.554E+03	2.250E+02	2.732E+00	4.210E-02	3.662E-03	2.770E-05	1.200E-11		
105	Rh-105			8.325E+04	2.147E+05	2.506E+04	1.192E+03	1.292E+01	1.741E-01	9.867E-03	3.139E-05			
103	Ru-103			1.292E+05	3.338E+05	3.940E+04	1.953E+03	2.387E+01	3.702E-01	3.283E-02	2.583E-04	1.257E-10		
105	Ru-105			7.641E+04	1.690E+05	1.462E+04	3.893E+02	1.373E+00	6.142E-03	1.308E-05	5.934E-11			
106	Ru-106			5.147E+04	1.331E+05	1.573E+04	7.816E+02	9.603E+00	1.497E-01	1.349E-02	1.095E-04	5.860E-11		
127	Sb-127			1.400E+05	3.594E+05	4.185E+04	2.019E+03	2.337E+01	3.434E-01	2.590E-02	1.472E-04	2.705E-11		
129	Sb-129			4.441E+05	9.782E+05	8.368E+04	2.195E+03	7.475E+00	3.231E-02	6.201E-05	2.285E-10			

TABLE 1. AST DBA-LOCA PRIMARY CONTAINMENT AIRBORNE ACTIVITY

EC-RADN-1134

PAGE 19

AST DBA-LOCA PRIMARY CONTAINMENT AIRBORNE ACTIVITY - 4032 MWt (CURIES)													
Isotope	Time Post-Accident												
	.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr	480 hr	720 hr
Sr-89			6.173E+05	1.595E+06	1.884E+05	9.342E+03	1.143E+02	1.776E+00	1.581E-01	1.253E-03	6.246E-10		
Sr-90			7.872E+04	2.036E+05	2.406E+04	1.196E+03	1.470E+01	2.294E-01	2.071E-02	1.687E-04	9.126E-11		
Sr-91			7.318E+05	1.759E+06	1.797E+05	6.672E+03	4.576E+01	3.982E-01	6.240E-03	1.532E-06			
Sr-92			6.470E+05	1.296E+06	9.182E+04	1.641E+03	2.607E+00	5.256E-03	1.024E-06				
Tc-99m			1.343E+05	3.468E+05	4.073E+04	1.983E+03	2.328E+01	3.443E-01	2.467E-02	1.217E-04	1.451E-11		
Te-127			1.398E+05	3.613E+05	4.259E+04	2.098E+03	2.523E+01	3.834E-01	3.070E-02	1.911E-04	5.294E-11		
Te-127m			2.386E+04	6.170E+04	7.293E+03	3.626E+02	4.457E+00	6.952E-02	6.268E-03	5.084E-05	2.681E-11		
Te-129			4.722E+05	1.125E+06	1.075E+05	3.377E+03	2.536E+01	2.935E-01	2.203E-02	1.716E-04	8.205E-11		
Te-129m			9.992E+04	2.584E+05	3.052E+04	1.515E+03	1.851E+01	2.870E-01	2.538E-02	1.985E-04	9.489E-11		
Te-131m			3.154E+05	7.969E+05	8.994E+04	4.077E+03	4.166E+01	5.402E-01	2.801E-02	7.530E-05			
Te-132			2.293E+06	5.877E+06	6.824E+05	3.274E+04	3.750E+02	5.450E+00	3.977E-01	2.118E-03	3.198E-10		
Xe-133	3.535E+06	1.080E+07	7.766E+07	2.113E+08	2.090E+08	2.042E+08	1.948E+08	1.859E+08	1.622E+08	1.234E+08	5.422E+07	1.377E+07	3.495E+06
Xe-135	1.181E+06	3.681E+06	2.743E+07	7.609E+07	6.706E+07	4.989E+07	2.737E+07	1.498E+07	2.438E+06	6.301E+04	1.047E+00	1.123E-08	
Y-90			1.081E+03	3.698E+03	9.435E+02	9.568E+01	2.302E+00	5.207E-02	8.390E-03	1.094E-04	8.493E-11		
Y-91			8.083E+03	2.106E+04	2.566E+03	1.338E+02	1.741E+00	2.795E-02	2.577E-03	2.064E-05	1.041E-11		
Y-92			4.550E+04	2.112E+05	5.545E+04	2.726E+03	1.246E+01	5.226E-02	5.483E-05	3.937E-11			
Y-93			5.993E+03	1.447E+04	1.491E+03	5.633E+01	3.999E-01	3.603E-03	6.265E-05	1.894E-08			
Zr-95			1.152E+04	2.979E+04	3.518E+03	1.746E+02	2.138E+00	3.324E-02	2.968E-03	2.367E-05	1.200E-11		
Zr-97			1.095E+04	2.718E+04	2.859E+03	1.249E+02	1.108E+00	1.242E-02	4.191E-04	4.769E-07			
SUM	2.210E+07	5.799E+07	2.438E+08	5.497E+08	3.503E+08	2.811E+08	2.315E+08	2.064E+08	1.681E+08	1.261E+08	5.626E+07	1.535E+07	4.862E+06

TABLE 2. AST DBA-LOCA SUPPRESSION POOL ACTIVITY

DBA		AST DBA-LOCA SUPPRESSION POOL ACTIVITY -- 4032 MWt (CURIES)												
ope	Isotope	Time Post-Accident												
		.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr	480 hr	720 hr
241	Am-241			1.693E+00	5.078E+00	5.069E+00	5.052E+00	5.016E+00	4.982E+00	4.878E+00	4.677E+00	4.115E+00	3.308E+00	2.647E+00
139	Ba-139			7.866E+05	1.426E+06	5.204E+05	6.828E+04	1.228E+03	2.177E+01	1.212E-04				
140	Ba-140			1.303E+06	3.898E+06	3.871E+06	3.817E+06	3.712E+06	3.610E+06	3.321E+06	2.810E+06	1.702E+06	7.377E+05	3.198E+05
141	Ce-141			2.996E+04	8.978E+04	8.944E+04	8.873E+04	8.728E+04	8.583E+04	8.161E+04	7.377E+04	5.449E+04	3.288E+04	1.985E+04
143	Ce-143			2.723E+04	7.996E+04	7.848E+04	6.998E+04	5.858E+04	4.904E+04	2.877E+04	9.903E+03	4.038E+02	1.951E+00	9.422E-03
144	Ce-144			2.519E+04	7.552E+04	7.532E+04	7.492E+04	7.414E+04	7.336E+04	7.108E+04	6.672E+04	5.520E+04	4.024E+04	2.933E+04
242	Cm-242			4.433E+02	1.329E+03	1.325E+03	1.318E+03	1.303E+03	1.289E+03	1.246E+03	1.166E+03	9.539E+02	6.829E+02	4.888E+02
244	Cm-244			2.599E+01	7.791E+01	7.772E+01	7.734E+01	7.659E+01	7.584E+01	7.366E+01	6.947E+01	5.828E+01	4.349E+01	3.245E+01
58	Co-58			4.936E+02	1.479E+03	1.474E+03	1.465E+03	1.448E+03	1.427E+03	1.373E+03	1.270E+03	1.005E+03	6.808E+02	4.811E+02
60	Co-60			2.857E+02	7.966E+02	7.946E+02	7.907E+02	7.830E+02	7.753E+02	7.527E+02	7.096E+02	5.944E+02	4.424E+02	3.293E+02
134	Cs-134	3.831E+05	1.149E+06	2.680E+06	5.739E+06	5.724E+06	5.696E+06	5.639E+06	5.582E+06	5.417E+06	5.101E+06	4.258E+06	3.152E+06	2.333E+06
136	Cs-136	1.223E+05	3.664E+05	8.538E+05	1.824E+06	1.812E+06	1.787E+06	1.739E+06	1.692E+06	1.559E+06	1.323E+06	8.084E+05	3.557E+05	1.566E+05
137	Cs-137	2.883E+05	8.646E+05	2.017E+06	4.319E+06	4.309E+06	4.288E+06	4.246E+06	4.205E+06	4.084E+06	3.852E+06	3.232E+06	2.413E+06	1.801E+06
31	I-131	1.780E+06	5.332E+06	1.419E+07	3.181E+07	3.151E+07	3.092E+07	2.977E+07	2.866E+07	2.557E+07	2.032E+07	1.018E+07	3.210E+06	1.013E+06
32	I-132	2.517E+06	7.176E+06	1.832E+07	3.711E+07	2.369E+07	1.219E+07	7.869E+06	7.231E+06	5.675E+06	3.498E+06	8.194E+05	7.294E+04	6.492E+03
33	I-133	3.683E+06	1.092E+07	2.864E+07	6.228E+07	5.813E+07	5.063E+07	3.840E+07	2.913E+07	1.272E+07	2.423E+06	1.678E+04	4.209E+00	1.057E-03
34	I-134	3.582E+06	8.252E+06	1.482E+07	1.511E+07	3.101E+06	1.306E+05	2.315E+02	4.105E-01	2.288E-08				
35	I-135	3.454E+06	1.000E+07	2.530E+07	5.124E+07	4.144E+07	2.711E+07	1.180E+07	4.967E+06	3.894E+05	2.394E+03	5.560E-04		
140	La-140			2.055E+04	9.440E+04	2.224E+05	4.619E+05	8.823E+05	1.234E+06	1.956E+06	2.478E+06	1.921E+06	8.563E+05	3.715E+05
141	La-141			9.934E+03	2.497E+04	1.750E+04	8.603E+03	2.078E+03	5.019E+02	7.073E+00	1.405E-03			
142	La-142			7.400E+03	1.416E+04	5.748E+03	9.470E+02	2.571E+01	6.978E-01	1.396E-05				
99	Mo-99			1.865E+05	4.941E+05	4.826E+05	4.605E+05	4.193E+05	3.818E+05	2.882E+05	1.842E+05	3.038E+04	1.825E+03	1.096E+02
95	Nb-95			1.279E+04	3.835E+04	3.826E+04	3.807E+04	3.770E+04	3.733E+04	3.624E+04	3.413E+04	2.839E+04	2.064E+04	1.482E+04
147	Nd-147			4.824E+03	1.443E+04	1.432E+04	1.410E+04	1.367E+04	1.326E+04	1.209E+04	1.005E+04	5.776E+03	2.295E+03	9.119E+02
239	Np-239			3.491E+05	1.034E+06	1.008E+06	9.535E+05	8.560E+05	7.685E+05	5.561E+05	2.912E+05	4.180E+04	1.645E+03	6.476E+01
43	Pr-143			1.073E+04	3.223E+04	3.235E+04	3.254E+04	3.278E+04	3.279E+04	3.213E+04	2.901E+04	1.857E+04	8.338E+03	3.736E+03
238	Pu-238			7.591E+01	2.276E+02	2.271E+02	2.280E+02	2.238E+02	2.216E+02	2.153E+02	2.031E+02	1.706E+02	1.276E+02	8.537E+01
239	Pu-239			8.063E+00	2.418E+01	2.413E+01	2.402E+01	2.381E+01	2.360E+01	2.298E+01	2.174E+01	1.830E+01	1.368E+01	1.022E+01
240	Pu-240			1.297E+01	3.887E+01	3.878E+01	3.859E+01	3.822E+01	3.785E+01	3.676E+01	3.468E+01	2.911E+01	2.174E+01	1.624E+01
241	Pu-241			3.198E+03	9.587E+03	9.564E+03	9.517E+03	9.425E+03	9.333E+03	9.064E+03	8.548E+03	7.170E+03	5.349E+03	3.990E+03
86	Rb-86	3.615E+03	1.083E+04	2.525E+04	5.400E+04	5.370E+04	5.311E+04	5.195E+04	5.082E+04	4.756E+04	4.165E+04	2.798E+04	1.441E+04	7.426E+03
105	Rh-105			9.236E+04	2.761E+05	2.720E+05	2.591E+05	2.282E+05	1.935E+05	1.180E+05	4.344E+04	2.167E+03	1.466E+01	9.913E-02
103	Ru-103			1.433E+05	4.294E+05	4.277E+05	4.244E+05	4.178E+05	4.114E+05	3.925E+05	3.575E+05	2.699E+05	1.690E+05	1.058E+05
105	Ru-105			8.477E+04	2.174E+05	1.587E+05	8.459E+04	2.403E+04	6.825E+03	1.564E+02	8.213E-02	1.190E-11		
106	Ru-106			5.710E+04	1.712E+05	1.707E+05	1.699E+05	1.681E+05	1.664E+05	1.613E+05	1.516E+05	1.258E+05	9.222E+04	6.761E+04
127	Sb-127			1.554E+05	4.623E+05	4.543E+05	4.388E+05	4.092E+05	3.818E+05	3.096E+05	2.037E+05	5.807E+04	7.167E+03	8.846E+02
129	Sb-129			4.927E+05	1.258E+06	9.108E+05	4.769E+05	1.309E+05	3.590E+04	7.414E+02	3.162E-01	2.452E-11		
89	Sr-89			6.848E+05	2.052E+06	2.045E+06	2.030E+06	2.001E+06	1.973E+06	1.890E+06	1.735E+06	1.341E+06	8.733E+05	5.667E+05
90	Sr-90			8.733E+04	2.618E+05	2.612E+05	2.599E+05	2.574E+05	2.549E+05	2.478E+05	2.335E+05	1.959E+05	1.463E+05	1.092E+05
91	Sr-91			8.119E+05	2.263E+06	1.450E+06	8.010E+05	4.425E+05	7.460E+04	2.121E+03	4.869E-02		9.032E-10	
92	Sr-92			7.179E+05	1.667E+06	9.968E+05	3.566E+05	4.563E+04	5.840E+03	1.224E+01	5.377E-05			

TABLE 2. AST DBA-LOCA SUPPRESSION POOL ACTIVITY

AST DBA-LOCA SUPPRESSION POOL ACTIVITY - 4032 MWt (CURIES)													
Isotope	Time Post-Accident												
	.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr	480 hr	720 hr
Tc-99m			1.490E+05	4.460E+05	4.422E+05	4.310E+05	4.075E+05	3.826E+05	2.949E+05	1.684E+05	3.115E+04	1.871E+03	1.124E+02
Te-127			1.551E+05	4.647E+05	4.624E+05	4.559E+05	4.416E+05	4.261E+05	3.871E+05	2.644E+05	1.137E+05	4.817E+04	2.988E+04
Te-127m			2.647E+04	7.936E+04	7.917E+04	7.879E+04	7.802E+04	7.725E+04	7.494E+04	7.036E+04	5.755E+04	4.056E+04	2.846E+04
Te-129			5.239E+05	1.447E+06	1.167E+06	7.340E+05	4.439E+05	3.262E+05	2.634E+05	2.375E+05	1.762E+05	1.071E+05	6.506E+04
Te-129m			1.109E+05	3.323E+05	3.314E+05	3.291E+05	3.241E+05	3.189E+05	3.034E+05	2.747E+05	2.037E+05	1.238E+05	7.524E+04
Te-131m			3.499E+05	1.025E+06	9.784E+05	8.859E+05	7.293E+05	6.003E+05	3.349E+05	1.042E+05	3.140E+03	9.163E+00	2.674E-02
Te-132			2.544E+06	7.559E+06	7.408E+06	7.115E+06	6.564E+06	6.056E+06	4.755E+06	2.931E+06	6.865E+05	6.111E+04	5.439E+03
Xe-133	2.489E+03	1.732E+04	7.498E+04	3.271E+05	9.814E+05	2.080E+06	3.811E+06	5.010E+06	6.588E+06	6.078E+06	2.483E+06	4.953E+05	9.889E+04
Xe-135	2.841E+04	1.932E+05	8.070E+05	3.278E+06	6.358E+06	1.361E+07	1.420E+07	1.065E+07	2.563E+06	7.883E+04	1.206E+00	1.017E-08	
Y-90			1.186E+03	4.947E+03	1.043E+04	2.097E+04	4.046E+04	5.801E+04	1.004E+05	1.515E+05	1.824E+05	1.463E+05	1.098E+05
Y-91			8.969E+03	2.712E+04	2.790E+04	2.910E+04	3.051E+04	3.109E+04	3.084E+04	2.860E+04	2.237E+04	1.484E+04	9.847E+03
Y-92			5.175E+04	2.951E+05	6.178E+05	5.997E+05	2.196E+05	5.838E+04	6.583E+02	5.470E-02			
Y-93			6.649E+03	1.861E+04	1.619E+04	1.224E+04	7.001E+03	4.004E+03	7.490E+02	2.621E+01	1.124E-03	5.898E-11	
Zr-95			1.279E+04	3.832E+04	3.819E+04	3.793E+04	3.743E+04	3.694E+04	3.549E+04	3.276E+04	2.577E+04	1.727E+04	1.158E+04
Zr-97			1.215E+04	3.496E+04	3.213E+04	2.713E+04	1.936E+04	1.381E+04	5.011E+03	6.600E+02	1.509E+00	5.983E-05	2.373E-09
Sum	1.584E+07	4.428E+07	1.178E+08	2.412E+08	2.048E+08	1.713E+08	1.373E+08	1.157E+08	8.076E+07	5.569E+07	2.919E+07	1.327E+07	7.369E+06

TABLE 3. ACTIVITY BUILDUP ON STANDBY GAS TREATMENT SYSTEM FILTER FOR DBA-LOCA - AST ^{EC-RADN-1134}
PAGE 22

ACTIVITY BUILDUP ON SGTS FILTER FOR DBA-LOCA - AST -- 4032 MWt (CURIES)												
ope	Isotope	Time Post-Accident										
		.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr
241	Am-241			2.257E-06	5.484E-05	3.850E-04	1.054E-03	1.864E-03	2.224E-03	2.323E-03	1.825E-03	8.118E-04
139	Ba-139			1.048E+00	1.540E+01	3.952E+01	1.446E+01	4.563E-01	9.717E-03	5.772E-08	0.000E+00	0.000E+00
140	Ba-140			1.737E+00	4.209E+01	2.940E+02	7.968E+02	1.379E+03	1.612E+03	1.582E+03	1.097E+03	3.357E+02
141	Ce-141			3.992E-02	9.694E-01	6.792E+00	1.852E+01	3.243E+01	3.832E+01	3.887E+01	2.879E+01	1.075E+01
143	Ce-143			3.630E-02	8.635E-01	5.809E+00	1.461E+01	2.177E+01	2.189E+01	1.370E+01	3.865E+00	7.967E-02
144	Ce-144			3.357E-02	8.155E-01	5.720E+00	1.564E+01	2.755E+01	3.275E+01	3.385E+01	2.604E+01	1.089E+01
242	Cm-242			5.908E-04	1.435E-02	1.006E-01	2.751E-01	4.842E-01	5.754E-01	5.936E-01	4.550E-01	1.882E-01
244	Cm-244			3.463E-05	8.414E-04	5.902E-03	1.614E-02	2.846E-02	3.386E-02	3.508E-02	2.711E-02	1.150E-02
58	Co-58	0.000E+00	0.000E+00	6.578E-04	1.597E-02	1.120E-01	3.058E-01	5.373E-01	6.372E-01	6.538E-01	4.956E-01	1.983E-01
60	Co-60			3.541E-04	8.603E-03	6.035E-02	1.850E-01	2.909E-01	3.461E-01	3.585E-01	2.769E-01	1.173E-01
134	Cs-134	2.237E-01	1.638E+00	1.158E+01	9.179E+01	4.847E+02	1.255E+03	2.176E+03	2.579E+03	2.662E+03	2.053E+03	8.664E+02
136	Cs-136	7.140E-02	5.225E-01	3.689E+00	2.918E+01	1.534E+02	3.938E+02	6.711E+02	7.818E+02	7.661E+02	5.325E+02	1.645E+02
137	Cs-137	1.684E-01	1.233E+00	8.714E+00	6.909E+01	3.648E+02	9.446E+02	1.639E+03	1.942E+03	2.007E+03	1.551E+03	6.577E+02
31	I-131	1.057E+00	7.760E+00	5.743E+01	4.957E+02	2.773E+03	7.775E+03	1.581E+04	2.189E+04	3.080E+04	3.451E+04	2.771E+04
32	I-132	1.480E+00	1.005E+01	6.789E+01	5.042E+02	1.960E+03	2.790E+03	3.044E+03	3.273E+03	2.725E+03	1.379E+03	1.649E+02
33	I-133	2.187E+00	1.590E+01	1.159E+02	9.707E+02	5.115E+03	1.273E+04	2.040E+04	2.226E+04	1.524E+04	4.124E+03	4.577E+01
34	I-134	2.127E+00	1.201E+01	5.996E+01	2.355E+02	2.728E+02	3.283E+01	1.230E-01	3.137E-04	0.000E+00	0.000E+00	0.000E+00
35	I-135	2.051E+00	1.458E+01	1.024E+02	7.986E+02	3.647E+03	6.818E+03	6.163E+03	3.796E+03	4.666E+02	4.074E+00	1.518E-06
140	La-140			3.088E-02	1.273E+00	1.753E+01	9.745E+01	3.292E+02	5.522E+02	8.323E+02	9.676E+02	3.791E+02
141	La-141			1.324E-02	2.696E-01	1.329E+00	1.796E+00	7.721E-01	2.241E-01	3.369E-03	6.482E-07	0.000E+00
142	La-142			9.868E-03	1.529E-01	4.366E-01	1.977E-01	9.552E-03	3.115E-04	6.641E-09	0.000E+00	0.000E+00
99	Mo-99			2.219E-01	5.336E+00	3.865E+01	8.612E+01	1.558E+02	1.705E+02	1.373E+02	8.409E+01	5.994E+00
95	Nb-95			1.705E-02	4.142E-01	2.905E+00	7.946E+00	1.401E+01	1.666E+01	1.726E+01	1.332E+01	5.602E+00
147	Nd-147			6.430E-03	1.558E-01	1.087E+00	2.942E+00	5.079E+00	5.918E+00	5.757E+00	3.922E+00	1.140E+00
239	Np-239			4.652E-01	1.116E+01	7.643E+01	1.990E+02	3.181E+02	3.431E+02	2.648E+02	1.136E+02	6.247E+00
143	Pr-143			1.431E-02	3.485E-01	2.458E+00	6.793E+00	1.217E+01	1.464E+01	1.530E+01	1.132E+01	3.663E+00
238	Pu-238			1.012E-04	2.458E-03	1.724E-02	4.716E-02	8.315E-02	9.894E-02	1.025E-01	7.927E-02	3.366E-02
239	Pu-239			1.075E-05	2.811E-04	1.832E-03	5.014E-03	8.848E-03	1.054E-02	1.094E-02	8.483E-03	3.611E-03
240	Pu-240			1.728E-05	4.198E-04	2.945E-03	8.055E-03	1.420E-02	1.690E-02	1.751E-02	1.353E-02	5.743E-03
241	Pu-241			4.262E-03	1.035E-01	7.264E-01	1.987E+00	3.502E+00	4.167E+00	4.317E+00	3.336E+00	1.415E+00
86	Rb-86	2.111E-03	1.545E-02	1.091E-01	8.637E-01	4.547E+00	1.170E+01	2.005E+01	2.347E+01	2.337E+01	1.677E+01	5.692E+00
105	Rh-105			1.231E-01	2.982E+00	2.068E+01	5.408E+01	8.406E+01	8.638E+01	5.618E+01	1.695E+01	4.276E-01
103	Ru-103			1.910E-01	4.637E+00	3.248E+01	8.858E+01	1.553E+02	1.837E+02	1.670E+02	1.395E+02	5.325E+01
105	Ru-105			1.130E-01	2.348E+00	1.205E+01	1.766E+01	8.928E+00	3.047E+00	7.449E-02	3.205E-05	0.000E+00
106	Ru-106			7.810E-02	1.849E+00	1.297E+01	3.545E+01	6.246E+01	7.428E+01	7.682E+01	5.916E+01	2.482E+01
127	Sb-127			2.071E-01	4.993E+00	3.450E+01	9.158E+01	1.521E+02	1.704E+02	1.475E+02	7.951E+01	1.146E+01
129	Sb-129			6.586E-01	1.359E+01	6.916E+01	9.955E+01	4.862E+01	1.603E+01	3.531E-01	1.234E-04	0.000E+00
89	Sr-89			9.127E-01	2.218E+01	1.553E+02	4.238E+02	7.437E+02	8.808E+02	9.002E+02	6.770E+02	2.646E+02
90	Sr-90			1.164E-01	2.628E+00	1.984E+01	5.425E+01	9.585E+01	1.138E+02	1.178E+02	9.113E+01	3.866E+01
91	Sr-91			1.082E+00	2.444E+01	1.482E+02	3.027E+02	2.976E+02	1.976E+02	3.553E+01	8.276E-01	9.606E-06
92	Sr-92			9.567E-01	1.800E+01	7.570E+01	7.443E+01	1.696E+01	2.607E+00	5.830E-03	2.099E-08	0.000E+00

TABLE 3. ACTIVITY BUILDUP ON STANDBY GAS TREATMENT SYSTEM FILTER FOR DBA-LOCA - AST ^{EC-RADN-1134}
PAGE 23

ACTIVITY BUILDUP ON SGTS FILTER FOR DBA-LOCA - AST - 4032 MW1 (CURIES)													
Isotope	Time Post-Accident												
	.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr	480 hr	720 hr
Tc-99m			1.986E-01	4.817E+00	3.358E+01	8.997E+01	1.514E+02	1.708E+02	1.405E+02	6.571E+01	6.146E+00	1.201E-01	2.464E-03
Te-127			2.067E-01	5.019E+00	3.511E+01	9.516E+01	1.641E+02	1.902E+02	1.748E+02	1.032E+02	2.242E+01	3.091E+00	6.551E-01
Te-127m			3.528E-02	8.570E-01	6.013E+00	1.845E+01	2.899E+01	3.449E+01	3.569E+01	2.746E+01	1.135E+01	2.603E+00	6.240E-01
Te-129			6.982E-01	1.563E+01	8.866E+01	1.532E+02	1.649E+02	1.456E+02	1.255E+02	9.269E+01	3.476E+01	6.870E+00	1.427E+00
Te-129m			1.477E-01	3.589E+00	2.517E+01	6.870E+01	1.204E+02	1.424E+02	1.445E+02	1.072E+02	4.019E+01	7.945E+00	1.650E+00
Te-131m			4.663E-01	1.107E+01	7.416E+01	1.849E+02	2.710E+02	2.680E+02	1.595E+02	4.067E+01	6.195E-01	5.880E-04	5.862E-07
Te-132			3.390E+00	8.163E+01	5.626E+02	1.485E+03	2.439E+03	2.704E+03	2.264E+03	1.144E+03	1.354E+02	3.921E+00	1.193E-01
Y-90			1.727E-03	6.420E-02	8.198E-01	4.422E+00	1.509E+01	2.596E+01	4.788E+01	5.915E+01	3.598E+01	9.387E+00	2.407E+00
Y-91			1.198E-02	2.948E-01	2.124E+00	6.083E+00	1.135E+01	1.389E+01	1.470E+01	1.117E+01	4.417E+00	9.532E-01	2.161E-01
Y-92			9.153E-02	4.515E+00	4.927E+01	1.270E+02	8.215E+01	2.620E+01	3.147E-01	2.142E-05	0.000E+00	0.000E+00	0.000E+00
Y-93			8.881E-03	2.010E-01	1.229E+00	2.555E+00	2.801E+00	1.787E+00	3.587E-01	1.023E-02	2.217E-07	0.000E+00	0.000E+00
Zr-95			1.704E-02	4.138E-01	2.900E+00	7.918E+00	1.391E+01	1.649E+01	1.690E+01	1.278E+01	5.084E+00	1.108E+00	2.538E-01
Zr-97			1.619E-02	3.775E-01	2.440E+00	5.664E+00	7.192E+00	6.184E+00	2.387E+00	2.578E-01	2.978E-04	3.839E-09	0.000E+00
SUM	9.366E+00	6.369E+01	4.411E+02	3.501E+03	1.673E+04	3.751E+04	5.738E+04	6.484E+04	6.219E+04	4.923E+04	3.107E+04	1.285E+04	4.929E+03

TABLE 4. AST DBA-LOCA SUPPRESSION POOL ACTIVITY CONCENTRATION

EC-RADN-1134

PAGE 24

AST DBA-LOCA SUPPRESSION POOL ACTIVITY CONCENTRATION -- 4032 MWt ($\mu\text{Ci/cc}$)												
pe	Isotope	Time Post-Accident										
		.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	720 hr
41	Am-241	0.000E+00	0.000E+00	4.530E-04	1.359E-03	1.356E-03	1.351E-03	1.342E-03	1.333E-03	1.305E-03	1.251E-03	1.101E-03
39	Ba-139	0.000E+00	0.000E+00	2.104E+02	3.816E+02	1.392E+02	1.854E+01	3.285E-01	5.823E-03	3.242E-08	0.000E+00	0.000E+00
40	Ba-140	0.000E+00	0.000E+00	3.486E+02	1.043E+03	1.036E+03	1.021E+03	9.932E+02	9.659E+02	8.885E+02	7.517E+02	4.553E+02
41	Ce-141	0.000E+00	0.000E+00	8.014E+00	2.402E+01	2.393E+01	2.374E+01	2.335E+01	2.296E+01	2.183E+01	1.974E+01	1.458E+01
43	Ce-143	0.000E+00	0.000E+00	7.286E+00	2.139E+01	2.046E+01	1.872E+01	1.567E+01	1.312E+01	7.697E+00	2.649E+00	1.080E-01
44	Ce-144	0.000E+00	0.000E+00	8.739E+00	2.020E+01	2.015E+01	2.004E+01	1.883E+01	1.983E+01	1.902E+01	1.785E+01	1.477E+01
42	Cm-242	0.000E+00	0.000E+00	1.186E-01	3.555E-01	3.545E-01	3.526E-01	3.487E-01	3.448E-01	3.335E-01	3.119E-01	2.552E-01
44	Cm-244	0.000E+00	0.000E+00	6.952E-03	2.084E-02	2.079E-02	2.069E-02	2.049E-02	2.029E-02	1.971E-02	1.858E-02	1.559E-02
38	Co-58	0.000E+00	0.000E+00	1.320E-01	3.957E-01	3.945E-01	3.919E-01	3.869E-01	3.819E-01	3.673E-01	3.397E-01	2.689E-01
30	Co-60	0.000E+00	0.000E+00	7.108E-02	2.131E-01	2.126E-01	2.115E-01	2.095E-01	2.074E-01	2.014E-01	1.898E-01	1.590E-01
34	Cs-134	1.025E+02	3.073E+02	7.169E+02	1.531E+03	1.531E+03	1.524E+03	1.509E+03	1.493E+03	1.449E+03	1.385E+03	1.139E+03
36	Cs-136	3.271E+01	9.802E+01	2.284E+02	4.881E+02	4.847E+02	4.782E+02	4.653E+02	4.527E+02	4.170E+02	3.539E+02	2.163E+02
37	Cs-137	7.714E+01	2.313E+02	5.398E+02	1.158E+03	1.153E+03	1.147E+03	1.136E+03	1.125E+03	1.093E+03	1.031E+03	8.648E+02
11	I-131	4.762E+02	1.426E+03	3.797E+03	8.510E+03	8.430E+03	8.272E+03	7.965E+03	7.669E+03	6.841E+03	5.437E+03	2.723E+03
12	I-132	6.734E+02	1.920E+03	4.902E+03	9.927E+03	6.338E+03	3.262E+03	2.105E+03	1.935E+03	1.518E+03	9.359E+02	2.192E+02
13	I-133	9.852E+02	2.922E+03	7.661E+03	1.668E+04	1.555E+04	1.354E+04	1.027E+04	7.794E+03	3.402E+03	6.482E+02	4.484E+00
14	I-134	9.582E+02	2.208E+03	3.964E+03	4.043E+03	8.296E+02	3.493E+01	6.194E-02	1.098E-04	6.122E-13	0.000E+00	0.000E+00
15	I-135	9.241E+02	2.676E+03	6.770E+03	1.371E+04	1.109E+04	7.253E+03	3.104E+03	1.329E+03	1.042E+02	6.404E-01	1.487E-07
40	La-140	0.000E+00	0.000E+00	5.499E+00	2.526E+01	5.949E+01	1.236E+02	2.380E+02	3.301E+02	5.232E+02	6.631E+02	5.140E+02
41	La-141	0.000E+00	0.000E+00	2.658E+00	6.680E+00	4.683E+00	2.302E+00	5.559E-01	1.343E-01	1.892E-03	0.000E+00	0.000E+00
42	La-142	0.000E+00	0.000E+00	1.980E+00	3.789E+00	1.538E+00	2.534E-01	6.878E-03	1.867E-04	3.734E-09	0.000E+00	0.000E+00
99	Mo-99	0.000E+00	0.000E+00	4.455E+01	1.322E+02	1.291E+02	1.232E+02	1.122E+02	1.021E+02	7.710E+01	4.393E+01	8.128E+00
95	Nb-95	0.000E+00	0.000E+00	3.422E+00	1.026E+01	1.023E+01	1.018E+01	1.009E+01	9.986E+00	9.694E+00	9.131E+00	7.596E+00
47	Nd-147	0.000E+00	0.000E+00	1.291E+00	3.859E+00	3.830E+00	3.771E+00	3.657E+00	3.546E+00	3.234E+00	2.688E+00	1.545E+00
39	Np-239	0.000E+00	0.000E+00	9.339E+01	2.766E+02	2.692E+02	2.551E+02	2.290E+02	2.056E+02	1.486E+02	7.790E+01	1.118E+01
43	Pr-143	0.000E+00	0.000E+00	2.871E+00	8.623E+00	8.854E+00	8.705E+00	8.763E+00	8.774E+00	8.595E+00	7.761E+00	4.967E+00
38	Pu-238	0.000E+00	0.000E+00	2.031E-02	6.089E-02	6.074E-02	6.045E-02	5.987E-02	5.929E-02	5.759E-02	5.434E-02	4.564E-02
39	Pu-239	0.000E+00	0.000E+00	2.157E-03	6.468E-03	6.454E-03	6.426E-03	6.371E-03	6.315E-03	6.147E-03	5.815E-03	4.896E-03
40	Pu-240	0.000E+00	0.000E+00	3.469E-03	1.040E-02	1.037E-02	1.032E-02	1.022E-02	1.013E-02	9.835E-03	9.277E-03	7.788E-03
41	Pu-241	0.000E+00	0.000E+00	8.555E-01	2.565E+00	2.559E+00	2.546E+00	2.521E+00	2.497E+00	2.425E+00	2.287E+00	1.918E+00
88	Rb-88	9.871E-01	2.898E+00	6.756E+00	1.445E+01	1.437E+01	1.421E+01	1.390E+01	1.359E+01	1.272E+01	1.114E+01	7.485E+00
105	Rh-105	0.000E+00	0.000E+00	2.471E+01	7.387E+01	7.277E+01	6.932E+01	6.052E+01	5.176E+01	3.156E+01	1.162E+01	5.799E-01
103	Ru-103	0.000E+00	0.000E+00	3.834E+01	1.149E+02	1.144E+02	1.135E+02	1.118E+02	1.101E+02	1.050E+02	9.563E+01	7.221E+01
105	Ru-105	0.000E+00	0.000E+00	2.268E+01	5.816E+01	4.246E+01	2.263E+01	6.428E+00	1.826E+00	4.184E-02	2.197E-05	3.182E-15
106	Ru-106	0.000E+00	0.000E+00	1.528E+01	4.580E+01	4.568E+01	4.544E+01	4.497E+01	4.451E+01	4.315E+01	4.055E+01	3.368E+01
127	Sb-127	0.000E+00	0.000E+00	4.156E+01	1.237E+02	1.215E+02	1.174E+02	1.095E+02	1.021E+02	8.283E+01	5.451E+01	1.553E+01
129	Sb-129	0.000E+00	0.000E+00	1.318E+02	3.366E+02	2.436E+02	1.278E+02	3.501E+01	9.605E+00	1.983E-01	8.458E-05	6.581E-15
89	Sr-89	0.000E+00	0.000E+00	1.832E+02	5.490E+02	5.471E+02	5.432E+02	5.354E+02	5.278E+02	5.057E+02	4.641E+02	3.588E+02
90	Sr-90	0.000E+00	0.000E+00	2.336E+01	7.005E+01	6.988E+01	6.954E+01	6.887E+01	6.820E+01	6.623E+01	6.247E+01	5.242E+01
91	Sr-91	0.000E+00	0.000E+00	2.172E+02	6.054E+02	5.219E+02	3.879E+02	2.143E+02	1.184E+02	1.998E+01	5.673E-01	1.303E-05
92	Sr-92	0.000E+00	0.000E+00	1.921E+02	4.458E+02	2.667E+02	9.540E+01	1.221E+01	1.562E+00	3.275E-03	1.439E-08	0.000E+00

TABLE 4. AST DBA-LOCA SUPPRESSION POOL ACTIVITY CONCENTRATION

EC-RADN-1134

PAGE 25

AST DBA-LOCA SUPPRESSION POOL ACTIVITY CONCENTRATION -- 4032 MWt ($\mu\text{Ci/cc}$)													
DBA Isotope	Time Post-Accident												
	.1667 hr	0.5 hr	1 hr	2 hr	4 hr	8 hr	16 hr	24 hr	48 hr	96 hr	240 hr	480 hr	720 hr
9m Te-99m	0.000E+00	0.000E+00	3.987E+01	1.193E+02	1.183E+02	1.153E+02	1.090E+02	1.024E+02	7.890E+01	4.504E+01	8.333E+00	5.006E-01	3.007E-02
127 Te-127	0.000E+00	0.000E+00	4.150E+01	1.243E+02	1.237E+02	1.220E+02	1.181E+02	1.140E+02	8.820E+01	7.075E+01	3.041E+01	1.289E+01	7.994E+00
127m Te-127m	0.000E+00	0.000E+00	7.081E+00	2.123E+01	2.118E+01	2.108E+01	2.087E+01	2.067E+01	2.005E+01	1.882E+01	1.540E+01	1.085E+01	7.614E+00
129 Te-129	0.000E+00	0.000E+00	1.402E+02	3.872E+02	3.123E+02	1.964E+02	1.188E+02	8.728E+01	7.047E+01	6.354E+01	4.713E+01	2.864E+01	1.741E+01
129m Te-129m	0.000E+00	0.000E+00	2.966E+01	8.891E+01	8.865E+01	8.805E+01	8.671E+01	8.531E+01	8.118E+01	7.348E+01	5.450E+01	3.312E+01	2.013E+01
131m Te-131m	0.000E+00	0.000E+00	9.361E+01	2.743E+02	2.612E+02	2.370E+02	1.951E+02	1.606E+02	8.959E+01	2.788E+01	8.401E-01	2.451E-03	7.153E-08
132 Te-132	0.000E+00	0.000E+00	6.805E+02	2.022E+03	1.982E+03	1.904E+03	1.758E+03	1.620E+03	1.272E+03	7.841E+02	1.837E+02	1.635E+01	1.455E+00
133 Xe-133	6.858E-01	4.635E+00	2.008E+01	8.750E+01	2.572E+02	5.565E+02	1.020E+03	1.340E+03	1.763E+03	1.626E+03	6.642E+02	1.325E+02	2.640E+01
135 Xe-135	7.601E+00	5.168E+01	2.159E+02	8.770E+02	2.236E+03	3.640E+03	3.798E+03	2.848E+03	6.858E+02	2.108E+01	3.227E-04	2.720E-12	0.000E+00
90 Y-90	0.000E+00	0.000E+00	3.172E-01	1.324E+00	2.790E+00	5.609E+00	1.082E+01	1.552E+01	2.687E+01	4.053E+01	4.878E+01	3.914E+01	2.836E+01
91 Y-91	0.000E+00	0.000E+00	2.400E+00	7.255E+00	7.463E+00	7.785E+00	8.161E+00	8.317E+00	8.251E+00	7.652E+00	5.984E+00	3.970E+00	2.634E+00
92 Y-92	0.000E+00	0.000E+00	1.384E+01	7.895E+01	1.653E+02	1.604E+02	5.875E+01	1.562E+01	1.761E-01	1.463E-05	0.000E+00	0.000E+00	0.000E+00
93 Y-93	0.000E+00	0.000E+00	1.778E+00	4.979E+00	4.330E+00	3.275E+00	1.873E+00	1.071E+00	2.004E-01	7.013E-03	3.006E-07	1.578E-14	0.000E+00
95 Zr-95	0.000E+00	0.000E+00	3.420E+00	1.025E+01	1.022E+01	1.015E+01	1.001E+01	9.881E+00	9.494E+00	8.764E+00	6.894E+00	4.621E+00	3.097E+00
97 Zr-97	0.000E+00	0.000E+00	3.250E+00	9.352E+00	8.595E+00	7.259E+00	5.178E+00	3.694E+00	1.341E+00	1.766E-01	4.036E-04	1.601E-08	6.348E-13
m Sum	4.239E+03	1.185E+04	3.151E+04	8.454E+04	5.479E+04	4.583E+04	3.674E+04	3.096E+04	2.161E+04	1.490E+04	7.808E+03	3.551E+03	1.971E+03

Note:
 Suppression Pool Activity Concentration ($\mu\text{Ci/cc}$) = (Corresponding Table 2 Activity Ci x 1000000 $\mu\text{Ci/Ci}$) / (132000 ft³ x 28316.85 cc/ft³)

**TABLE 5. EVALUATION OF DBA-LOCA AST SOURCE TERMS FOR
COMPARISON OF AST AND TID DOSES FOR NUREG-0737**

EC-RADN-1134
PAGE 26

Isotope	AST DBA-LOCA SOURCE TERMS - 2 HOURS POST-ACCIDENT				
	(1) Containment Activity (Ci)	(2) Suppression Pool Activity (Ci)	(3) Primary Coolant Activity (Ci)	(4) Reactor Coolant Liquid Activity Concentration (μ Ci/cc)	(5) Reactor Coolant Steam Activity Concentration (μ Ci/cc)
Am-241	3.948E+00	5.078E+00	5.078E+00	1.368E-02	1.343E-02
Ba-139	1.109E+06	1.426E+06	1.426E+06	3.843E+03	3.771E+03
Ba-140	3.030E+06	3.898E+06	3.898E+06	1.050E+04	1.031E+04
Ce-141	6.980E+04	8.978E+04	8.978E+04	2.419E+02	2.374E+02
Ce-143	6.216E+04	7.996E+04	7.996E+04	2.154E+02	2.114E+02
Ce-144	5.871E+04	7.552E+04	7.552E+04	2.034E+02	1.997E+02
Cm-242	1.033E+03	1.329E+03	1.329E+03	3.580E+00	3.513E+00
Cm-244	6.057E+01	7.791E+01	7.791E+01	2.099E-01	2.060E-01
Co-58	1.150E+03	1.479E+03	1.479E+03	3.985E+00	3.911E+00
Co-60	6.193E+02	7.966E+02	7.966E+02	2.146E+00	2.106E+00
Cs-134	4.107E+06	5.739E+06	5.739E+06	1.546E+04	1.397E+04
Cs-136	1.306E+06	1.824E+06	1.824E+06	4.915E+03	4.441E+03
Cs-137	3.091E+06	4.319E+06	4.319E+06	1.164E+04	1.051E+04
I-131	2.353E+07	3.181E+07	3.181E+07	8.570E+04	8.003E+04
I-132	2.830E+07	3.711E+07	3.711E+07	9.997E+04	9.625E+04
I-133	4.607E+07	6.228E+07	6.228E+07	1.678E+05	1.567E+05
I-134	1.118E+07	1.511E+07	1.511E+07	4.071E+04	3.801E+04
I-135	3.790E+07	5.124E+07	5.124E+07	1.380E+05	1.289E+05
Kr-85	1.479E+06		1.479E+06	3.985E+03	5.031E+03
Kr-85m	1.967E+07		1.967E+07	5.299E+04	6.690E+04
Kr-87	1.802E+07		1.802E+07	4.855E+04	6.129E+04
Kr-88	4.577E+07		4.577E+07	1.233E+05	1.556E+05
La-140	6.989E+04	9.440E+04	9.440E+04	2.543E+02	2.377E+02
La-141	1.941E+04	2.497E+04	2.497E+04	6.727E+01	6.602E+01
La-142	1.101E+04	1.416E+04	1.416E+04	3.815E+01	3.744E+01
Mo-99	3.841E+05	4.941E+05	4.941E+05	1.331E+03	1.306E+03

**TABLE 5. EVALUATION OF DBA-LOCA AST SOURCE TERMS FOR
COMPARISON OF AST AND TID DOSES FOR NUREG-0737**

EC-RADN-1134
PAGE 27

Isotope	(1) Containment Activity (Ci)	(2) Suppression Pool Activity (Ci)	(3) Primary Coolant Activity (Ci)	(4) Reactor Coolant Liquid Activity Concentration ($\mu\text{Ci/cc}$)	(5) Reactor Coolant Steam Activity Concentration ($\mu\text{Ci/cc}$)
Nb-95	2.981E+04	3.835E+04	3.835E+04	1.033E+02	1.014E+02
Nd-147	1.122E+04	1.443E+04	1.443E+04	3.887E+01	3.814E+01
Np-239	8.037E+05	1.034E+06	1.034E+06	2.785E+03	2.733E+03
Pr-143	2.505E+04	3.223E+04	3.223E+04	8.683E+01	8.520E+01
Pu-238	1.770E+02	2.276E+02	2.276E+02	6.132E-01	6.018E-01
Pu-239	1.880E+01	2.418E+01	2.418E+01	6.514E-02	6.392E-02
Pu-240	3.022E+01	3.887E+01	3.887E+01	1.047E-01	1.028E-01
Pu-241	7.454E+03	9.587E+03	9.587E+03	2.583E+01	2.535E+01
Rb-86	3.865E+04	5.400E+04	5.400E+04	1.455E+02	1.314E+02
Rh-105	2.147E+05	2.761E+05	2.761E+05	7.439E+02	7.300E+02
Ru-103	3.338E+05	4.294E+05	4.294E+05	1.157E+03	1.135E+03
Ru-105	1.690E+05	2.174E+05	2.174E+05	5.857E+02	5.748E+02
Ru-106	1.331E+05	1.712E+05	1.712E+05	4.612E+02	4.526E+02
Sb-127	3.594E+05	4.623E+05	4.623E+05	1.246E+03	1.222E+03
Sb-129	9.782E+05	1.258E+06	1.258E+06	3.389E+03	3.327E+03
Sr-89	1.595E+06	2.052E+06	2.052E+06	5.529E+03	5.426E+03
Sr-90	2.036E+05	2.618E+05	2.618E+05	7.054E+02	6.923E+02
Sr-91	1.759E+06	2.263E+06	2.263E+06	6.097E+03	5.983E+03
Sr-92	1.296E+06	1.667E+06	1.667E+06	4.490E+03	4.406E+03
Tc-99m	3.468E+05	4.460E+05	4.460E+05	1.202E+03	1.179E+03
Te-127	3.613E+05	4.647E+05	4.647E+05	1.252E+03	1.229E+03
Te-127m	6.170E+04	7.936E+04	7.936E+04	2.138E+02	2.098E+02
Te-129	1.125E+06	1.447E+06	1.447E+06	3.899E+03	3.827E+03
Te-129m	2.584E+05	3.323E+05	3.323E+05	8.953E+02	8.787E+02
Te-131m	7.969E+05	1.025E+06	1.025E+06	2.762E+03	2.710E+03
Te-132	5.877E+06	7.559E+06	7.559E+06	2.036E+04	1.999E+04
Xe-133	2.113E+08	3.271E+05	2.116E+08	5.701E+05	7.185E+05

**TABLE 5. EVALUATION OF DBA-LOCA AST SOURCE TERMS FOR
COMPARISON OF AST AND TID DOSES FOR NUREG-0737**

EC-RADN-1134
PAGE 28

Isotope	(1) Containment Activity (Ci)	(2) Suppression Pool Activity (Ci)	(3) Primary Coolant Activity (Ci)	(4) Reactor Coolant Liquid Activity Concentration ($\mu\text{Ci/cc}$)	(5) Reactor Coolant Steam Activity Concentration ($\mu\text{Ci/cc}$)
Xe-135	7.609E+07	3.278E+06	7.936E+07	2.138E+05	2.588E+05
Y-90	3.698E+03	4.947E+03	4.947E+03	1.333E+01	1.258E+01
Y-91	2.106E+04	2.712E+04	2.712E+04	7.306E+01	7.161E+01
Y-92	2.112E+05	2.951E+05	2.951E+05	7.950E+02	7.181E+02
Y-93	1.447E+04	1.861E+04	1.861E+04	5.014E+01	4.921E+01
Zr-95	2.979E+04	3.832E+04	3.832E+04	1.032E+02	1.013E+02
Zr-97	2.718E+04	3.496E+04	3.496E+04	9.418E+01	9.243E+01
SUM	5.497E+08	2.412E+08	6.135E+08	1.653E+06	1.869E+06

Notes:

(1) Obtained from Table 1, Column 5.

(2) Obtained from Table 2, Column 5.

(3) = sum of Column 2 + Column 3 for noble gases; = column 3 all other isotopes.

(4) = (Column 4 x 1000000 $\mu\text{Ci/Ci}$) / (13108 ft³ x 28316.85 cc/ft³)

(5) = (Column 2 x 1000000 $\mu\text{Ci/Ci}$) / (10384 ft³ x 28316.85 cc/ft³)

**TABLE 6. Comparison Of Dose Rates For NUREG-0737 Reactor Coolant Liquid Source
For TID-14844 And AST DBA-LOCA Releases**

Concrete Shield Thickness (ft)	Source - Receiver Distance (ft)	MICROSHIELD Calculated Dose Rate (mrem/hr)	RADTRAD 60 Isotope Dose Correction Factor	Reactor Core Power Correction Factor For 3616 MWt	Dose Rate For AST (mrem/hr)	Dose Rate For TID14844 (mrem/hr)	Ratio Of Dose Rates AST / TID
2" Schedule 80 Pipe							
0	Contact	6.906E+07	1.12	0.9	6.961E+07	1.610E+08	4.324E-01
0	10	4.945E+05	1.12	0.9	4.985E+05	1.070E+06	4.658E-01
0	30	6.854E+04	1.12	0.9	6.909E+04	1.470E+05	4.700E-01
0.5	Contact-shield	1.018E+06	1.16	0.9	1.063E+06	2.140E+06	4.966E-01
1	Contact-shield	1.348E+05	1.2	0.9	1.456E+05	2.670E+05	5.453E-01
2	Contact-shield	3.369E+03	1.41	0.9	4.275E+03	6.470E+03	6.608E-01
3	Contact-shield	1.176E+02	1.69	0.9	1.789E+02	2.230E+02	8.021E-01
24" Nominal Pipe; 0.375 Wall Thickness							
0	Contact	4.975E+08	1.12	0.9	5.015E+08	1.130E+09	4.438E-01
0	10	2.797E+07	1.12	0.9	2.819E+07	6.170E+07	4.569E-01
0	30	4.416E+06	1.12	0.9	4.451E+06	9.540E+06	4.666E-01
0.5	Contact-shield	2.971E+07	1.16	0.9	3.102E+07	6.060E+07	5.118E-01
1	Contact-shield	4.348E+06	1.2	0.9	4.696E+06	8.540E+06	5.499E-01
2	Contact-shield	1.280E+05	1.41	0.9	1.624E+05	2.450E+05	6.630E-01
3	Contact-shield	4.914E+03	1.69	0.9	7.474E+03	9.280E+03	8.054E-01

**TABLE 7. Comparison Of Dose Rates For NUREG-0737 Reactor Coolant Steam Source
For TID-14844 And AST DBA-LOCA Releases**

Concrete Shield Thickness (ft)	Source - Receiver Distance (ft)	MICROSHIELD Calculated Dose Rate (mrem/hr)	RADTRAD 60 Isotope Dose Correction Factor	Reactor Core Power Correction Factor For 3616 MWt	Dose Rate For AST (mrem/hr)	Dose Rate For TID14844 (mrem/hr)	Ratio Of Dose Rates AST / TID
4" Schedule 80 Pipe							
0	Contact	1.349E+08	1.12	0.9	1.360E+08	2.470E+08	5.505E-01
0	10	1.653E+06	1.12	0.9	1.666E+06	2.820E+06	5.909E-01
0	30	2.322E+05	1.12	0.9	2.341E+05	3.860E+05	6.064E-01
0.5	Contact-shield	3.079E+06	1.16	0.9	3.214E+06	5.230E+06	6.146E-01
1	Contact-shield	4.248E+05	1.2	0.9	4.588E+05	7.220E+05	6.354E-01
2	Contact-shield	1.146E+04	1.41	0.9	1.454E+04	2.030E+04	7.164E-01
3	Contact-shield	4.193E+02	1.69	0.9	6.378E+02	7.530E+02	8.470E-01
20" Nominal Pipe; 0.975 Wall Thickness							
0	Contact	1.038E+09	1.12	0.9	1.046E+09	1.960E+09	5.338E-01
0	10	4.260E+07	1.12	0.9	4.294E+07	7.520E+08	5.710E-02
0	30	6.335E+06	1.12	0.9	6.386E+06	1.090E+07	5.858E-01
0.5	Contact-shield	6.357E+07	1.16	0.9	6.637E+07	1.090E+08	6.089E-01
1	Contact-shield	9.240E+06	1.2	0.9	9.979E+06	1.580E+07	6.316E-01
2	Contact-shield	2.667E+05	1.41	0.9	3.384E+05	4.740E+05	7.140E-01
3	Contact-shield	1.016E+04	1.69	0.9	1.545E+04	1.840E+04	8.399E-01

TABLE 8. Comparison Of Dose Rates For NUREG-0737 Suppression Pool Coolant Liquid Source For TID-14844 And AST DBA-LOCA Releases

Concrete Shield Thickness (ft)	Source - Receiver Distance (ft)	MICROSHIELD Calculated Dose Rate (mrem/hr)	RADTRAD 60 Isotope Dose Correction Factor	Reactor Core Power Correction Factor For 3616 MWt	Dose Rate For AST (mrem/hr)	Dose Rate For TID14844 (mrem/hr)	Ratio Of Dose Rates AST / TID
3" Schedule 80 Pipe							
0	Contact	8.764E+06	1.12	0.9	8.834E+06	2.070E+07	4.268E-01
0	10	8.461E+04	1.12	0.9	8.529E+04	1.860E+05	4.585E-01
0	30	1.180E+04	1.12	0.9	1.189E+04	2.590E+04	4.592E-01
0.5	Contact-shield	1.607E+05	1.16	0.9	1.678E+05	3.110E+05	5.395E-01
1	Contact-shield	1.892E+04	1.2	0.9	2.043E+04	3.230E+04	6.326E-01
2	Contact-shield	3.338E+02	1.41	0.9	4.236E+02	5.030E+02	8.421E-01
3	Contact-shield	8.188E+00	1.69	0.9	1.245E+01	1.210E+01	1.029E+00
24" Schedule 40 Pipe							
0	Contact	2.362E+07	1.12	0.9	2.381E+07	4.970E+07	4.791E-01
0	10	1.458E+06	1.12	0.9	1.470E+06	3.090E+06	4.756E-01
0	30	2.354E+05	1.12	0.9	2.373E+05	4.880E+05	4.862E-01
0.5	Contact-shield	1.303E+06	1.16	0.9	1.360E+06	2.340E+06	5.813E-01
1	Contact-shield	1.645E+05	1.2	0.9	1.777E+05	2.700E+05	6.580E-01
2	Contact-shield	3.424E+03	1.41	0.9	4.345E+03	5.100E+03	8.520E-01
3	Contact-shield	9.276E+01	1.69	0.9	1.411E+02	1.420E+02	9.936E-01

PP&L CALCULATION SHEET

Dept.

Date

Designed By T.F.Mackay

Checked By

PROJECT

Impact Of AST On Current

NUREG-0737 Radiological

Evaluations That Use

TID14844 DBA-LOCA

Releases

Calc. No. EC-RADN-1134

Sh. No. 32

ATTACHMENT 1
MICROSHIELD COMPUTER CODE OUTPUTS
AST REACTOR COOLANT LIQUID

33 PAGES

MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 2RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:43:07 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 33

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 24 in Reactor Coolant Unshielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 2.46 cm 1.0 in

Dose Points

	X	Y	Z
# 1	4.01 cm 1.6 in	304.8 cm 10 ft 0.0 in	0 cm 0.0 in
# 2	308.81 cm 10 ft 1.6 in	304.8 cm 10 ft 0.0 in	0 cm 0.0 in
# 3	918.41 cm 30 ft 1.6 in	304.8 cm 10 ft 0.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.16e+04 cm ³	Water	1
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.554 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5854e-004	5.8661e+006	1.3680e-002	5.0616e+002
Ba-137m	1.2762e+002	4.7218e+012	1.1011e+004	4.0742e+008
Ba-139	4.4538e+001	1.6479e+012	3.8430e+003	1.4219e+008
Ba-140	1.2169e+002	4.5025e+012	1.0500e+004	3.8850e+008
Ce-141	2.8035e+000	1.0373e+011	2.4190e+002	8.9503e+006
Ce-143	2.4964e+000	9.2366e+010	2.1540e+002	7.9698e+006
Ce-144	2.3573e+000	8.7220e+010	2.0340e+002	7.5258e+006
Cm-242	4.1490e-002	1.5351e+009	3.5800e+000	1.3246e+005
Cm-244	2.4326e-003	9.0008e+007	2.0990e-001	7.7663e+003
Co-58	4.6184e-002	1.7088e+009	3.9850e+000	1.4745e+005
Co-60	2.4871e-002	9.2023e+008	2.1460e+000	7.9402e+004
Cs-134	1.7917e+002	6.6294e+012	1.5460e+004	5.7202e+008
Cs-136	5.6962e+001	2.1076e+012	4.9150e+003	1.8186e+008
Cs-137	1.3490e+002	4.9914e+012	1.1640e+004	4.3068e+008
I-131	9.9322e+002	3.6749e+013	8.5700e+004	3.1709e+009
I-132	1.1586e+003	4.2868e+013	9.9970e+004	3.6989e+009
I-133	1.9447e+003	7.1955e+013	1.6780e+005	6.2086e+009
I-134	4.7181e+002	1.7457e+013	4.0710e+004	1.5063e+009
I-135	1.5994e+003	5.9176e+013	1.3800e+005	5.1060e+009
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2980e+004	1.9606e+009
I-133m	1.9447e+003	7.1955e+013	1.6780e+005	6.2086e+009
X-134...	4.7181e+002	1.7457e+013	4.0710e+004	1.5063e+009

Page : 2
 DOS File: 2RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:43:07 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 34

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
Kr-87	5.6267e+002	2.0819e+013	4.8550e+004	1.7964e+009
Kr-88	1.4290e+003	5.2873e+013	1.2330e+005	4.5621e+009
La-140	2.9472e+000	1.0905e+011	2.5430e+002	9.4091e+006
La-141	7.7963e-001	2.8846e+010	6.7270e+001	2.4890e+006
La-142	4.4214e-001	1.6359e+010	3.8150e+001	1.4115e+006
Mo-99	1.5426e+001	5.7075e+011	1.3310e+003	4.9247e+007
Nb-95	1.1972e+000	4.4296e+010	1.0330e+002	3.8221e+006
Nd-147	4.5048e-001	1.6668e+010	3.8870e+001	1.4382e+006
Np-239	3.2277e+001	1.1942e+012	2.7850e+003	1.0305e+008
Pr-143	1.0063e+000	3.7234e+010	8.6830e+001	3.2127e+006
Pr-144	2.3236e+000	8.5973e+010	2.0049e+002	7.4182e+006
Pu-238	7.1067e-003	2.6295e+008	6.1320e-001	2.2688e+004
Pu-239	7.5494e-004	2.7933e+007	6.5140e-002	2.4102e+003
Pu-240	1.2134e-003	4.4897e+007	1.0470e-001	3.8739e+003
Pu-241	2.9936e-001	1.1076e+010	2.5830e+001	9.5571e+005
Rb-86	1.6863e+000	6.2392e+010	1.4550e+002	5.3835e+006
Rh-103m	1.3374e+001	4.9483e+011	1.1540e+003	4.2696e+007
Rh-105	8.6214e+000	3.1899e+011	7.4390e+002	2.7524e+007
Rh-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Ru-103	1.3409e+001	4.9614e+011	1.1570e+003	4.2809e+007
Ru-105	6.7880e+000	2.5116e+011	5.8570e+002	2.1671e+007
Ru-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Sb-127	1.4441e+001	5.3430e+011	1.2460e+003	4.6102e+007
Sb-129	3.9277e+001	1.4532e+012	3.3890e+003	1.2539e+008
Sr-89	6.4078e+001	2.3709e+012	5.5290e+003	2.0457e+008
Sr-90	8.1752e+000	3.0248e+011	7.0540e+002	2.6100e+007
Sr-91	7.0661e+001	2.6145e+012	6.0970e+003	2.2559e+008
Sr-92	5.2037e+001	1.9254e+012	4.4900e+003	1.6613e+008
Tc-99m	1.3931e+001	5.1543e+011	1.2020e+003	4.4474e+007
Te-127	1.4510e+001	5.3687e+011	1.2520e+003	4.6324e+007
Te-127m	2.4778e+000	9.1680e+010	2.1380e+002	7.9106e+006
Te-129	4.5187e+001	1.6719e+012	3.8990e+003	1.4426e+008
Te-129m	1.0376e+001	3.8392e+011	8.9530e+002	3.3126e+007
Te-131m	3.2010e+001	1.1844e+012	2.7620e+003	1.0219e+008
Te-132	2.3596e+002	8.7306e+012	2.0360e+004	7.5332e+008
Xe-133	6.6072e+003	2.4447e+014	5.7010e+005	2.1094e+010
Xe-135	2.4778e+003	9.1680e+013	2.1380e+005	7.9106e+009
Y-90	1.5449e-001	5.7161e+009	1.3330e+001	4.9321e+005
Y-91	8.4673e-001	3.1329e+010	7.3060e+001	2.7032e+006
Y-92	9.2137e+000	3.4091e+011	7.9500e+002	2.9415e+007
Y-93	5.8110e-001	2.1501e+010	5.0140e+001	1.8552e+006
Zr-95	1.1960e+000	4.4253e+010	1.0320e+002	3.8184e+006
Zr-97	1.0915e+000	4.0385e+010	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results - Dose Point # 1 - (4.01,304.8,0) -cm

Circumferential	25
Y Direction (axial)	25

Page : 3
 DOS File: 2RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:43:07 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 35

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.015	5.620e+07	6.315e-119	1.576e-24	5.417e-120	1.352e-25
0.02	1.007e+11	2.472e-50	8.555e-21	8.564e-52	2.964e-22
0.03	1.335e+14	1.816e-10	6.591e-09	1.800e-12	6.532e-11
0.04	2.682e+11	2.407e-03	1.909e-01	1.065e-05	8.444e-04
0.05	1.148e+12	6.150e+01	6.122e+03	1.638e-01	1.631e+01
0.06	2.948e+11	9.830e+02	8.033e+04	1.952e+00	1.596e+02
0.08	9.087e+13	1.167e+07	4.369e+08	1.847e+04	6.914e+05
0.1	1.416e+12	8.320e+05	1.525e+07	1.273e+03	2.332e+04
0.15	2.151e+13	5.513e+07	3.898e+08	9.079e+04	6.419e+05
0.2	1.068e+14	5.077e+08	2.391e+09	8.961e+05	4.221e+06
0.3	1.167e+13	1.083e+08	3.338e+08	2.054e+05	6.331e+05
0.4	4.941e+13	6.982e+08	1.769e+09	1.360e+06	3.447e+06
0.5	8.380e+13	1.619e+09	3.601e+09	3.178e+06	7.068e+06
0.6	8.145e+13	2.021e+09	4.109e+09	3.944e+06	8.020e+06
0.8	1.029e+14	3.765e+09	6.752e+09	7.161e+06	1.284e+07
1.0	5.448e+13	2.680e+09	4.452e+09	4.941e+06	8.207e+06
1.5	5.530e+13	4.610e+09	6.769e+09	7.756e+06	1.139e+07
2.0	4.222e+13	5.046e+09	6.949e+09	7.804e+06	1.075e+07
3.0	3.328e+12	6.475e+08	8.306e+08	8.784e+05	1.127e+06
4.0	4.294e+08	1.164e+05	1.435e+05	1.440e+02	1.775e+02
TOTALS:	8.405e+14	2.177e+10	3.880e+10	3.823e+07	6.906e+07

Results - Dose Point # 2 - (308.81,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.015	5.620e+07	9.796e-111	9.492e-27	8.403e-112	8.142e-28
0.02	1.007e+11	1.384e-47	5.152e-23	4.794e-49	1.785e-24
0.03	1.335e+14	8.694e-11	2.782e-09	8.617e-13	2.757e-11
0.04	2.682e+11	1.590e-04	1.081e-02	7.032e-07	4.782e-05
0.05	1.148e+12	1.821e+00	1.488e+02	4.851e-03	3.965e-01
0.06	2.948e+11	1.936e+01	1.263e+03	3.846e-02	2.509e+00
0.08	9.087e+13	1.546e+05	4.531e+06	2.446e+02	7.170e+03
0.1	1.416e+12	9.232e+03	1.336e+05	1.412e+01	2.043e+02
0.15	2.151e+13	5.210e+05	2.997e+06	8.579e+02	4.936e+03
0.2	1.068e+14	4.552e+06	1.760e+07	8.033e+03	3.107e+04
0.3	1.167e+13	9.306e+05	2.416e+06	1.765e+03	4.584e+03
0.4	4.941e+13	5.872e+06	1.274e+07	1.144e+04	2.483e+04
0.5	8.380e+13	1.342e+07	2.588e+07	2.633e+04	5.079e+04
0.6	8.145e+13	1.655e+07	2.947e+07	3.230e+04	5.752e+04
0.8	1.029e+14	3.027e+07	4.821e+07	5.757e+04	9.169e+04
1.0	5.448e+13	2.124e+07	3.165e+07	3.915e+04	5.835e+04
1.5	5.530e+13	3.559e+07	4.769e+07	5.988e+04	8.024e+04
2.0	4.222e+13	3.831e+07	4.866e+07	5.925e+04	7.525e+04
3.0	3.328e+12	4.817e+06	5.775e+06	6.535e+03	7.835e+03
4.0	4.294e+08	8.561e+02	9.946e+02	1.059e+00	1.230e+00
TOTALS:	8.405e+14	1.722e+08	2.778e+08	3.034e+05	4.945e+05

Results - Dose Point # 3 - (918.41,304.8,0) cm

TOTALS: 8.405e+14 1.722e+08 2.778e+08 3.034e+05 4.945e+05

Page : 4
 DOS File: 2RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:43:07 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 36

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.620e+07	1.356e-111	1.313e-27	1.163e-112	1.126e-28
0.02	1.007e+11	2.920e-48	7.128e-24	1.011e-49	2.469e-25
0.03	1.335e+14	2.210e-11	7.100e-10	2.191e-13	7.036e-12
0.04	2.682e+11	3.734e-05	2.524e-03	1.652e-07	1.116e-05
0.05	1.148e+12	3.729e-01	2.969e+01	9.934e-04	7.910e-02
0.06	2.948e+11	3.526e+00	2.204e+02	7.004e-03	4.377e-01
0.08	9.087e+13	2.443e+04	6.820e+05	3.866e+01	1.079e+03
0.1	1.416e+12	1.368e+03	1.905e+04	2.092e+00	2.915e+01
0.15	2.151e+13	7.317e+04	4.181e+05	1.205e+02	6.885e+02
0.2	1.068e+14	6.311e+05	2.445e+06	1.114e+03	4.315e+03
0.3	1.167e+13	1.283e+05	3.349e+05	2.435e+02	6.353e+02
0.4	4.941e+13	8.093e+05	1.765e+06	1.577e+03	3.439e+03
0.5	8.380e+13	1.849e+06	3.583e+06	3.630e+03	7.032e+03
0.6	8.145e+13	2.282e+06	4.079e+06	4.454e+03	7.962e+03
0.8	1.029e+14	4.176e+06	6.671e+06	7.943e+03	1.269e+04
1.0	5.448e+13	2.932e+06	4.380e+06	5.405e+03	8.074e+03
1.5	5.530e+13	4.917e+06	6.599e+06	8.273e+03	1.110e+04
2.0	4.222e+13	5.297e+06	6.732e+06	8.191e+03	1.041e+04
3.0	3.328e+12	6.667e+05	7.993e+05	9.046e+02	1.084e+03
4.0	4.294e+08	1.186e+02	1.377e+02	1.467e-01	1.704e-01
TOTALS:	8.405e+14	2.379e+07	3.851e+07	4.189e+04	6.854e+04

MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 2RC6.MS5
 Run Date: September 21, 2005
 Run Time: 10:42:34 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 37

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 3 in Reactor Coolant = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 2.46 cm 1.0 in

Dose Points
 # 1 X 49.73 cm 304.8 cm Z 0 cm
 1 ft 7.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.16e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	15.24 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.554 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5854e-004	5.8661e+006	1.3680e-002	5.0616e+002
Ba-137m	1.2762e+002	4.7218e+012	1.1011e+004	4.0742e+008
Ba-139	4.4538e+001	1.6479e+012	3.8430e+003	1.4219e+008
Ba-140	1.2169e+002	4.5025e+012	1.0500e+004	3.8850e+008
Ce-141	2.8035e+000	1.0373e+011	2.4190e+002	8.9503e+006
Ce-143	2.4964e+000	9.2366e+010	2.1540e+002	7.9698e+006
Ce-144	2.3573e+000	8.7220e+010	2.0340e+002	7.5258e+006
Cm-242	4.1490e-002	1.5351e+009	3.5800e+000	1.3246e+005
Cm-244	2.4326e-003	9.0008e+007	2.0990e-001	7.7663e+003
Co-58	4.6184e-002	1.7088e+009	3.9850e+000	1.4745e+005
Co-60	2.4871e-002	9.2023e+008	2.1460e+000	7.9402e+004
Cs-134	1.7917e+002	6.6294e+012	1.5460e+004	5.7202e+008
Cs-136	5.6962e+001	2.1076e+012	4.9150e+003	1.8186e+008
Cs-137	1.3490e+002	4.9914e+012	1.1640e+004	4.3068e+008
I-131	9.9322e+002	3.6749e+013	8.5700e+004	3.1709e+009
I-132	1.1586e+003	4.2868e+013	9.9970e+004	3.6989e+009
I-133	1.9447e+003	7.1955e+013	1.6780e+005	6.2086e+009
I-134	4.7181e+002	1.7457e+013	4.0710e+004	1.5063e+009
I-135	1.5994e+003	5.9176e+013	1.3800e+005	5.1060e+009
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009
Kr-87	5.6267e+002	2.0819e+013	4.8550e+004	1.7964e+009
Kr-88	1.4290e+003	5.2873e+013	1.2330e+005	4.5621e+009
La-140	2.9172e+000	1.0805e+011	2.5430e+002	9.4791e+006
La-140	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
La-140	6.3412e+003	2.3723e+013	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 2RC6.MS5
 Run Date: September 21, 2005
 Run Time: 10:42:34 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 38

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	7.7963e-001	2.8846e+010	6.7270e+001	2.4890e+006
La-142	4.4214e-001	1.6359e+010	3.8150e+001	1.4115e+006
Mo-99	1.5426e+001	5.7075e+011	1.3310e+003	4.9247e+007
Nb-95	1.1972e+000	4.4296e+010	1.0330e+002	3.8221e+006
Nd-147	4.5048e-001	1.6668e+010	3.8870e+001	1.4382e+006
Np-239	3.2277e+001	1.1942e+012	2.7850e+003	1.0305e+008
Pr-143	1.0063e+000	3.7234e+010	8.6830e+001	3.2127e+006
Pr-144	2.3236e+000	8.5973e+010	2.0049e+002	7.4182e+006
Pu-238	7.1067e-003	2.6295e+008	6.1320e-001	2.2688e+004
Pu-239	7.5494e-004	2.7933e+007	6.5140e-002	2.4102e+003
Pu-240	1.2134e-003	4.4897e+007	1.0470e-001	3.8739e+003
Pu-241	2.9936e-001	1.1076e+010	2.5830e+001	9.5571e+005
Rb-86	1.6863e+000	6.2392e+010	1.4550e+002	5.3835e+006
Rh-103m	1.3374e+001	4.9483e+011	1.1540e+003	4.2696e+007
Rh-105	8.6214e+000	3.1899e+011	7.4390e+002	2.7524e+007
Rh-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Ru-103	1.3409e+001	4.9614e+011	1.1570e+003	4.2809e+007
Ru-105	6.7880e+000	2.5116e+011	5.8570e+002	2.1671e+007
Ru-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Sb-127	1.4441e+001	5.3430e+011	1.2460e+003	4.6102e+007
Sb-129	3.9277e+001	1.4532e+012	3.3890e+003	1.2539e+008
Sr-89	6.4078e+001	2.3709e+012	5.5290e+003	2.0457e+008
Sr-90	8.1752e+000	3.0248e+011	7.0540e+002	2.6100e+007
Sr-91	7.0661e+001	2.6145e+012	6.0970e+003	2.2559e+008
Sr-92	5.2037e+001	1.9254e+012	4.4900e+003	1.6613e+008
Tc-99m	1.3931e+001	5.1543e+011	1.2020e+003	4.4474e+007
Te-127	1.4510e+001	5.3687e+011	1.2520e+003	4.6324e+007
Te-127m	2.4778e+000	9.1680e+010	2.1380e+002	7.9106e+006
Te-129	4.5187e+001	1.6719e+012	3.8990e+003	1.4426e+008
Te-129m	1.0376e+001	3.8392e+011	8.9530e+002	3.3126e+007
Te-131m	3.2010e+001	1.1844e+012	2.7620e+003	1.0219e+008
Te-132	2.3596e+002	8.7306e+012	2.0360e+004	7.5332e+008
Xe-133	6.6072e+003	2.4447e+014	5.7010e+005	2.1094e+010
Xe-135	2.4778e+003	9.1680e+013	2.1380e+005	7.9106e+009
Y-90	1.5449e-001	5.7161e+009	1.3330e+001	4.9321e+005
Y-91	8.4673e-001	3.1329e+010	7.3060e+001	2.7032e+006
Y-92	9.2137e+000	3.4091e+011	7.9500e+002	2.9415e+007
Y-93	5.8110e-001	2.1501e+010	5.0140e+001	1.8552e+006
Zr-95	1.1960e+000	4.4253e+010	1.0320e+002	3.8184e+006
Zr-97	1.0915e+000	4.0385e+010	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.620e+07	1.995e-235	1.067e-25	1.711e-236	9.150e-27

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
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Page : 3
 DOS File: 2RC6.MS5
 Run Date: September 21, 2005
 Run Time: 10:42:34 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 39

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	1.007e+11	2.273e-101	5.790e-22	7.873e-103	2.006e-23
0.03	1.335e+14	6.965e-28	1.662e-17	6.903e-30	1.648e-19
0.04	2.682e+11	1.035e-12	2.348e-10	4.577e-15	1.039e-12
0.05	1.148e+12	1.692e-05	6.903e-03	4.507e-08	1.839e-05
0.06	2.948e+11	4.468e-03	1.980e+00	8.874e-06	3.933e-03
0.08	9.087e+13	5.079e+02	1.651e+05	8.038e-01	2.613e+02
0.1	1.416e+12	8.922e+01	1.968e+04	1.365e-01	3.011e+01
0.15	2.151e+13	1.547e+04	1.590e+06	2.547e+01	2.618e+03
0.2	1.068e+14	2.358e+05	1.420e+07	4.161e+02	2.507e+04
0.3	1.167e+13	9.475e+04	2.850e+06	1.797e+02	5.405e+03
0.4	4.941e+13	9.319e+05	1.771e+07	1.816e+03	3.450e+04
0.5	8.380e+13	2.960e+06	4.041e+07	5.810e+03	7.933e+04
0.6	8.145e+13	4.730e+06	5.045e+07	9.232e+03	9.847e+04
0.8	1.029e+14	1.280e+07	9.471e+07	2.434e+04	1.801e+05
1.0	5.448e+13	1.199e+07	6.877e+07	2.209e+04	1.268e+05
1.5	5.530e+13	3.257e+07	1.259e+08	5.481e+04	2.118e+05
2.0	4.222e+13	4.729e+07	1.460e+08	7.313e+04	2.257e+05
3.0	3.328e+12	8.465e+06	2.019e+07	1.148e+04	2.739e+04
4.0	4.294e+08	1.843e+03	3.790e+03	2.280e+00	4.689e+00
TOTALS:	8.405e+14	1.221e+08	5.829e+08	2.033e+05	1.018e+06

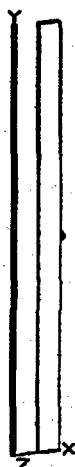
MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 2RC12.MS5
 Run Date: September 21, 2005
 Run Time: 10:40:49 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 40

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 3 in Reactor Coolant Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 2.46 cm 1.0 in

Dose Points
 # 1 X Y Z
 64.97 cm 304.8 cm 0 cm
 2 ft 1.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.16e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	30.48 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.554 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5854e-004	5.8661e+006	1.3680e-002	5.0616e+002
Ba-137m	1.2762e+002	4.7218e+012	1.1011e+004	4.0742e+008
Ba-139	4.4538e+001	1.6479e+012	3.8430e+003	1.4219e+008
Ba-140	1.2169e+002	4.5025e+012	1.0500e+004	3.8850e+008
Ce-141	2.8035e+000	1.0373e+011	2.4190e+002	8.9503e+006
Ce-143	2.4964e+000	9.2366e+010	2.1540e+002	7.9698e+006
Ce-144	2.3573e+000	8.7220e+010	2.0340e+002	7.5258e+006
Cm-242	4.1490e-002	1.5351e+009	3.5800e+000	1.3246e+005
Cm-244	2.4326e-003	9.0008e+007	2.0990e-001	7.7663e+003
Co-58	4.6184e-002	1.7088e+009	3.9850e+000	1.4745e+005
Co-60	2.4871e-002	9.2023e+008	2.1460e+000	7.9402e+004
Cs-134	1.7917e+002	6.6294e+012	1.5460e+004	5.7202e+008
Cs-136	5.6962e+001	2.1076e+012	4.9150e+003	1.8186e+008
Cs-137	1.3490e+002	4.9914e+012	1.1640e+004	4.3068e+008
I-131	9.9322e+002	3.6749e+013	8.5700e+004	3.1709e+009
I-132	1.1586e+003	4.2868e+013	9.9970e+004	3.6989e+009
I-133	1.9447e+003	7.1955e+013	1.6780e+005	6.2086e+009
I-134	4.7181e+002	1.7457e+013	4.0710e+004	1.5063e+009
I-135	1.5994e+003	5.9176e+013	1.3800e+005	5.1060e+009
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009
Kr-87	5.6267e+002	2.0819e+013	4.8550e+004	1.7964e+009
Kr-88	1.4290e+003	5.2873e+013	1.2330e+005	4.5621e+009
La-140	2.9472e+000	1.0905e+011	2.5430e+002	9.4091e+006
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 2RC12.MS5
 Run Date: September 21, 2005
 Run Time: 10:40:49 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 41

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>µCi/cm³</u>	<u>Bq/cm³</u>
La-141	7.7963e-001	2.8846e+010	6.7270e+001	2.4890e+006
La-142	4.4214e-001	1.6359e+010	3.8150e+001	1.4115e+006
Mo-99	1.5426e+001	5.7075e+011	1.3310e+003	4.9247e+007
Nb-95	1.1972e+000	4.4296e+010	1.0330e+002	3.8221e+006
Nd-147	4.5048e-001	1.6668e+010	3.8870e+001	1.4382e+006
Np-239	3.2277e+001	1.1942e+012	2.7850e+003	1.0305e+008
Pr-143	1.0063e+000	3.7234e+010	8.6830e+001	3.2127e+006
Pr-144	2.3236e+000	8.5973e+010	2.0049e+002	7.4182e+006
Pu-238	7.1067e-003	2.6295e+008	6.1320e-001	2.2688e+004
Pu-239	7.5494e-004	2.7933e+007	6.5140e-002	2.4102e+003
Pu-240	1.2134e-003	4.4897e+007	1.0470e-001	3.8739e+003
Pu-241	2.9936e-001	1.1076e+010	2.5830e+001	9.5571e+005
Rb-86	1.6863e+000	6.2392e+010	1.4550e+002	5.3835e+006
Rh-103m	1.3374e+001	4.9483e+011	1.1540e+003	4.2696e+007
Rh-105	8.6214e+000	3.1899e+011	7.4390e+002	2.7524e+007
Rh-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Ru-103	1.3409e+001	4.9614e+011	1.1570e+003	4.2809e+007
Ru-105	6.7880e+000	2.5116e+011	5.8570e+002	2.1671e+007
Ru-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Sb-127	1.4441e+001	5.3430e+011	1.2460e+003	4.6102e+007
Sb-129	3.9277e+001	1.4532e+012	3.3890e+003	1.2539e+008
Sr-89	6.4078e+001	2.3709e+012	5.5290e+003	2.0457e+008
Sr-90	8.1752e+000	3.0248e+011	7.0540e+002	2.6100e+007
Sr-91	7.0661e+001	2.6145e+012	6.0970e+003	2.2559e+008
Sr-92	5.2037e+001	1.9254e+012	4.4900e+003	1.6613e+008
Tc-99m	1.3931e+001	5.1543e+011	1.2020e+003	4.4474e+007
Te-127	1.4510e+001	5.3687e+011	1.2520e+003	4.6324e+007
Te-127m	2.4778e+000	9.1680e+010	2.1380e+002	7.9106e+006
Te-129	4.5187e+001	1.6719e+012	3.8990e+003	1.4426e+008
Te-129m	1.0376e+001	3.8392e+011	8.9530e+002	3.3126e+007
Te-131m	3.2010e+001	1.1844e+012	2.7620e+003	1.0219e+008
Te-132	2.3596e+002	8.7306e+012	2.0360e+004	7.5332e+008
Xe-133	6.6072e+003	2.4447e+014	5.7010e+005	2.1094e+010
Xe-135	2.4778e+003	9.1680e+013	2.1380e+005	7.9106e+009
Y-90	1.5449e-001	5.7161e+009	1.3330e+001	4.9321e+005
Y-91	8.4673e-001	3.1329e+010	7.3060e+001	2.7032e+006
Y-92	9.2137e+000	3.4091e+011	7.9500e+002	2.9415e+007
Y-93	5.8110e-001	2.1501e+010	5.0140e+001	1.8552e+006
Zr-95	1.1960e+000	4.4253e+010	1.0320e+002	3.8184e+006
Zr-97	1.0915e+000	4.0385e+010	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.620e+07	0.000e+00	7.884e-26	0.000e+00	6.762e-27
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 2RC12.MS5
 Run Date: September 21, 2005
 Run Time: 10:40:49 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 42

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	1.007e+11	3.515e-156	4.280e-22	1.217e-157	1.482e-23
0.03	1.335e+14	7.410e-46	1.229e-17	7.344e-48	1.218e-19
0.04	2.682e+11	9.283e-22	6.283e-19	4.105e-24	2.779e-21
0.05	1.148e+12	2.186e-11	2.439e-08	5.823e-14	6.497e-11
0.06	2.948e+11	1.451e-07	2.061e-04	2.883e-10	4.093e-07
0.08	9.087e+13	2.346e-01	2.824e+02	3.713e-04	4.470e-01
0.1	1.416e+12	1.193e-01	1.055e+02	1.825e-04	1.614e-01
0.15	2.151e+13	6.122e+01	2.570e+04	1.008e-01	4.231e+01
0.2	1.068e+14	1.585e+03	3.631e+05	2.797e+00	6.408e+02
0.3	1.167e+13	1.204e+03	1.175e+05	2.284e+00	2.229e+02
0.4	4.941e+13	1.793e+04	9.727e+05	3.493e+01	1.895e+03
0.5	8.380e+13	7.728e+04	2.736e+06	1.517e+02	5.371e+03
0.6	8.145e+13	1.568e+05	3.990e+06	3.060e+02	7.788e+03
0.8	1.029e+14	6.068e+05	9.609e+06	1.154e+03	1.828e+04
1.0	5.448e+13	7.380e+05	8.301e+06	1.360e+03	1.530e+04
1.5	5.530e+13	3.090e+06	2.050e+07	5.200e+03	3.449e+04
2.0	4.222e+13	5.838e+06	2.854e+07	9.028e+03	4.414e+04
3.0	3.328e+12	1.420e+06	4.864e+06	1.926e+03	6.599e+03
4.0	4.294e+08	3.678e+02	1.021e+03	4.551e-01	1.263e+00
TOTALS:	8.405e+14	1.195e+07	8.002e+07	1.917e+04	1.348e+05

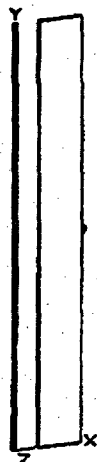
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 2RC24.MS5
Run Date: September 21, 2005
Run Time: 10:41:23 AM
Duration: 00:00:35

EC-RADN-1134
Page 43

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 3 in Reactor Coolant Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 2.46 cm 1.0 in

Dose Points
1 X 95.45 cm Y 304.8 cm Z 0 cm
3 ft 1.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.16e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	60.96 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.554 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5854e-004	5.8661e+006	1.3680e-002	5.0616e+002
Ba-137m	1.2762e+002	4.7218e+012	1.1011e+004	4.0742e+008
Ba-139	4.4538e+001	1.6479e+012	3.8430e+003	1.4219e+008
Ba-140	1.2169e+002	4.5025e+012	1.0500e+004	3.8850e+008
Ce-141	2.8035e+000	1.0373e+011	2.4190e+002	8.9503e+006
Ce-143	2.4964e+000	9.2366e+010	2.1540e+002	7.9698e+006
Ce-144	2.3573e+000	8.7220e+010	2.0340e+002	7.5258e+006
Cm-242	4.1490e-002	1.5351e+009	3.5800e+000	1.3246e+005
Cm-244	2.4326e-003	9.0008e+007	2.0990e-001	7.7663e+003
Co-58	4.6184e-002	1.7088e+009	3.9850e+000	1.4745e+005
Co-60	2.4871e-002	9.2023e+008	2.1460e+000	7.9402e+004
Cs-134	1.7917e+002	6.6294e+012	1.5460e+004	5.7202e+008
Cs-136	5.6962e+001	2.1076e+012	4.9150e+003	1.8186e+008
Cs-137	1.3490e+002	4.9914e+012	1.1640e+004	4.3068e+008
I-131	9.9322e+002	3.6749e+013	8.5700e+004	3.1709e+009
I-132	1.1586e+003	4.2868e+013	9.9970e+004	3.6989e+009
I-133	1.9447e+003	7.1955e+013	1.6780e+005	6.2086e+009
I-134	4.7181e+002	1.7457e+013	4.0710e+004	1.5063e+009
I-135	1.5994e+003	5.9176e+013	1.3800e+005	5.1060e+009
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009
Kr-87	5.6267e+002	2.0819e+013	4.8550e+004	1.7964e+009
Kr-88	1.4290e+003	5.2873e+013	1.2330e+005	4.5621e+009
La-140	2.9472e+000	1.0905e+011	2.5430e+002	9.4091e+006
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 2RC24.MS5
 Run Date: September 21, 2005
 Run Time: 10:41:23 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 44

Nuclide	curies	becquerels	$\mu\text{Ci/cm}^3$	Bq/cm ³
La-141	7.7963e-001	2.8846e+010	6.7270e+001	2.4890e+006
La-142	4.4214e-001	1.6359e+010	3.8150e+001	1.4115e+006
Mo-99	1.5426e+001	5.7075e+011	1.3310e+003	4.9247e+007
Nb-95	1.1972e+000	4.4296e+010	1.0330e+002	3.8221e+006
Nd-147	4.5048e-001	1.6668e+010	3.8870e+001	1.4382e+006
Np-239	3.2277e+001	1.1942e+012	2.7850e+003	1.0305e+008
Pr-143	1.0063e+000	3.7234e+010	8.6830e+001	3.2127e+006
Pr-144	2.3236e+000	8.5973e+010	2.0049e+002	7.4182e+006
Pu-238	7.1067e-003	2.6295e+008	6.1320e-001	2.2688e+004
Pu-239	7.5494e-004	2.7933e+007	6.5140e-002	2.4102e+003
Pu-240	1.2134e-003	4.4897e+007	1.0470e-001	3.8739e+003
Pu-241	2.9936e-001	1.1076e+010	2.5830e+001	9.5571e+005
Rb-86	1.6863e+000	6.2392e+010	1.4550e+002	5.3835e+006
Rh-103m	1.3374e+001	4.9483e+011	1.1540e+003	4.2696e+007
Rh-105	8.6214e+000	3.1899e+011	7.4390e+002	2.7524e+007
Rh-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Ru-103	1.3409e+001	4.9614e+011	1.1570e+003	4.2809e+007
Ru-105	6.7880e+000	2.5116e+011	5.8570e+002	2.1671e+007
Ru-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Sb-127	1.4441e+001	5.3430e+011	1.2460e+003	4.6102e+007
Sb-129	3.9277e+001	1.4532e+012	3.3890e+003	1.2539e+008
Sr-89	6.4078e+001	2.3709e+012	5.5290e+003	2.0457e+008
Sr-90	8.1752e+000	3.0248e+011	7.0540e+002	2.6100e+007
Sr-91	7.0661e+001	2.6145e+012	6.0970e+003	2.2559e+008
Sr-92	5.2037e+001	1.9254e+012	4.4900e+003	1.6613e+008
Tc-99m	1.3931e+001	5.1543e+011	1.2020e+003	4.4474e+007
Te-127	1.4510e+001	5.3687e+011	1.2520e+003	4.6324e+007
Te-127m	2.4778e+000	9.1680e+010	2.1380e+002	7.9106e+006
Te-129	4.5187e+001	1.6719e+012	3.8990e+003	1.4426e+008
Te-129m	1.0376e+001	3.8392e+011	8.9530e+002	3.3126e+007
Te-131m	3.2010e+001	1.1844e+012	2.7620e+003	1.0219e+008
Te-132	2.3596e+002	8.7306e+012	2.0360e+004	7.5332e+008
Xe-133	6.6072e+003	2.4447e+014	5.7010e+005	2.1094e+010
Xe-135	2.4778e+003	9.1680e+013	2.1380e+005	7.9106e+009
Y-90	1.5449e-001	5.7161e+009	1.3330e+001	4.9321e+005
Y-91	8.4673e-001	3.1329e+010	7.3060e+001	2.7032e+006
Y-92	9.2137e+000	3.4091e+011	7.9500e+002	2.9415e+007
Y-93	5.8110e-001	2.1501e+010	5.0140e+001	1.8552e+006
Zr-95	1.1960e+000	4.4253e+010	1.0320e+002	3.8184e+006
Zr-97	1.0915e+000	4.0385e+010	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.015	5.620e+07	0.000e+00	4.997e-26	0.000e+00	4.286e-27
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 2RC24.MS5
 Run Date: September 21, 2005
 Run Time: 10:41:23 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 45

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.02	1.007e+11	1.133e-265	2.713e-22	3.926e-267	9.396e-24
0.03	1.335e+14	1.161e-81	7.788e-18	1.151e-83	7.719e-20
0.04	2.682e+11	1.023e-39	1.587e-19	4.526e-42	7.020e-22
0.05	1.148e+12	5.048e-23	5.638e-18	1.345e-25	1.502e-20
0.06	2.948e+11	2.145e-16	1.458e-12	4.261e-19	2.896e-15
0.08	9.087e+13	7.144e-08	5.029e-04	1.130e-10	7.959e-07
0.1	1.416e+12	3.077e-07	1.699e-03	4.707e-10	2.600e-06
0.15	2.151e+13	1.397e-03	3.540e+00	2.301e-06	5.829e-03
0.2	1.068e+14	1.044e-01	1.280e+02	1.843e-04	2.260e-01
0.3	1.167e+13	2.825e-01	1.190e+02	5.359e-04	2.257e-01
0.4	4.941e+13	9.597e+00	1.902e+03	1.870e-02	3.706e+00
0.5	8.380e+13	7.590e+01	8.670e+03	1.490e-01	1.702e+01
0.6	8.145e+13	2.472e+02	1.854e+04	4.826e-01	3.619e+01
0.8	1.029e+14	1.945e+03	7.873e+04	3.700e+00	1.497e+02
1.0	5.448e+13	3.968e+03	1.040e+05	7.314e+00	1.917e+02
1.5	5.530e+13	3.900e+04	5.134e+05	6.562e+01	8.639e+02
2.0	4.222e+13	1.237e+05	1.096e+06	1.913e+02	1.695e+03
3.0	3.328e+12	5.486e+04	3.038e+05	7.442e+01	4.121e+02
4.0	4.294e+08	1.994e+01	8.371e+01	2.467e-02	1.036e-01
TOTALS:		8.405e+14	2.238e+05	2.125e+06	3.430e+02
					3.369e+03

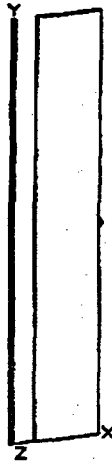
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 2RC36.MS5
Run Date: September 21, 2005
Run Time: 10:41:59 AM
Duration: 00:00:34

EC-RADN-1134
Page 46

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 3 in Reactor Coolant Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 2.46 cm 1.0 in

Dose Points
1 X Y Z
125.93 cm 304.8 cm 0 cm
4 ft 1.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.16e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	91.44 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.554 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5854e-004	5.8661e+006	1.3680e-002	5.0616e+002
Ba-137m	1.2762e+002	4.7218e+012	1.1011e+004	4.0742e+008
Ba-139	4.4538e+001	1.6479e+012	3.8430e+003	1.4219e+008
Ba-140	1.2169e+002	4.5025e+012	1.0500e+004	3.8850e+008
Ce-141	2.8035e+000	1.0373e+011	2.4190e+002	8.9503e+006
Ce-143	2.4964e+000	9.2366e+010	2.1540e+002	7.9698e+006
Ce-144	2.3573e+000	8.7220e+010	2.0340e+002	7.5258e+006
Cm-242	4.1490e-002	1.5351e+009	3.5800e+000	1.3246e+005
Cm-244	2.4326e-003	9.0008e+007	2.0990e-001	7.7663e+003
Co-58	4.6184e-002	1.7088e+009	3.9850e+000	1.4745e+005
Co-60	2.4871e-002	9.2023e+008	2.1460e+000	7.9402e+004
Cs-134	1.7917e+002	6.6294e+012	1.5460e+004	5.7202e+008
Cs-136	5.6962e+001	2.1076e+012	4.9150e+003	1.8186e+008
Cs-137	1.3490e+002	4.9914e+012	1.1640e+004	4.3068e+008
I-131	9.9322e+002	3.6749e+013	8.5700e+004	3.1709e+009
I-132	1.1586e+003	4.2868e+013	9.9970e+004	3.6989e+009
I-133	1.9447e+003	7.1955e+013	1.6780e+005	6.2086e+009
I-134	4.7181e+002	1.7457e+013	4.0710e+004	1.5063e+009
I-135	1.5994e+003	5.9176e+013	1.3800e+005	5.1060e+009
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009
Kr-87	5.6267e+002	2.0819e+013	4.8550e+004	1.7964e+009
Kr-88	1.4290e+003	5.2873e+013	1.2330e+005	4.5621e+009
La-140	2.9472e+000	1.0905e+011	2.5430e+002	9.4091e+006
Kr-85	4.6184e+001	1.7088e+012	3.9850e+003	1.4745e+008
Kr-85m	6.1413e+002	2.2723e+013	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 2RC36.MS5
 Run Date: September 21, 2005
 Run Time: 10:41:59 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 47

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	7.7963e-001	2.8846e+010	6.7270e+001	2.4890e+006
La-142	4.4214e-001	1.6359e+010	3.8150e+001	1.4115e+006
Mo-99	1.5426e+001	5.7075e+011	1.3310e+003	4.9247e+007
Nb-95	1.1972e+000	4.4296e+010	1.0330e+002	3.8221e+006
Nd-147	4.5048e-001	1.6668e+010	3.8870e+001	1.4382e+006
Np-239	3.2277e+001	1.1942e+012	2.7850e+003	1.0305e+008
Pr-143	1.0063e+000	3.7234e+010	8.6830e+001	3.2127e+006
Pr-144	2.3236e+000	8.5973e+010	2.0049e+002	7.4182e+006
Pu-238	7.1067e-003	2.6295e+008	6.1320e-001	2.2688e+004
Pu-239	7.5494e-004	2.7933e+007	6.5140e-002	2.4102e+003
Pu-240	1.2134e-003	4.4897e+007	1.0470e-001	3.8739e+003
Pu-241	2.9936e-001	1.1076e+010	2.5830e+001	9.5571e+005
Rb-86	1.6863e+000	6.2392e+010	1.4550e+002	5.3835e+006
Rh-103m	1.3374e+001	4.9483e+011	1.1540e+003	4.2696e+007
Rh-105	8.6214e+000	3.1899e+011	7.4390e+002	2.7524e+007
Rh-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Ru-103	1.3409e+001	4.9614e+011	1.1570e+003	4.2809e+007
Ru-105	6.7880e+000	2.5116e+011	5.8570e+002	2.1671e+007
Ru-106	5.3451e+000	1.9777e+011	4.6120e+002	1.7064e+007
Sb-127	1.4441e+001	5.3430e+011	1.2460e+003	4.6102e+007
Sb-129	3.9277e+001	1.4532e+012	3.3890e+003	1.2539e+008
Sr-89	6.4078e+001	2.3709e+012	5.5290e+003	2.0457e+008
Sr-90	8.1752e+000	3.0248e+011	7.0540e+002	2.6100e+007
Sr-91	7.0661e+001	2.6145e+012	6.0970e+003	2.2559e+008
Sr-92	5.2037e+001	1.9254e+012	4.4900e+003	1.6613e+008
Tc-99m	1.3931e+001	5.1543e+011	1.2020e+003	4.4474e+007
Te-127	1.4510e+001	5.3687e+011	1.2520e+003	4.6324e+007
Te-127m	2.4778e+000	9.1680e+010	2.1380e+002	7.9106e+006
Te-129	4.5187e+001	1.6719e+012	3.8990e+003	1.4426e+008
Te-129m	1.0376e+001	3.8392e+011	8.9530e+002	3.3126e+007
Te-131m	3.2010e+001	1.1844e+012	2.7620e+003	1.0219e+008
Te-132	2.3596e+002	8.7306e+012	2.0360e+004	7.5332e+008
Xe-133	6.6072e+003	2.4447e+014	5.7010e+005	2.1094e+010
Xe-135	2.4778e+003	9.1680e+013	2.1380e+005	7.9106e+009
Y-90	1.5449e-001	5.7161e+009	1.3330e+001	4.9321e+005
Y-91	8.4673e-001	3.1329e+010	7.3060e+001	2.7032e+006
Y-92	9.2137e+000	3.4091e+011	7.9500e+002	2.9415e+007
Y-93	5.8110e-001	2.1501e+010	5.0140e+001	1.8552e+006
Zr-95	1.1960e+000	4.4253e+010	1.0320e+002	3.8184e+006
Zr-97	1.0915e+000	4.0385e+010	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.620e+07	0.000e+00	3.524e-26	0.000e+00	3.022e-27
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 2RC36.MS5
 Run Date: September 21, 2005
 Run Time: 10:41:59 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 48

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	1.007e+11	0.000e+00	1.913e-22	0.000e+00	6.625e-24
0.03	1.335e+14	2.240e-117	5.491e-18	2.220e-119	5.442e-20
0.04	2.682e+11	1.371e-57	1.119e-19	6.064e-60	4.950e-22
0.05	1.148e+12	1.429e-34	3.975e-18	3.806e-37	1.059e-20
0.06	2.948e+11	3.906e-25	5.066e-18	7.758e-28	1.006e-20
0.08	9.087e+13	2.694e-14	6.545e-10	4.264e-17	1.036e-12
0.1	1.416e+12	9.859e-13	1.920e-08	1.508e-15	2.938e-11
0.15	2.151e+13	3.973e-08	3.523e-04	6.543e-11	5.802e-07
0.2	1.068e+14	8.571e-06	3.403e-02	1.513e-08	6.006e-05
0.3	1.167e+13	8.246e-05	9.323e-02	1.564e-07	1.768e-04
0.4	4.941e+13	6.381e-03	2.990e+00	1.243e-05	5.826e-03
0.5	8.380e+13	9.247e-02	2.294e+01	1.815e-04	4.503e-02
0.6	8.145e+13	4.830e-01	7.371e+01	9.427e-04	1.439e-01
0.8	1.029e+14	7.708e+00	5.816e+02	1.466e-02	1.106e+00
1.0	5.448e+13	2.632e+01	1.205e+03	4.851e-02	2.221e+00
1.5	5.530e+13	6.047e+02	1.267e+04	1.017e+00	2.131e+01
2.0	4.222e+13	3.209e+03	4.248e+04	4.962e+00	6.569e+01
3.0	3.328e+12	2.582e+03	1.996e+04	3.503e+00	2.707e+01
4.0	4.294e+08	1.313e+00	7.373e+00	1.624e-03	9.122e-03
TOTALS:	8.405e+14	6.432e+03	7.699e+04	9.549e+00	1.176e+02

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24RCU.MS5
Run Date: September 21, 2005
Run Time: 10:35:16 AM
Duration: 00:01:34

EC-RADN-1134
Page 49

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Reactor Coolant Unshielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 29.53 cm 11.6 in

Dose Points

	X	Y	Z
# 1	31.48 cm	304.8 cm	0 cm
	1 ft 0.4 in	10 ft 0.0 in	0.0 in
# 2	336.28 cm	304.8 cm	0 cm
	11 ft 0.4 in	10 ft 0.0 in	0.0 in
# 3	945.88 cm	304.8 cm	0 cm
	31 ft 0.4 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.67e+06 cm ³	Water	1
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.953 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.2846e-002	8.4530e+008	1.3680e-002	5.0616e+002
Ba-137m	1.8389e+004	6.8041e+014	1.1011e+004	4.0742e+008
Ba-139	6.4179e+003	2.3746e+014	3.8430e+003	1.4219e+008
Ba-140	1.7535e+004	6.4880e+014	1.0500e+004	3.8850e+008
Ce-141	4.0398e+002	1.4947e+013	2.4190e+002	8.9503e+006
Ce-143	3.5972e+002	1.3310e+013	2.1540e+002	7.9698e+006
Ce-144	3.3968e+002	1.2568e+013	2.0340e+002	7.5258e+006
Cm-242	5.9787e+000	2.2121e+011	3.5800e+000	1.3246e+005
Cm-244	3.5054e-001	1.2970e+010	2.0990e-001	7.7663e+003
Co-58	6.6550e+000	2.4624e+011	3.9850e+000	1.4745e+005
Co-60	3.5839e+000	1.3260e+011	2.1460e+000	7.9402e+004
Cs-134	2.5819e+004	9.5528e+014	1.5460e+004	5.7202e+008
Cs-136	8.2081e+003	3.0370e+014	4.9150e+003	1.8186e+008
Cs-137	1.9439e+004	7.1924e+014	1.1640e+004	4.3068e+008
I-131	1.4312e+005	5.2955e+015	8.5700e+004	3.1709e+009
I-132	1.6695e+005	6.1772e+015	9.9970e+004	3.6989e+009
I-133	2.8023e+005	1.0368e+016	1.6780e+005	6.2086e+009
I-134	6.7987e+004	2.5155e+015	4.0710e+004	1.5063e+009
I-135	2.3046e+005	8.5271e+015	1.3800e+005	5.1060e+009
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009
I-133m	2.8023e+005	1.0368e+016	1.6780e+005	6.2086e+009
I-134m	6.7987e+004	2.5155e+015	4.0710e+004	1.5063e+009

Page : 2
 DOS File: 24RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:35:16 AM
 Duration: 00:01:34

EC-RADN-1134
 Page 50

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
Kr-87	8.1079e+004	2.9999e+015	4.8550e+004	1.7964e+009
Kr-88	2.0591e+005	7.6188e+015	1.2330e+005	4.5621e+009
La-140	4.2469e+002	1.5713e+013	2.5430e+002	9.4091e+006
La-141	1.1234e+002	4.1567e+012	6.7270e+001	2.4890e+006
La-142	6.3711e+001	2.3573e+012	3.8150e+001	1.4115e+006
Mo-99	2.2228e+003	8.2243e+013	1.3310e+003	4.9247e+007
Nb-95	1.7251e+002	6.3830e+012	1.0330e+002	3.8221e+006
Nd-147	6.4914e+001	2.4018e+012	3.8870e+001	1.4382e+006
Np-239	4.6510e+003	1.7209e+014	2.7850e+003	1.0304e+008
Pr-143	1.4501e+002	5.3653e+012	8.6830e+001	3.2127e+006
Pr-144	3.3482e+002	1.2389e+013	2.0049e+002	7.4182e+006
Pu-238	1.0241e+000	3.7890e+010	6.1320e-001	2.2688e+004
Pu-239	1.0879e-001	4.0250e+009	6.5140e-002	2.4102e+003
Pu-240	1.7485e-001	6.4695e+009	1.0470e-001	3.8739e+003
Pu-241	4.3137e+001	1.5961e+012	2.5830e+001	9.5571e+005
Rb-86	2.4299e+002	8.9906e+012	1.4550e+002	5.3835e+006
Rh-103m	1.9271e+003	7.1304e+013	1.1540e+003	4.2696e+007
Rh-105	1.2423e+003	4.5966e+013	7.4390e+002	2.7524e+007
Rh-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Ru-103	1.9322e+003	7.1492e+013	1.1570e+003	4.2809e+007
Ru-105	9.7813e+002	3.6191e+013	5.8570e+002	2.1671e+007
Ru-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Sb-127	2.0808e+003	7.6991e+013	1.2460e+003	4.6102e+007
Sb-129	5.6597e+003	2.0941e+014	3.3890e+003	1.2539e+008
Sr-89	9.2335e+003	3.4164e+014	5.5290e+003	2.0457e+008
Sr-90	1.1780e+003	4.3587e+013	7.0540e+002	2.6100e+007
Sr-91	1.0182e+004	3.7674e+014	6.0970e+003	2.2559e+008
Sr-92	7.4984e+003	2.7744e+014	4.4900e+003	1.6613e+008
Tc-99m	2.0074e+003	7.4272e+013	1.2020e+003	4.4474e+007
Te-127	2.0909e+003	7.7362e+013	1.2520e+003	4.6324e+007
Te-127m	3.5705e+002	1.3211e+013	2.1380e+002	7.9106e+006
Te-129	6.5114e+003	2.4092e+014	3.8990e+003	1.4426e+008
Te-129m	1.4952e+003	5.5321e+013	8.9530e+002	3.3126e+007
Te-131m	4.6126e+003	1.7067e+014	2.7620e+003	1.0219e+008
Te-132	3.4002e+004	1.2581e+015	2.0360e+004	7.5332e+008
Xe-133	9.5208e+005	3.5227e+016	5.7010e+005	2.1094e+010
Xe-135	3.5705e+005	1.3211e+016	2.1380e+005	7.9106e+009
Y-90	2.2261e+001	8.2367e+011	1.3330e+001	4.9321e+005
Y-91	1.2201e+002	4.5144e+012	7.3060e+001	2.7032e+006
Y-92	1.3277e+003	4.9124e+013	7.9500e+002	2.9415e+007
Y-93	8.3735e+001	3.0982e+012	5.0140e+001	1.8552e+006
Zr-95	1.7235e+002	6.3768e+012	1.0320e+002	3.8184e+006
Zr-97	1.5728e+002	5.8195e+012	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results - Dose Point # 1 - (31.48,304.8,0) cm

Circumferential	25
Y Direction (axial)	25

Page : 3
 DOS File: 24RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:35:16 AM
 Duration: 00:01:34

EC-RADN-1134
 Page 51

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.099e+09	9.296e-195	3.048e-23	7.973e-196	2.615e-24
0.02	1.451e+13	8.655e-84	1.655e-19	2.998e-85	5.731e-21
0.03	1.924e+16	1.016e-20	4.750e-15	1.007e-22	4.708e-17
0.04	3.865e+13	1.045e-07	1.695e-05	4.621e-10	7.495e-08
0.05	1.654e+14	3.719e-01	8.657e+01	9.907e-04	2.306e-01
0.06	4.249e+13	5.494e+01	1.119e+04	1.091e-01	2.223e+01
0.08	1.309e+16	4.182e+06	4.238e+08	6.618e+03	6.706e+05
0.1	2.040e+14	6.186e+05	3.291e+07	9.463e+02	5.034e+04
0.15	3.100e+15	7.838e+07	1.624e+09	1.291e+05	2.674e+06
0.2	1.539e+16	9.117e+08	1.226e+10	1.609e+06	2.163e+07
0.3	1.682e+15	2.433e+08	1.978e+09	4.616e+05	3.752e+06
0.4	7.120e+15	1.798e+09	1.111e+10	3.504e+06	2.164e+07
0.5	1.208e+16	4.622e+09	2.355e+10	9.072e+06	4.622e+07
0.6	1.174e+16	6.271e+09	2.772e+10	1.224e+07	5.410e+07
0.8	1.483e+16	1.336e+10	4.799e+10	2.541e+07	9.128e+07
1.0	7.850e+15	1.057e+10	3.294e+10	1.948e+07	6.072e+07
1.5	7.969e+15	2.202e+10	5.463e+10	3.704e+07	9.192e+07
2.0	6.084e+15	2.744e+10	5.972e+10	4.243e+07	9.236e+07
3.0	4.795e+14	4.161e+09	7.742e+09	5.646e+06	1.050e+07
4.0	6.188e+10	8.304e+05	1.406e+06	1.027e+03	1.739e+03
TOTALS:	1.211e+17	9.147e+10	2.817e+11	1.570e+08	4.975e+08

Results - Dose Point # 2 - (336.28,304.8,0) cm

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.099e+09	8.460e-187	1.190e-24	7.256e-188	1.021e-25
0.02	1.451e+13	3.730e-81	6.461e-21	1.292e-82	2.238e-22
0.03	1.924e+16	1.018e-20	1.855e-16	1.009e-22	1.838e-18
0.04	3.865e+13	2.575e-08	3.785e-06	1.139e-10	1.674e-08
0.05	1.654e+14	5.454e-02	1.124e+01	1.453e-04	2.993e-02
0.06	4.249e+13	6.226e+00	1.117e+03	1.237e-02	2.218e+00
0.08	1.309e+16	3.645e+05	3.298e+07	5.768e+02	5.220e+04
0.1	2.040e+14	4.738e+04	2.293e+06	7.249e+01	3.509e+03
0.15	3.100e+15	5.283e+06	1.019e+08	8.700e+03	1.677e+05
0.2	1.539e+16	5.887e+07	7.401e+08	1.039e+05	1.306e+06
0.3	1.682e+15	1.522e+07	1.160e+08	2.887e+04	2.200e+05
0.4	7.120e+15	1.108e+08	6.433e+08	2.160e+05	1.254e+06
0.5	1.208e+16	2.821e+08	1.353e+09	5.537e+05	2.656e+06
0.6	1.174e+16	3.799e+08	1.583e+09	7.414e+05	3.090e+06
0.8	1.483e+16	7.991e+08	2.713e+09	1.520e+06	5.160e+06
1.0	7.850e+15	6.258e+08	1.847e+09	1.154e+06	3.405e+06
1.5	7.969e+15	1.278e+09	3.011e+09	2.151e+06	5.066e+06
2.0	6.084e+15	1.571e+09	3.250e+09	2.430e+06	5.026e+06
3.0	4.795e+14	2.339e+08	4.144e+08	3.173e+05	5.622e+05
4.0	6.188e+10	4.612e+04	7.453e+04	5.705e+01	9.220e+01
TOTALS:	1.211e+17	5.361e+09	1.581e+10	9.225e+06	2.797e+07

Results - Dose Point # 3 - (945.88,304.8,0) cm

TOTALS: 1.211e+17 5.361e+09 1.581e+10 9.225e+06 2.797e+07

Page : 4
 DOS File: 24RCU.MS5
 Run Date: September 21, 2005
 Run Time: 10:35:16 AM
 Duration: 00:01:34

EC-RADN-1134
 Page 52

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.099e+09	9.669e-188	1.788e-25	8.293e-189	1.534e-26
0.02	1.451e+13	7.720e-82	9.706e-22	2.674e-83	3.362e-23
0.03	1.924e+16	2.808e-21	2.787e-17	2.783e-23	2.762e-19
0.04	3.865e+13	7.076e-09	1.041e-06	3.130e-11	4.605e-09
0.05	1.654e+14	1.363e-02	2.775e+00	3.630e-05	7.393e-03
0.06	4.249e+13	1.397e+00	2.441e+02	2.775e-03	4.848e-01
0.08	1.309e+16	6.991e+04	6.094e+06	1.106e+02	9.643e+03
0.1	2.040e+14	8.373e+03	3.930e+05	1.281e+01	6.013e+02
0.15	3.100e+15	8.686e+05	1.656e+07	1.430e+03	2.728e+04
0.2	1.539e+16	9.502e+06	1.190e+08	1.677e+04	2.100e+05
0.3	1.682e+15	2.434e+06	1.850e+07	4.618e+03	3.510e+04
0.4	7.120e+15	1.769e+07	1.023e+08	3.447e+04	1.994e+05
0.5	1.208e+16	4.499e+07	2.148e+08	8.831e+04	4.216e+05
0.6	1.174e+16	6.055e+07	2.509e+08	1.182e+05	4.897e+05
0.8	1.483e+16	1.272e+08	4.288e+08	2.420e+05	8.156e+05
1.0	7.850e+15	9.954e+07	2.914e+08	1.835e+05	5.370e+05
1.5	7.969e+15	2.027e+08	4.728e+08	3.411e+05	7.955e+05
2.0	6.084e+15	2.486e+08	5.088e+08	3.845e+05	7.868e+05
3.0	4.795e+14	3.688e+07	6.463e+07	5.003e+04	8.768e+04
4.0	6.188e+10	7.253e+03	1.160e+04	8.973e+00	1.435e+01
TOTALS:	1.211e+17	8.511e+08	2.495e+09	1.465e+06	4.416e+06

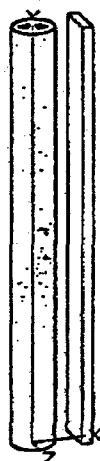
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24RC6.MS5
Run Date: September 21, 2005
Run Time: 10:34:43 AM
Duration: 00:00:32

EC-RADN-1134
Page 53

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Reactor Coolant Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 29.53 cm 11.6 in

Dose Points
1 X Y Z
77.2 cm 304.8 cm 0 cm
2 ft 6.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.67e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	15.24 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.953 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.2846e-002	8.4530e+008	1.3680e-002	5.0616e+002
Ba-137m	1.8389e+004	6.8041e+014	1.1011e+004	4.0742e+008
Ba-139	6.4179e+003	2.3746e+014	3.8430e+003	1.4219e+008
Ba-140	1.7535e+004	6.4880e+014	1.0500e+004	3.8850e+008
Ce-141	4.0398e+002	1.4947e+013	2.4190e+002	8.9503e+006
Ce-143	3.5972e+002	1.3310e+013	2.1540e+002	7.9698e+006
Ce-144	3.3968e+002	1.2568e+013	2.0340e+002	7.5258e+006
Cm-242	5.9787e+000	2.2121e+011	3.5800e+000	1.3246e+005
Cm-244	3.5054e-001	1.2970e+010	2.0990e-001	7.7663e+003
Co-58	6.6550e+000	2.4624e+011	3.9850e+000	1.4745e+005
Co-60	3.5839e+000	1.3260e+011	2.1460e+000	7.9402e+004
Cs-134	2.5819e+004	9.5528e+014	1.5460e+004	5.7202e+008
Cs-136	8.2081e+003	3.0370e+014	4.9150e+003	1.8186e+008
Cs-137	1.9439e+004	7.1924e+014	1.1640e+004	4.3068e+008
I-131	1.4312e+005	5.2955e+015	8.5700e+004	3.1709e+009
I-132	1.6695e+005	6.1772e+015	9.9970e+004	3.6989e+009
I-133	2.8023e+005	1.0368e+016	1.6780e+005	6.2086e+009
I-134	6.7987e+004	2.5155e+015	4.0710e+004	1.5063e+009
I-135	2.3046e+005	8.5271e+015	1.3800e+005	5.1060e+009
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009
Kr-87	8.1079e+004	2.9999e+015	4.8550e+004	1.7964e+009
Kr-88	2.0591e+005	7.6188e+015	1.2330e+005	4.5621e+009
La-140	4.2469e+002	1.5713e+013	2.5430e+002	9.4091e+006
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 24RC6.MS5
 Run Date: September 21, 2005
 Run Time: 10:34:43 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 54

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	1.1234e+002	4.1567e+012	6.7270e+001	2.4890e+006
La-142	6.3711e+001	2.3573e+012	3.8150e+001	1.4115e+006
Mo-99	2.2228e+003	8.2243e+013	1.3310e+003	4.9247e+007
Nb-95	1.7251e+002	6.3830e+012	1.0330e+002	3.8221e+006
Nd-147	6.4914e+001	2.4018e+012	3.8870e+001	1.4382e+006
Np-239	4.6510e+003	1.7209e+014	2.7850e+003	1.0304e+008
Pr-143	1.4501e+002	5.3653e+012	8.6830e+001	3.2127e+006
Pr-144	3.3482e+002	1.2389e+013	2.0049e+002	7.4182e+006
Pu-238	1.0241e+000	3.7890e+010	6.1320e-001	2.2688e+004
Pu-239	1.0879e-001	4.0250e+009	6.5140e-002	2.4102e+003
Pu-240	1.7485e-001	6.4695e+009	1.0470e-001	3.8739e+003
Pu-241	4.3137e+001	1.5961e+012	2.5830e+001	9.5571e+005
Rb-86	2.4299e+002	8.9906e+012	1.4550e+002	5.3835e+006
Rh-103m	1.9271e+003	7.1304e+013	1.1540e+003	4.2696e+007
Rh-105	1.2423e+003	4.5966e+013	7.4390e+002	2.7524e+007
Rh-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Ru-103	1.9322e+003	7.1492e+013	1.1570e+003	4.2809e+007
Ru-105	9.7813e+002	3.6191e+013	5.8570e+002	2.1671e+007
Ru-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Sb-127	2.0808e+003	7.6991e+013	1.2460e+003	4.6102e+007
Sb-129	5.6597e+003	2.0941e+014	3.3890e+003	1.2539e+008
Sr-89	9.2335e+003	3.4164e+014	5.5290e+003	2.0457e+008
Sr-90	1.1780e+003	4.3587e+013	7.0540e+002	2.6100e+007
Sr-91	1.0182e+004	3.7674e+014	6.0970e+003	2.2559e+008
Sr-92	7.4984e+003	2.7744e+014	4.4900e+003	1.6613e+008
Tc-99m	2.0074e+003	7.4272e+013	1.2020e+003	4.4474e+007
Te-127	2.0909e+003	7.7362e+013	1.2520e+003	4.6324e+007
Te-127m	3.5705e+002	1.3211e+013	2.1380e+002	7.9106e+006
Te-129	6.5114e+003	2.4092e+014	3.8990e+003	1.4426e+008
Te-129m	1.4952e+003	5.5321e+013	8.9530e+002	3.3126e+007
Te-131m	4.6126e+003	1.7067e+014	2.7620e+003	1.0219e+008
Te-132	3.4002e+004	1.2581e+015	2.0360e+004	7.5332e+008
Xe-133	9.5208e+005	3.5227e+016	5.7010e+005	2.1094e+010
Xe-135	3.5705e+005	1.3211e+016	2.1380e+005	7.9106e+009
Y-90	2.2261e+001	8.2367e+011	1.3330e+001	4.9321e+005
Y-91	1.2201e+002	4.5144e+012	7.3060e+001	2.7032e+006
Y-92	1.3277e+003	4.9124e+013	7.9500e+002	2.9415e+007
Y-93	8.3735e+001	3.0982e+012	5.0140e+001	1.8552e+006
Zr-95	1.7235e+002	6.3768e+012	1.0320e+002	3.8184e+006
Zr-97	1.5728e+002	5.8195e+012	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.099e+09	1.143e-311	9.508e-24	9.801e-313	8.155e-25
			<u>Results</u>		
<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>

Page : 3
 DOS File: 24RC6.MS5
 Run Date: September 21, 2005
 Run Time: 10:34:43 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 55

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	1.451e+13	4.780e-135	5.161e-20	1.656e-136	1.788e-21
0.03	1.924e+16	6.326e-38	1.482e-15	6.270e-40	1.469e-17
0.04	3.865e+13	1.258e-16	4.462e-14	5.564e-19	1.973e-16
0.05	1.654e+14	3.815e-07	2.672e-04	1.016e-09	7.117e-07
0.06	4.249e+13	1.070e-03	8.283e-01	2.126e-06	1.645e-03
0.08	1.309e+16	8.641e+02	4.760e+05	1.367e+00	7.533e+02
0.1	2.040e+14	3.232e+02	1.186e+05	4.945e-01	1.815e+02
0.15	3.100e+15	1.084e+05	1.819e+07	1.786e+02	2.995e+04
0.2	1.539e+16	2.098e+06	2.035e+08	3.702e+03	3.591e+05
0.3	1.682e+15	1.064e+06	5.007e+07	2.018e+03	9.497e+04
0.4	7.120e+15	1.208e+07	3.510e+08	2.353e+04	6.838e+05
0.5	1.208e+16	4.273e+07	8.753e+08	8.388e+04	1.718e+06
0.6	1.174e+16	7.454e+07	1.168e+09	1.455e+05	2.279e+06
0.8	1.483e+16	2.318e+08	2.454e+09	4.410e+05	4.667e+06
1.0	7.850e+15	2.421e+08	1.938e+09	4.463e+05	3.573e+06
1.5	7.969e+15	8.007e+08	4.137e+09	1.347e+06	6.961e+06
2.0	6.084e+15	1.325e+09	5.311e+09	2.049e+06	8.213e+06
3.0	4.795e+14	2.804e+08	8.319e+08	3.804e+05	1.129e+06
4.0	6.188e+10	6.767e+04	1.679e+05	8.371e+01	2.077e+02
TOTALS:	1.211e+17	3.013e+09	1.734e+10	4.923e+06	2.971e+07

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24RC12.MS5
Run Date: September 21, 2005
Run Time: 10:33:00 AM
Duration: 00:00:33

EC-RADN-1134
Page 56

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Reactor Coolant Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 29.53 cm 11.6 in

Dose Points
1 X Y Z
92.44 cm 304.8 cm 0 cm
3 ft 0.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.67e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	30.48 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.953 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.2846e-002	8.4530e+008	1.3680e-002	5.0616e+002
Ba-137m	1.8389e+004	6.8041e+014	1.1011e+004	4.0742e+008
Ba-139	6.4179e+003	2.3746e+014	3.8430e+003	1.4219e+008
Ba-140	1.7535e+004	6.4880e+014	1.0500e+004	3.8850e+008
Ce-141	4.0398e+002	1.4947e+013	2.4190e+002	8.9503e+006
Ce-143	3.5972e+002	1.3310e+013	2.1540e+002	7.9698e+006
Ce-144	3.3968e+002	1.2568e+013	2.0340e+002	7.5258e+006
Cm-242	5.9787e+000	2.2121e+011	3.5800e+000	1.3246e+005
Cm-244	3.5054e-001	1.2970e+010	2.0990e-001	7.7663e+003
Co-58	6.6550e+000	2.4624e+011	3.9850e+000	1.4745e+005
Co-60	3.5839e+000	1.3260e+011	2.1460e+000	7.9402e+004
Cs-134	2.5819e+004	9.5528e+014	1.5460e+004	5.7202e+008
Cs-136	8.2081e+003	3.0370e+014	4.9150e+003	1.8186e+008
Cs-137	1.9439e+004	7.1924e+014	1.1640e+004	4.3068e+008
I-131	1.4312e+005	5.2955e+015	8.5700e+004	3.1709e+009
I-132	1.6695e+005	6.1772e+015	9.9970e+004	3.6989e+009
I-133	2.8023e+005	1.0368e+016	1.6780e+005	6.2086e+009
I-134	6.7987e+004	2.5155e+015	4.0710e+004	1.5063e+009
I-135	2.3046e+005	8.5271e+015	1.3800e+005	5.1060e+009
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009
Kr-87	8.1079e+004	2.9999e+015	4.8550e+004	1.7964e+009
Kr-88	2.0591e+005	7.6188e+015	1.2330e+005	4.5621e+009
La-140	4.2469e+002	1.5713e+013	2.5430e+002	9.4091e+006
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 24RC12.MS5
 Run Date: September 21, 2005
 Run Time: 10:33:00 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 57

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	1.1234e+002	4.1567e+012	6.7270e+001	2.4890e+006
La-142	6.3711e+001	2.3573e+012	3.8150e+001	1.4115e+006
Mo-99	2.2228e+003	8.2243e+013	1.3310e+003	4.9247e+007
Nb-95	1.7251e+002	6.3830e+012	1.0330e+002	3.8221e+006
Nd-147	6.4914e+001	2.4018e+012	3.8870e+001	1.4382e+006
Np-239	4.6510e+003	1.7209e+014	2.7850e+003	1.0304e+008
Pr-143	1.4501e+002	5.3653e+012	8.6830e+001	3.2127e+006
Pr-144	3.3482e+002	1.2389e+013	2.0049e+002	7.4182e+006
Pu-238	1.0241e+000	3.7890e+010	6.1320e-001	2.2688e+004
Pu-239	1.0879e-001	4.0250e+009	6.5140e-002	2.4102e+003
Pu-240	1.7485e-001	6.4695e+009	1.0470e-001	3.8739e+003
Pu-241	4.3137e+001	1.5961e+012	2.5830e+001	9.5571e+005
Rb-86	2.4299e+002	8.9906e+012	1.4550e+002	5.3835e+006
Rh-103m	1.9271e+003	7.1304e+013	1.1540e+003	4.2696e+007
Rh-105	1.2423e+003	4.5966e+013	7.4390e+002	2.7524e+007
Rh-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Ru-103	1.9322e+003	7.1492e+013	1.1570e+003	4.2809e+007
Ru-105	9.7813e+002	3.6191e+013	5.8570e+002	2.1671e+007
Ru-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Sb-127	2.0808e+003	7.6991e+013	1.2460e+003	4.6102e+007
Sb-129	5.6597e+003	2.0941e+014	3.3890e+003	1.2539e+008
Sr-89	9.2335e+003	3.4164e+014	5.5290e+003	2.0457e+008
Sr-90	1.1780e+003	4.3587e+013	7.0540e+002	2.6100e+007
Sr-91	1.0182e+004	3.7674e+014	6.0970e+003	2.2559e+008
Sr-92	7.4984e+003	2.7744e+014	4.4900e+003	1.6613e+008
Tc-99m	2.0074e+003	7.4272e+013	1.2020e+003	4.4474e+007
Te-127	2.0909e+003	7.7362e+013	1.2520e+003	4.6324e+007
Te-127m	3.5705e+002	1.3211e+013	2.1380e+002	7.9106e+006
Te-129	6.5114e+003	2.4092e+014	3.8990e+003	1.4426e+008
Te-129m	1.4952e+003	5.5321e+013	8.9530e+002	3.3126e+007
Te-131m	4.6126e+003	1.7067e+014	2.7620e+003	1.0219e+008
Te-132	3.4002e+004	1.2581e+015	2.0360e+004	7.5332e+008
Xe-133	9.5208e+005	3.5227e+016	5.7010e+005	2.1094e+010
Xe-135	3.5705e+005	1.3211e+016	2.1380e+005	7.9106e+009
Y-90	2.2261e+001	8.2367e+011	1.3330e+001	4.9321e+005
Y-91	1.2201e+002	4.5144e+012	7.3060e+001	2.7032e+006
Y-92	1.3277e+003	4.9124e+013	7.9500e+002	2.9415e+007
Y-93	8.3735e+001	3.0982e+012	5.0140e+001	1.8552e+006
Zr-95	1.7235e+002	6.3768e+012	1.0320e+002	3.8184e+006
Zr-97	1.5728e+002	5.8195e+012	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.099e+09	0.000e+00	7.612e-24	0.000e+00	6.529e-25
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 24RC12.MS5
 Run Date: September 21, 2005
 Run Time: 10:33:00 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 58

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	1.451e+13	8.354e-190	4.132e-20	2.894e-191	1.431e-21
0.03	1.924e+16	7.427e-56	1.186e-15	7.361e-58	1.176e-17
0.04	3.865e+13	1.266e-25	2.418e-17	5.599e-28	1.069e-19
0.05	1.654e+14	5.497e-13	9.015e-10	1.464e-15	2.402e-12
0.06	4.249e+13	3.856e-08	8.205e-05	7.658e-11	1.630e-07
0.08	1.309e+16	4.395e-01	7.705e+02	6.955e-04	1.219e+00
0.1	2.040e+14	4.736e-01	5.980e+02	7.246e-04	9.149e-01
0.15	3.100e+15	4.685e+02	2.740e+05	7.716e-01	4.512e+02
0.2	1.539e+16	1.540e+04	4.856e+06	2.718e+01	8.571e+03
0.3	1.682e+15	1.481e+04	1.954e+06	2.809e+01	3.706e+03
0.4	7.120e+15	2.552e+05	1.840e+07	4.973e+02	3.585e+04
0.5	1.208e+16	1.228e+06	5.705e+07	2.411e+03	1.120e+05
0.6	1.174e+16	2.725e+06	9.014e+07	5.320e+03	1.759e+05
0.8	1.483e+16	1.216e+07	2.458e+08	2.313e+04	4.676e+05
1.0	7.850e+15	1.653e+07	2.347e+08	3.048e+04	4.326e+05
1.5	7.969e+15	8.455e+07	6.892e+08	1.422e+05	1.160e+06
2.0	6.084e+15	1.825e+08	1.076e+09	2.822e+05	1.665e+06
3.0	4.795e+14	5.255e+07	2.115e+08	7.129e+04	2.870e+05
4.0	6.188e+10	1.510e+04	4.846e+04	1.868e+01	5.995e+01
TOTALS:	1.211e+17	3.525e+08	2.630e+09	5.576e+05	4.348e+06

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24RC24.MS5
Run Date: September 21, 2005
Run Time: 10:33:34 AM
Duration: 00:00:34

EC-RADN-1134
Page 59

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Reactor Coolant Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 29.53 cm 11.6 in

Dose Points
1 X 122.92 cm 304.8 cm Z 0 cm
4 ft 0.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.67e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	60.96 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.953 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.2846e-002	8.4530e+008	1.3680e-002	5.0616e+002
Ba-137m	1.8389e+004	6.8041e+014	1.1011e+004	4.0742e+008
Ba-139	6.4179e+003	2.3746e+014	3.8430e+003	1.4219e+008
Ba-140	1.7535e+004	6.4880e+014	1.0500e+004	3.8850e+008
Ce-141	4.0398e+002	1.4947e+013	2.4190e+002	8.9503e+006
Ce-143	3.5972e+002	1.3310e+013	2.1540e+002	7.9698e+006
Ce-144	3.3968e+002	1.2568e+013	2.0340e+002	7.5258e+006
Cm-242	5.9787e+000	2.2121e+011	3.5800e+000	1.3246e+005
Cm-244	3.5054e-001	1.2970e+010	2.0990e-001	7.7663e+003
Co-58	6.6550e+000	2.4624e+011	3.9850e+000	1.4745e+005
Co-60	3.5839e+000	1.3260e+011	2.1460e+000	7.9402e+004
Cs-134	2.5819e+004	9.5528e+014	1.5460e+004	5.7202e+008
Cs-136	8.2081e+003	3.0370e+014	4.9150e+003	1.8186e+008
Cs-137	1.9439e+004	7.1924e+014	1.1640e+004	4.3068e+008
I-131	1.4312e+005	5.2955e+015	8.5700e+004	3.1709e+009
I-132	1.6695e+005	6.1772e+015	9.9970e+004	3.6989e+009
I-133	2.8023e+005	1.0368e+016	1.6780e+005	6.2086e+009
I-134	6.7987e+004	2.5155e+015	4.0710e+004	1.5063e+009
I-135	2.3046e+005	8.5271e+015	1.3800e+005	5.1060e+009
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009
Kr-87	8.1079e+004	2.9999e+015	4.8550e+004	1.7964e+009
Kr-88	2.0591e+005	7.6188e+015	1.2330e+005	4.5621e+009
La-140	4.2469e+002	1.5713e+013	2.5430e+002	9.4091e+006
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85w	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 24RC24.MS5
 Run Date: September 21, 2005
 Run Time: 10:33:34 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 60

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	1.1234e+002	4.1567e+012	6.7270e+001	2.4890e+006
La-142	6.3711e+001	2.3573e+012	3.8150e+001	1.4115e+006
Mo-99	2.2228e+003	8.2243e+013	1.3310e+003	4.9247e+007
Nb-95	1.7251e+002	6.3830e+012	1.0330e+002	3.8221e+006
Nd-147	6.4914e+001	2.4018e+012	3.8870e+001	1.4382e+006
Np-239	4.6510e+003	1.7209e+014	2.7850e+003	1.0304e+008
Pr-143	1.4501e+002	5.3653e+012	8.6830e+001	3.2127e+006
Pr-144	3.3482e+002	1.2389e+013	2.0049e+002	7.4182e+006
Pu-238	1.0241e+000	3.7890e+010	6.1320e-001	2.2688e+004
Pu-239	1.0879e-001	4.0250e+009	6.5140e-002	2.4102e+003
Pu-240	1.7485e-001	6.4695e+009	1.0470e-001	3.8739e+003
Pu-241	4.3137e+001	1.5961e+012	2.5830e+001	9.5571e+005
Rb-86	2.4299e+002	8.9906e+012	1.4550e+002	5.3835e+006
Rh-103m	1.9271e+003	7.1304e+013	1.1540e+003	4.2696e+007
Rh-105	1.2423e+003	4.5966e+013	7.4390e+002	2.7524e+007
Rh-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Ru-103	1.9322e+003	7.1492e+013	1.1570e+003	4.2809e+007
Ru-105	9.7813e+002	3.6191e+013	5.8570e+002	2.1671e+007
Ru-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Sb-127	2.0808e+003	7.6991e+013	1.2460e+003	4.6102e+007
Sb-129	5.6597e+003	2.0941e+014	3.3890e+003	1.2539e+008
Sr-89	9.2335e+003	3.4164e+014	5.5290e+003	2.0457e+008
Sr-90	1.1780e+003	4.3587e+013	7.0540e+002	2.6100e+007
Sr-91	1.0182e+004	3.7674e+014	6.0970e+003	2.2559e+008
Sr-92	7.4984e+003	2.7744e+014	4.4900e+003	1.6613e+008
Tc-99m	2.0074e+003	7.4272e+013	1.2020e+003	4.4474e+007
Te-127	2.0909e+003	7.7362e+013	1.2520e+003	4.6324e+007
Te-127m	3.5705e+002	1.3211e+013	2.1380e+002	7.9106e+006
Te-129	6.5114e+003	2.4092e+014	3.8990e+003	1.4426e+008
Te-129m	1.4952e+003	5.5321e+013	8.9530e+002	3.3126e+007
Te-131m	4.6126e+003	1.7067e+014	2.7620e+003	1.0219e+008
Te-132	3.4002e+004	1.2581e+015	2.0360e+004	7.5332e+008
Xe-133	9.5208e+005	3.5227e+016	5.7010e+005	2.1094e+010
Xe-135	3.5705e+005	1.3211e+016	2.1380e+005	7.9106e+009
Y-90	2.2261e+001	8.2367e+011	1.3330e+001	4.9321e+005
Y-91	1.2201e+002	4.5144e+012	7.3060e+001	2.7032e+006
Y-92	1.3277e+003	4.9124e+013	7.9500e+002	2.9415e+007
Y-93	8.3735e+001	3.0982e+012	5.0140e+001	1.8552e+006
Zr-95	1.7235e+002	6.3768e+012	1.0320e+002	3.8184e+006
Zr-97	1.5728e+002	5.8195e+012	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	8.000e+00	0.000e+00	5.292e-24	0.000e+00	4.539e-25
		<u>Results</u>	<u>Results</u>	<u>Results</u>	<u>Results</u>
		<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>

Page : 3
 DOS File: 24RC24.MS5
 Run Date: September 21, 2005
 Run Time: 10:33:34 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 61

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	1.451e+13	3.060e-299	2.873e-20	1.060e-300	9.950e-22
0.03	1.924e+16	1.311e-91	8.247e-16	1.299e-93	8.174e-18
0.04	3.865e+13	1.589e-43	1.681e-17	7.028e-46	7.434e-20
0.05	1.654e+14	1.436e-24	5.970e-16	3.824e-27	1.590e-18
0.06	4.249e+13	6.418e-17	5.556e-13	1.275e-19	1.104e-15
0.08	1.309e+16	1.499e-07	1.357e-03	2.372e-10	2.147e-06
0.1	2.040e+14	1.364e-06	9.517e-03	2.086e-09	1.456e-05
0.15	3.100e+15	1.191e-02	3.733e+01	1.961e-05	6.148e-02
0.2	1.539e+16	1.130e+00	1.697e+03	1.994e-03	2.995e+00
0.3	1.682e+15	3.875e+00	1.968e+03	7.351e-03	3.733e+00
0.4	7.120e+15	1.526e+02	3.607e+04	2.974e-01	7.027e+01
0.5	1.208e+16	1.350e+03	1.822e+05	2.650e+00	3.576e+02
0.6	1.174e+16	4.815e+03	4.250e+05	9.399e+00	8.296e+02
0.8	1.483e+16	4.377e+04	2.063e+06	8.326e+01	3.925e+03
1.0	7.850e+15	9.995e+04	3.028e+06	1.842e+02	5.582e+03
1.5	7.969e+15	1.203e+06	1.807e+07	2.024e+03	3.041e+04
2.0	6.084e+15	4.365e+06	4.371e+07	6.750e+03	6.760e+04
3.0	4.795e+14	2.295e+06	1.417e+07	3.114e+03	1.922e+04
4.0	6.188e+10	9.261e+02	4.289e+03	1.146e+00	5.306e+00
TOTALS:	1.211e+17	8.014e+06	8.170e+07	1.217e+04	1.280e+05

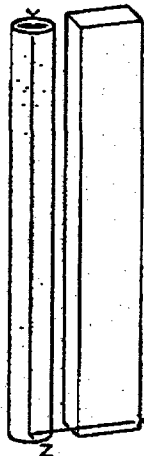
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24RC36.MS5
Run Date: September 21, 2005
Run Time: 10:34:08 AM
Duration: 00:00:34

EC-RADN-1134
Page 62

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Reactor Coolant Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 29.53 cm 11.6 in

Dose Points
1 X 153.4 cm 304.8 cm Z 0 cm
5 ft 0.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.67e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	91.44 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.953 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.2846e-002	8.4530e+008	1.3680e-002	5.0616e+002
Ba-137m	1.8389e+004	6.8041e+014	1.1011e+004	4.0742e+008
Ba-139	6.4179e+003	2.3746e+014	3.8430e+003	1.4219e+008
Ba-140	1.7535e+004	6.4880e+014	1.0500e+004	3.8850e+008
Ce-141	4.0398e+002	1.4947e+013	2.4190e+002	8.9503e+006
Ce-143	3.5972e+002	1.3310e+013	2.1540e+002	7.9698e+006
Ce-144	3.3968e+002	1.2568e+013	2.0340e+002	7.5258e+006
Cm-242	5.9787e+000	2.2121e+011	3.5800e+000	1.3246e+005
Cm-244	3.5054e-001	1.2970e+010	2.0990e-001	7.7663e+003
Co-58	6.6550e+000	2.4624e+011	3.9850e+000	1.4745e+005
Co-60	3.5839e+000	1.3260e+011	2.1460e+000	7.9402e+004
Cs-134	2.5819e+004	9.5528e+014	1.5460e+004	5.7202e+008
Cs-136	8.2081e+003	3.0370e+014	4.9150e+003	1.8186e+008
Cs-137	1.9439e+004	7.1924e+014	1.1640e+004	4.3068e+008
I-131	1.4312e+005	5.2955e+015	8.5700e+004	3.1709e+009
I-132	1.6695e+005	6.1772e+015	9.9970e+004	3.6989e+009
I-133	2.8023e+005	1.0368e+016	1.6780e+005	6.2086e+009
I-134	6.7987e+004	2.5155e+015	4.0710e+004	1.5063e+009
I-135	2.3046e+005	8.5271e+015	1.3800e+005	5.1060e+009
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009
Kr-87	8.1079e+004	2.9999e+015	4.8550e+004	1.7964e+009
Kr-88	2.0591e+005	7.6188e+015	1.2330e+005	4.5621e+009
La-140	4.2469e+002	1.5713e+013	2.5430e+002	9.4091e+006
Kr-85	6.6550e+003	2.4624e+014	3.9850e+003	1.4745e+008
Kr-85m	8.8494e+004	3.2743e+015	5.2990e+004	1.9606e+009

Page : 2
 DOS File: 24RC36.MS5
 Run Date: September 21, 2005
 Run Time: 10:34:08 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 63

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
La-141	1.1234e+002	4.1567e+012	6.7270e+001	2.4890e+006
La-142	6.3711e+001	2.3573e+012	3.8150e+001	1.4115e+006
Mo-99	2.2228e+003	8.2243e+013	1.3310e+003	4.9247e+007
Nb-95	1.7251e+002	6.3830e+012	1.0330e+002	3.8221e+006
Nd-147	6.4914e+001	2.4018e+012	3.8870e+001	1.4382e+006
Np-239	4.6510e+003	1.7209e+014	2.7850e+003	1.0304e+008
Pr-143	1.4501e+002	5.3653e+012	8.6830e+001	3.2127e+006
Pr-144	3.3482e+002	1.2389e+013	2.0049e+002	7.4182e+006
Pu-238	1.0241e+000	3.7890e+010	6.1320e-001	2.2688e+004
Pu-239	1.0879e-001	4.0250e+009	6.5140e-002	2.4102e+003
Pu-240	1.7485e-001	6.4695e+009	1.0470e-001	3.8739e+003
Pu-241	4.3137e+001	1.5961e+012	2.5830e+001	9.5571e+005
Rb-86	2.4299e+002	8.9906e+012	1.4550e+002	5.3835e+006
Rh-103m	1.9271e+003	7.1304e+013	1.1540e+003	4.2696e+007
Rh-105	1.2423e+003	4.5966e+013	7.4390e+002	2.7524e+007
Rh-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Ru-103	1.9322e+003	7.1492e+013	1.1570e+003	4.2809e+007
Ru-105	9.7813e+002	3.6191e+013	5.8570e+002	2.1671e+007
Ru-106	7.7021e+002	2.8498e+013	4.6120e+002	1.7064e+007
Sb-127	2.0808e+003	7.6991e+013	1.2460e+003	4.6102e+007
Sb-129	5.6597e+003	2.0941e+014	3.3890e+003	1.2539e+008
Sr-89	9.2335e+003	3.4164e+014	5.5290e+003	2.0457e+008
Sr-90	1.1780e+003	4.3587e+013	7.0540e+002	2.6100e+007
Sr-91	1.0182e+004	3.7674e+014	6.0970e+003	2.2559e+008
Sr-92	7.4984e+003	2.7744e+014	4.4900e+003	1.6613e+008
Tc-99m	2.0074e+003	7.4272e+013	1.2020e+003	4.4474e+007
Te-127	2.0909e+003	7.7362e+013	1.2520e+003	4.6324e+007
Te-127m	3.5705e+002	1.3211e+013	2.1380e+002	7.9106e+006
Te-129	6.5114e+003	2.4092e+014	3.8990e+003	1.4426e+008
Te-129m	1.4952e+003	5.5321e+013	8.9530e+002	3.3126e+007
Te-131m	4.6126e+003	1.7067e+014	2.7620e+003	1.0219e+008
Te-132	3.4002e+004	1.2581e+015	2.0360e+004	7.5332e+008
Xe-133	9.5208e+005	3.5227e+016	5.7010e+005	2.1094e+010
Xe-135	3.5705e+005	1.3211e+016	2.1380e+005	7.9106e+009
Y-90	2.2261e+001	8.2367e+011	1.3330e+001	4.9321e+005
Y-91	1.2201e+002	4.5144e+012	7.3060e+001	2.7032e+006
Y-92	1.3277e+003	4.9124e+013	7.9500e+002	2.9415e+007
Y-93	8.3735e+001	3.0982e+012	5.0140e+001	1.8552e+006
Zr-95	1.7235e+002	6.3768e+012	1.0320e+002	3.8184e+006
Zr-97	1.5728e+002	5.8195e+012	9.4180e+001	3.4847e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
MeV	photons/sec	MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	8.099e+09	0.000e+00	3.932e-24	0.000e+00	3.373e-25
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 24RC36.MS5
 Run Date: September 21, 2005
 Run Time: 10:34:08 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 64

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		No Buildup	With Buildup	No Buildup	With Buildup
0.02	1.451e+13	0.000e+00	2.135e-20	0.000e+00	7.394e-22
0.03	1.924e+16	2.721e-127	6.128e-16	2.697e-129	6.074e-18
0.04	3.865e+13	2.294e-61	1.249e-17	1.014e-63	5.524e-20
0.05	1.654e+14	4.366e-36	4.436e-16	1.163e-38	1.182e-18
0.06	4.249e+13	1.254e-25	5.654e-16	2.491e-28	1.123e-18
0.08	1.309e+16	6.057e-14	1.755e-09	9.584e-17	2.777e-12
0.1	2.040e+14	4.678e-12	1.068e-07	7.156e-15	1.634e-10
0.15	3.100e+15	3.621e-07	3.769e-03	5.963e-10	6.207e-06
0.2	1.539e+16	9.920e-05	4.603e-01	1.751e-07	8.123e-04
0.3	1.682e+15	1.210e-03	1.567e+00	2.296e-06	2.973e-03
0.4	7.120e+15	1.086e-01	5.773e+01	2.116e-04	1.125e-01
0.5	1.208e+16	1.760e+00	4.929e+02	3.455e-03	9.674e-01
0.6	1.174e+16	1.007e+01	1.724e+03	1.966e-02	3.365e+00
0.8	1.483e+16	1.858e+02	1.566e+04	3.533e-01	2.978e+01
1.0	7.850e+15	7.101e+02	3.610e+04	1.309e+00	6.655e+01
1.5	7.969e+15	1.999e+04	4.605e+05	3.362e+01	7.748e+02
2.0	6.084e+15	1.214e+05	1.759e+06	1.877e+02	2.720e+03
3.0	4.795e+14	1.158e+05	9.713e+05	1.571e+02	1.318e+03
4.0	6.188e+10	6.535e+01	3.957e+02	8.085e-02	4.895e-01
TOTALS:	1.211e+17	2.582e+05	3.245e+06	3.802e+02	4.914e+03

PP&L CALCULATION SHEET

Dept.

Date

Designed By T.F.Mackay

Checked By

PROJECT

Impact Of AST On Current

NUREG-0737 Radiological

Evaluations That Use

TID14844 DBA-LOCA

Releases

Calc. No. EC-RADN-1134

Sh. No. 65

**ATTACHMENT 2
MICROSHIELD COMPUTER CODE OUTPUTS
AST REACTOR COOLANT STEAM**

33 PAGES

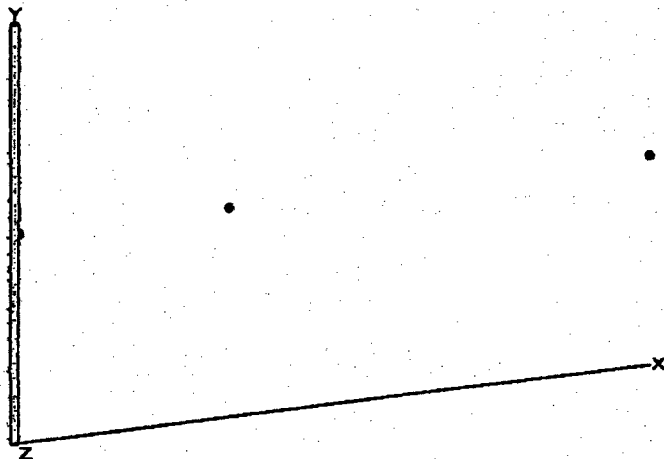
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 4RSUN.MS5
Run Date: September 25, 2005
Run Time: 2:09:57 PM
Duration: 00:01:33

EC-RADN-1134
Page 66

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 4 in Reactor Coolant Steam Unshielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 4.6 cm 1.8 in

Dose Points

	X	Y	Z
# 1	6.71 cm 2.6 in	304.8 cm 10 ft 0.0 in	0 cm 0.0 in
# 2	311.51 cm 10 ft 2.6 in	304.8 cm 10 ft 0.0 in	0 cm 0.0 in
# 3	921.11 cm 30 ft 2.6 in	304.8 cm 10 ft 0.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.05e+04 cm ³	Water	0.035
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	1.11 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	5.4424e-004	2.0137e+007	1.3430e-002	4.9691e+002
Ba-137m	4.0291e+002	1.4908e+013	9.9425e+003	3.6787e+008
Ba-139	1.5282e+002	5.6542e+012	3.7710e+003	1.3953e+008
Ba-140	4.1780e+002	1.5459e+013	1.0310e+004	3.8147e+008
Ce-141	9.6204e+000	3.5595e+011	2.3740e+002	8.7838e+006
Ce-143	8.5667e+000	3.1697e+011	2.1140e+002	7.8218e+006
Ce-144	8.0926e+000	2.9943e+011	1.9970e+002	7.3889e+006
Cm-242	1.4236e-001	5.2673e+009	3.5130e+000	1.2998e+005
Cm-244	8.3479e-003	3.0887e+008	2.0600e-001	7.6220e+003
Co-58	1.5849e-001	5.8641e+009	3.9110e+000	1.4471e+005
Co-60	8.5343e-002	3.1577e+009	2.1060e+000	7.7922e+004
Cs-134	5.6612e+002	2.0946e+013	1.3970e+004	5.1689e+008
Cs-136	1.7997e+002	6.6588e+012	4.4410e+003	1.6432e+008
Cs-137	4.2591e+002	1.5759e+013	1.0510e+004	3.8887e+008
I-131	3.2431e+003	1.2000e+014	8.0030e+004	2.9611e+009
I-132	3.9004e+003	1.4432e+014	9.6250e+004	3.5613e+009
I-133	6.3501e+003	2.3495e+014	1.5670e+005	5.7979e+009
I-134	1.5403e+003	5.6992e+013	3.8010e+004	1.4064e+009
I-135	5.2235e+003	1.9327e+014	1.2890e+005	4.7693e+009
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009
I-133m	6.3501e+003	2.3495e+014	1.5670e+005	5.7979e+009
I-134	1.5403e+003	5.6992e+013	3.8010e+004	1.4064e+009

Page : 2
 DOS File: 4RSUN.MS5
 Run Date: September 25, 2005
 Run Time: 2:09:57 PM
 Duration: 00:01:33

EC-RADN-1134
 Page 67

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
Kr-87	2.4837e+003	9.1897e+013	6.1290e+004	2.2677e+009
Kr-88	6.3055e+003	2.3330e+014	1.5560e+005	5.7572e+009
La-140	9.6325e+000	3.5640e+011	2.3770e+002	8.7949e+006
La-141	2.6754e+000	9.8989e+010	6.6020e+001	2.4427e+006
La-142	1.5172e+000	5.6137e+010	3.7440e+001	1.3853e+006
Mo-99	5.2924e+001	1.9582e+012	1.3060e+003	4.8322e+007
Nb-95	4.1091e+000	1.5204e+011	1.0140e+002	3.7518e+006
Nd-147	1.5456e+000	5.7186e+010	3.8140e+001	1.4112e+006
Np-239	1.1075e+002	4.0978e+012	2.7330e+003	1.0112e+008
Pr-143	3.4526e+000	1.2775e+011	8.5200e+001	3.1524e+006
Pr-144	7.9769e+000	2.9514e+011	1.9684e+002	7.2832e+006
Pu-238	2.4387e-002	9.0233e+008	6.0180e-001	2.2267e+004
Pu-239	2.5903e-003	9.5840e+007	6.3920e-002	2.3650e+003
Pu-240	4.1658e-003	1.5414e+008	1.0280e-001	3.8036e+003
Pu-241	1.0273e+000	3.8009e+010	2.5350e+001	9.3795e+005
Rb-86	5.3248e+000	1.9702e+011	1.3140e+002	4.8618e+006
Rh-103m	4.5874e+001	1.6973e+012	1.1320e+003	4.1885e+007
Rh-105	2.9582e+001	1.0945e+012	7.3000e+002	2.7010e+007
Rh-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Ru-103	4.5995e+001	1.7018e+012	1.1350e+003	4.1995e+007
Ru-105	2.3293e+001	8.6184e+011	5.7480e+002	2.1268e+007
Ru-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Sb-127	4.9520e+001	1.8322e+012	1.2220e+003	4.5214e+007
Sb-129	1.3482e+002	4.9884e+012	3.3270e+003	1.2310e+008
Sr-89	2.1988e+002	8.1356e+012	5.4260e+003	2.0076e+008
Sr-90	2.8055e+001	1.0380e+012	6.9230e+002	2.5615e+007
Sr-91	2.4245e+002	8.9708e+012	5.9830e+003	2.2137e+008
Sr-92	1.7855e+002	6.6063e+012	4.4060e+003	1.6302e+008
Tc-99m	4.7778e+001	1.7678e+012	1.1790e+003	4.3623e+007
Te-127	4.9804e+001	1.8427e+012	1.2290e+003	4.5473e+007
Te-127m	8.5019e+000	3.1457e+011	2.0980e+002	7.7626e+006
Te-129	1.5508e+002	5.7381e+012	3.8270e+003	1.4160e+008
Te-129m	3.5608e+001	1.3175e+012	8.7870e+002	3.2512e+007
Te-131m	1.0982e+002	4.0633e+012	2.7100e+003	1.0027e+008
Te-132	8.1007e+002	2.9973e+013	1.9990e+004	7.3963e+008
Xe-133	2.9116e+004	1.0773e+015	7.1850e+005	2.6584e+010
Xe-135	1.0488e+004	3.8804e+014	2.5880e+005	9.5756e+009
Y-90	5.0979e-001	1.8862e+010	1.2580e+001	4.6546e+005
Y-91	2.9019e+000	1.0737e+011	7.1610e+001	2.6496e+006
Y-92	2.9100e+001	1.0767e+012	7.1810e+002	2.6570e+007
Y-93	1.9942e+000	7.3785e+010	4.9210e+001	1.8208e+006
Zr-95	4.1051e+000	1.5189e+011	1.0130e+002	3.7481e+006
Zr-97	3.7456e+000	1.3859e+011	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results - Dose Point # 1 - (6.71,304.8,0) cm

Circumferential	25
Y Direction (axial)	25

Page : 3
 DOS File: 4RSUN.MS5
 Run Date: September 25, 2005
 Run Time: 2:09:57 PM
 Duration: 00:01:33

EC-RADN-1134
 Page 68

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.929e+08	3.714e-220	3.264e-24	3.186e-221	2.800e-25
0.02	3.454e+11	1.826e-95	1.771e-20	6.326e-97	6.134e-22
0.03	5.766e+14	2.499e-24	6.403e-16	2.477e-26	6.346e-18
0.04	8.808e+11	2.694e-09	4.929e-07	1.192e-11	2.180e-09
0.05	3.940e+12	5.959e-02	1.500e+01	1.587e-04	3.996e-02
0.06	9.403e+11	1.742e+01	3.532e+03	3.460e-02	7.016e+00
0.08	3.991e+14	3.138e+06	2.614e+08	4.966e+03	4.137e+05
0.1	4.958e+12	4.320e+05	1.588e+07	6.610e+02	2.429e+04
0.15	9.230e+13	7.083e+07	7.895e+08	1.166e+05	1.300e+06
0.2	4.460e+14	7.720e+08	5.255e+09	1.363e+06	9.275e+06
0.3	4.204e+13	1.615e+08	6.519e+08	3.064e+05	1.237e+06
0.4	1.757e+14	1.081e+09	3.432e+09	2.107e+06	6.687e+06
0.5	2.755e+14	2.388e+09	6.466e+09	4.688e+06	1.269e+07
0.6	2.737e+14	3.112e+09	7.547e+09	6.073e+06	1.473e+07
0.8	3.506e+14	6.054e+09	1.258e+10	1.151e+07	2.393e+07
1.0	1.844e+14	4.375e+09	8.257e+09	8.064e+06	1.522e+07
1.5	1.932e+14	8.033e+09	1.303e+10	1.351e+07	2.192e+07
2.0	1.757e+14	1.065e+10	1.597e+10	1.647e+07	2.470e+07
3.0	1.468e+13	1.471e+09	2.025e+09	1.995e+06	2.748e+06
4.0	1.474e+09	2.065e+05	2.714e+05	2.555e+02	3.358e+02
TOTALS:	3.211e+15	3.817e+10	7.628e+10	6.622e+07	1.349e+08

Results - Dose Point # 2 - (311.51,304.8,0) cm

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.929e+08	1.135e-216	3.212e-26	9.735e-218	2.755e-27
0.02	3.454e+11	1.220e-94	1.742e-22	4.225e-96	6.035e-24
0.03	5.766e+14	3.423e-25	6.300e-18	3.393e-27	6.243e-20
0.04	8.808e+11	1.168e-10	2.045e-08	5.165e-13	9.046e-11
0.05	3.940e+12	1.667e-03	3.989e-01	4.441e-06	1.063e-03
0.06	9.403e+11	4.001e-01	7.724e+01	7.947e-04	1.534e-01
0.08	3.991e+14	6.064e+04	4.776e+06	9.596e+01	7.558e+03
0.1	4.958e+12	7.654e+03	2.594e+05	1.171e+01	3.968e+02
0.15	9.230e+13	1.128e+06	1.105e+07	1.858e+03	1.820e+04
0.2	4.460e+14	1.176e+07	6.947e+07	2.076e+04	1.226e+05
0.3	4.204e+13	2.366e+06	8.253e+06	4.489e+03	1.566e+04
0.4	1.757e+14	1.552e+07	4.286e+07	3.024e+04	8.352e+04
0.5	2.755e+14	3.379e+07	8.008e+07	6.633e+04	1.572e+05
0.6	2.737e+14	4.352e+07	9.298e+07	8.495e+04	1.815e+05
0.8	3.506e+14	8.313e+07	1.537e+08	1.581e+05	2.923e+05
1.0	1.844e+14	5.919e+07	1.002e+08	1.091e+05	1.848e+05
1.5	1.932e+14	1.058e+08	1.561e+08	1.779e+05	2.627e+05
2.0	1.757e+14	1.378e+08	1.899e+08	2.131e+05	2.937e+05
3.0	1.468e+13	1.864e+07	2.389e+07	2.529e+04	3.242e+04
4.0	1.474e+09	2.590e+03	3.193e+03	3.204e+00	3.950e+00
TOTALS:	3.211e+15	5.127e+08	9.336e+08	8.923e+05	1.653e+06

Results - Dose Point # 3 - (921.11,304.8,0) cm

TOTALS: 3.211e+15 5.127e+08 9.336e+08 8.923e+05 1.653e+06

Page : 4
 DOS File: 4RSUN.MS5
 Run Date: September 25, 2005
 Run Time: 2:09:57 PM
 Duration: 00:01:33

EC-RADN-1134
 Page 69

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.015	1.929e+08	1.351e-217	4.481e-27	1.159e-218	3.844e-28
0.02	3.454e+11	2.490e-95	2.431e-23	8.627e-97	8.421e-25
0.03	5.766e+14	9.111e-26	8.790e-19	9.030e-28	8.711e-21
0.04	8.808e+11	3.119e-11	5.471e-09	1.379e-13	2.420e-11
0.05	3.940e+12	4.057e-04	9.596e-02	1.081e-06	2.556e-04
0.06	9.403e+11	8.679e-02	1.625e+01	1.724e-04	3.227e-02
0.08	3.991e+14	1.096e+04	8.157e+05	1.734e+01	1.291e+03
0.1	4.958e+12	1.250e+03	3.990e+04	1.912e+00	6.104e+01
0.15	9.230e+13	1.677e+05	1.582e+06	2.762e+02	2.605e+03
0.2	4.460e+14	1.704e+06	9.817e+06	3.007e+03	1.733e+04
0.3	4.204e+13	3.379e+05	1.160e+06	6.410e+02	2.201e+03
0.4	1.757e+14	2.207e+06	6.020e+06	4.300e+03	1.173e+04
0.5	2.755e+14	4.795e+06	1.124e+07	9.411e+03	2.206e+04
0.6	2.737e+14	6.168e+06	1.305e+07	1.204e+04	2.547e+04
0.8	3.506e+14	1.176e+07	2.155e+07	2.237e+04	4.100e+04
1.0	1.844e+14	8.364e+06	1.406e+07	1.542e+04	2.591e+04
1.5	1.932e+14	1.492e+07	2.190e+07	2.510e+04	3.684e+04
2.0	1.757e+14	1.943e+07	2.664e+07	3.005e+04	4.119e+04
3.0	1.468e+13	2.629e+06	3.351e+06	3.566e+03	4.546e+03
4.0	1.474e+09	3.654e+02	4.481e+02	4.521e-01	5.543e-01
TOTALS:	3.211e+15	7.249e+07	1.312e+08	1.262e+05	2.322e+05

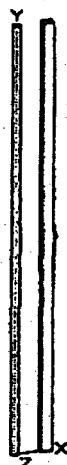
MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 4RS6.MS5
 Run Date: September 25, 2005
 Run Time: 2:09:24 PM
 Duration: 00:00:32

EC-RADN-1134
 Page 70

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 4 in Reactor Coolant Steam Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 4.6 cm 1.8 in

Dose Points
 # 1 X 52.42 cm 304.8 cm Z 0 cm
 1 ft 8.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.05e+04 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	15.24 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.11 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	5.4424e-004	2.0137e+007	1.3430e-002	4.9691e+002
Ba-137m	4.0291e+002	1.4908e+013	9.9425e+003	3.6787e+008
Ba-139	1.5282e+002	5.6542e+012	3.7710e+003	1.3953e+008
Ba-140	4.1780e+002	1.5459e+013	1.0310e+004	3.8147e+008
Ce-141	9.6204e+000	3.5595e+011	2.3740e+002	8.7838e+006
Ce-143	8.5667e+000	3.1697e+011	2.1140e+002	7.8218e+006
Ce-144	8.0926e+000	2.9943e+011	1.9970e+002	7.3889e+006
Cm-242	1.4236e-001	5.2673e+009	3.5130e+000	1.2998e+005
Cm-244	8.3479e-003	3.0887e+008	2.0600e-001	7.6220e+003
Co-58	1.5849e-001	5.8641e+009	3.9110e+000	1.4471e+005
Co-60	8.5343e-002	3.1577e+009	2.1060e+000	7.7922e+004
Cs-134	5.6612e+002	2.0946e+013	1.3970e+004	5.1689e+008
Cs-136	1.7997e+002	6.6588e+012	4.4410e+003	1.6432e+008
Cs-137	4.2591e+002	1.5759e+013	1.0510e+004	3.8887e+008
I-131	3.2431e+003	1.2000e+014	8.0030e+004	2.9611e+009
I-132	3.9004e+003	1.4432e+014	9.6250e+004	3.5613e+009
I-133	6.3501e+003	2.3495e+014	1.5670e+005	5.7979e+009
I-134	1.5403e+003	5.6992e+013	3.8010e+004	1.4064e+009
I-135	5.2235e+003	1.9327e+014	1.2890e+005	4.7693e+009
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009
Kr-87	2.4837e+003	9.1897e+013	6.1290e+004	2.2677e+009
Kr-88	6.3055e+003	2.3330e+014	1.5560e+005	5.7572e+009
La-140	9.6325e+000	3.5640e+011	2.3770e+002	8.7949e+006
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 4RS6.MS5
 Run Date: September 25, 2005
 Run Time: 2:09:24 PM
 Duration: 00:00:32

EC-RADN-1134
 Page 71

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	2.6754e+000	9.8989e+010	6.6020e+001	2.4427e+006
La-142	1.5172e+000	5.6137e+010	3.7440e+001	1.3853e+006
Mo-99	5.2924e+001	1.9582e+012	1.3060e+003	4.8322e+007
Nb-95	4.1091e+000	1.5204e+011	1.0140e+002	3.7518e+006
Nd-147	1.5456e+000	5.7186e+010	3.8140e+001	1.4112e+006
Np-239	1.1075e+002	4.0978e+012	2.7330e+003	1.0112e+008
Pr-143	3.4526e+000	1.2775e+011	8.5200e+001	3.1524e+006
Pr-144	7.9769e+000	2.9514e+011	1.9684e+002	7.2832e+006
Pu-238	2.4387e-002	9.0233e+008	6.0180e-001	2.2267e+004
Pu-239	2.5903e-003	9.5840e+007	6.3920e-002	2.3650e+003
Pu-240	4.1658e-003	1.5414e+008	1.0280e-001	3.8036e+003
Pu-241	1.0273e+000	3.8009e+010	2.5350e+001	9.3795e+005
Rb-86	5.3248e+000	1.9702e+011	1.3140e+002	4.8618e+006
Rh-103m	4.5874e+001	1.6973e+012	1.1320e+003	4.1885e+007
Rh-105	2.9582e+001	1.0945e+012	7.3000e+002	2.7010e+007
Rh-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Ru-103	4.5995e+001	1.7018e+012	1.1350e+003	4.1995e+007
Ru-105	2.3293e+001	8.6184e+011	5.7480e+002	2.1268e+007
Ru-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Sb-127	4.9520e+001	1.8322e+012	1.2220e+003	4.5214e+007
Sb-129	1.3482e+002	4.9884e+012	3.3270e+003	1.2310e+008
Sr-89	2.1988e+002	8.1356e+012	5.4260e+003	2.0076e+008
Sr-90	2.8055e+001	1.0380e+012	6.9230e+002	2.5615e+007
Sr-91	2.4245e+002	8.9708e+012	5.9830e+003	2.2137e+008
Sr-92	1.7855e+002	6.6063e+012	4.4060e+003	1.6302e+008
Tc-99m	4.7778e+001	1.7678e+012	1.1790e+003	4.3623e+007
Te-127	4.9804e+001	1.8427e+012	1.2290e+003	4.5473e+007
Te-127m	8.5019e+000	3.1457e+011	2.0980e+002	7.7626e+006
Te-129	1.5508e+002	5.7381e+012	3.8270e+003	1.4160e+008
Te-129m	3.5608e+001	1.3175e+012	8.7870e+002	3.2512e+007
Te-131m	1.0982e+002	4.0633e+012	2.7100e+003	1.0027e+008
Te-132	8.1007e+002	2.9973e+013	1.9990e+004	7.3963e+008
Xe-133	2.9116e+004	1.0773e+015	7.1850e+005	2.6584e+010
Xe-135	1.0488e+004	3.8804e+014	2.5880e+005	9.5756e+009
Y-90	5.0979e-001	1.8862e+010	1.2580e+001	4.6546e+005
Y-91	2.9019e+000	1.0737e+011	7.1610e+001	2.6496e+006
Y-92	2.9100e+001	1.0767e+012	7.1810e+002	2.6570e+007
Y-93	1.9942e+000	7.3785e+010	4.9210e+001	1.8208e+006
Zr-95	4.1051e+000	1.5189e+011	1.0130e+002	3.7481e+006
Zr-97	3.7456e+000	1.3859e+011	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.929e+08	0.000e+00	3.455e-25	0.000e+00	2.963e-26
<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>

Page : 3
 DOS File: 4RS6.MS5
 Run Date: September 25, 2005
 Run Time: 2:09:24 PM
 Duration: 00:00:32

EC-RADN-1134
 Page 72

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.02	3.454e+11	2.252e-148	1.874e-21	7.801e-150	6.492e-23
0.03	5.766e+14	3.104e-42	6.776e-17	3.076e-44	6.716e-19
0.04	8.808e+11	8.301e-19	3.273e-16	3.671e-21	1.448e-18
0.05	3.940e+12	1.694e-08	1.307e-05	4.514e-11	3.481e-08
0.06	9.403e+11	9.959e-05	8.046e-02	1.978e-07	1.598e-04
0.08	3.991e+14	2.060e+02	1.050e+05	3.259e-01	1.662e+02
0.1	4.958e+12	7.433e+01	2.300e+04	1.137e-01	3.519e+01
0.15	9.230e+13	3.278e+04	4.136e+06	5.399e+01	6.810e+03
0.2	4.460e+14	5.917e+05	4.154e+07	1.044e+03	7.332e+04
0.3	4.204e+13	2.327e+05	7.844e+06	4.414e+02	1.488e+04
0.4	1.757e+14	2.373e+06	4.966e+07	4.624e+03	9.676e+04
0.5	2.755e+14	7.170e+06	1.067e+08	1.407e+04	2.094e+05
0.6	2.737e+14	1.195e+07	1.378e+08	2.332e+04	2.690e+05
0.8	3.506e+14	3.370e+07	2.666e+08	6.410e+04	5.071e+05
1.0	1.844e+14	3.198e+07	1.947e+08	5.896e+04	3.588e+05
1.5	1.932e+14	9.252e+07	3.748e+08	1.557e+05	6.306e+05
2.0	1.757e+14	1.624e+08	5.222e+08	2.512e+05	8.075e+05
3.0	1.468e+13	3.122e+07	7.705e+07	4.236e+04	1.045e+05
4.0	1.474e+09	5.307e+03	1.125e+04	6.566e+00	1.392e+01
TOTALS:	3.211e+15	3.742e+08	1.783e+09	6.158e+05	3.079e+06

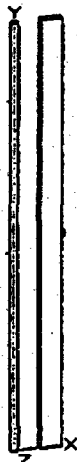
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 4RS12.MS5
Run Date: September 25, 2005
Run Time: 2:07:41 PM
Duration: 00:00:33

EC-RADN-1134
Page 73

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 4 in Reactor Coolant Steam Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 4.6 cm 1.8 in

Dose Points
1 X 67.67 cm Y 304.8 cm Z 0 cm
2 ft 2.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.05e+04 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	30.48 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.11 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	5.4424e-004	2.0137e+007	1.3430e-002	4.9691e+002
Ba-137m	4.0291e+002	1.4908e+013	9.9425e+003	3.6787e+008
Ba-139	1.5282e+002	5.6542e+012	3.7710e+003	1.3953e+008
Ba-140	4.1780e+002	1.5459e+013	1.0310e+004	3.8147e+008
Ce-141	9.6204e+000	3.5595e+011	2.3740e+002	8.7838e+006
Ce-143	8.5667e+000	3.1697e+011	2.1140e+002	7.8218e+006
Ce-144	8.0926e+000	2.9943e+011	1.9970e+002	7.3889e+006
Cm-242	1.4236e-001	5.2673e+009	3.5130e+000	1.2998e+005
Cm-244	8.3479e-003	3.0887e+008	2.0600e-001	7.6220e+003
Co-58	1.5849e-001	5.8641e+009	3.9110e+000	1.4471e+005
Co-60	8.5343e-002	3.1577e+009	2.1060e+000	7.7922e+004
Cs-134	5.6612e+002	2.0946e+013	1.3970e+004	5.1689e+008
Cs-136	1.7997e+002	6.6588e+012	4.4410e+003	1.6432e+008
Cs-137	4.2591e+002	1.5759e+013	1.0510e+004	3.8887e+008
I-131	3.2431e+003	1.2000e+014	8.0030e+004	2.9611e+009
I-132	3.9004e+003	1.4432e+014	9.6250e+004	3.5613e+009
I-133	6.3501e+003	2.3495e+014	1.5670e+005	5.7979e+009
I-134	1.5403e+003	5.6992e+013	3.8010e+004	1.4064e+009
I-135	5.2235e+003	1.9327e+014	1.2890e+005	4.7693e+009
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009
Kr-87	2.4837e+003	9.1897e+013	6.1290e+004	2.2677e+009
Kr-88	6.3055e+003	2.3330e+014	1.5560e+005	5.7572e+009
La-140	9.6325e+000	3.5640e+011	2.3770e+002	8.7949e+006
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 4RS12.MS5
 Run Date: September 25, 2005
 Run Time: 2:07:41 PM
 Duration: 00:00:33

EC-RADN-1134
 Page 74

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	2.6754e+000	9.8989e+010	6.6020e+001	2.4427e+006
La-142	1.5172e+000	5.6137e+010	3.7440e+001	1.3853e+006
Mo-99	5.2924e+001	1.9582e+012	1.3060e+003	4.8322e+007
Nb-95	4.1091e+000	1.5204e+011	1.0140e+002	3.7518e+006
Nd-147	1.5456e+000	5.7186e+010	3.8140e+001	1.4112e+006
Np-239	1.1075e+002	4.0978e+012	2.7330e+003	1.0112e+008
Pr-143	3.4526e+000	1.2775e+011	8.5200e+001	3.1524e+006
Pr-144	7.9769e+000	2.9514e+011	1.9684e+002	7.2832e+006
Pu-238	2.4387e-002	9.0233e+008	6.0180e-001	2.2267e+004
Pu-239	2.5903e-003	9.5840e+007	6.3920e-002	2.3650e+003
Pu-240	4.1658e-003	1.5414e+008	1.0280e-001	3.8036e+003
Pu-241	1.0273e+000	3.8009e+010	2.5350e+001	9.3795e+005
Rb-86	5.3248e+000	1.9702e+011	1.3140e+002	4.8618e+006
Rh-103m	4.5874e+001	1.6973e+012	1.1320e+003	4.1885e+007
Rh-105	2.9582e+001	1.0945e+012	7.3000e+002	2.7010e+007
Rh-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Ru-103	4.5995e+001	1.7018e+012	1.1350e+003	4.1995e+007
Ru-105	2.3293e+001	8.6184e+011	5.7480e+002	2.1268e+007
Ru-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Sb-127	4.9520e+001	1.8322e+012	1.2220e+003	4.5214e+007
Sb-129	1.3482e+002	4.9884e+012	3.3270e+003	1.2310e+008
Sr-89	2.1988e+002	8.1356e+012	5.4260e+003	2.0076e+008
Sr-90	2.8055e+001	1.0380e+012	6.9230e+002	2.5615e+007
Sr-91	2.4245e+002	8.9708e+012	5.9830e+003	2.2137e+008
Sr-92	1.7855e+002	6.6063e+012	4.4060e+003	1.6302e+008
Tc-99m	4.7778e+001	1.7678e+012	1.1790e+003	4.3623e+007
Te-127	4.9804e+001	1.8427e+012	1.2290e+003	4.5473e+007
Te-127m	8.5019e+000	3.1457e+011	2.0980e+002	7.7626e+006
Te-129	1.5508e+002	5.7381e+012	3.8270e+003	1.4160e+008
Te-129m	3.5608e+001	1.3175e+012	8.7870e+002	3.2512e+007
Te-131m	1.0982e+002	4.0633e+012	2.7100e+003	1.0027e+008
Te-132	8.1007e+002	2.9973e+013	1.9990e+004	7.3963e+008
Xe-133	2.9116e+004	1.0773e+015	7.1850e+005	2.6584e+010
Xe-135	1.0488e+004	3.8804e+014	2.5880e+005	9.5756e+009
Y-90	5.0979e-001	1.8862e+010	1.2580e+001	4.6546e+005
Y-91	2.9019e+000	1.0737e+011	7.1610e+001	2.6496e+006
Y-92	2.9100e+001	1.0767e+012	7.1810e+002	2.6570e+007
Y-93	1.9942e+000	7.3785e+010	4.9210e+001	1.8208e+006
Zr-95	4.1051e+000	1.5189e+011	1.0130e+002	3.7481e+006
Zr-97	3.7456e+000	1.3859e+011	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Results</u>			
		<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.929e+08	0.000e+00	2.583e-25	0.000e+00	2.216e-26
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 4RS12.MS5
 Run Date: September 25, 2005
 Run Time: 2:07:41 PM
 Duration: 00:00:33

EC-RADN-1134
 Page 75

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	3.454e+11	3.747e-203	1.401e-21	1.298e-204	4.854e-23
0.03	5.766e+14	3.475e-60	5.067e-17	3.444e-62	5.021e-19
0.04	8.808e+11	7.970e-28	7.850e-19	3.525e-30	3.472e-21
0.05	3.940e+12	2.327e-14	4.085e-11	6.200e-17	1.088e-13
0.06	9.403e+11	3.414e-09	7.500e-06	6.782e-12	1.490e-08
0.08	3.991e+14	9.938e-02	1.645e+02	1.573e-04	2.603e-01
0.1	4.958e+12	1.030e-01	1.151e+02	1.576e-04	1.762e-01
0.15	9.230e+13	1.333e+02	6.407e+04	2.195e-01	1.055e+02
0.2	4.460e+14	4.074e+03	1.031e+06	7.190e+00	1.820e+03
0.3	4.204e+13	3.022e+03	3.176e+05	5.733e+00	6.025e+02
0.4	1.757e+14	4.662e+04	2.692e+06	9.084e+01	5.245e+03
0.5	2.755e+14	1.911e+05	7.150e+06	3.752e+02	1.403e+04
0.6	2.737e+14	4.043e+05	1.082e+07	7.891e+02	2.111e+04
0.8	3.506e+14	1.630e+06	2.696e+07	3.101e+03	5.128e+04
1.0	1.844e+14	2.009e+06	2.349e+07	3.703e+03	4.329e+04
1.5	1.932e+14	8.949e+06	6.126e+07	1.506e+04	1.031e+05
2.0	1.757e+14	2.044e+07	1.027e+08	3.161e+04	1.588e+05
3.0	1.468e+13	5.339e+06	1.873e+07	7.243e+03	2.541e+04
4.0	1.474e+09	1.080e+03	3.067e+03	1.336e+00	3.794e+00
TOTALS:	3.211e+15	3.901e+07	2.552e+08	6.198e+04	4.248e+05

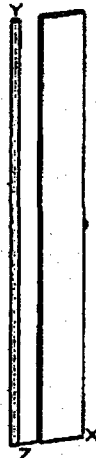
MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 4RS24.MS5
 Run Date: September 25, 2005
 Run Time: 2:08:15 PM
 Duration: 00:00:34

EC-RADN-1134
 Page 76

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 4 in Reactor Coolant Steam Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 4.6 cm 1.8 in

Dose Points
 # 1 X 98.15 cm 304.8 cm Z 0 cm
 3 ft 2.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.05e+04 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	60.96 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.11 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	5.4424e-004	2.0137e+007	1.3430e-002	4.9691e+002
Ba-137m	4.0291e+002	1.4908e+013	9.9425e+003	3.6787e+008
Ba-139	1.5282e+002	5.6542e+012	3.7710e+003	1.3953e+008
Ba-140	4.1780e+002	1.5459e+013	1.0310e+004	3.8147e+008
Ce-141	9.6204e+000	3.5595e+011	2.3740e+002	8.7838e+006
Ce-143	8.5667e+000	3.1697e+011	2.1140e+002	7.8218e+006
Ce-144	8.0926e+000	2.9943e+011	1.9970e+002	7.3889e+006
Cm-242	1.4236e-001	5.2673e+009	3.5130e+000	1.2998e+005
Cm-244	8.3479e-003	3.0887e+008	2.0600e-001	7.6220e+003
Co-58	1.5849e-001	5.8641e+009	3.9110e+000	1.4471e+005
Co-60	8.5343e-002	3.1577e+009	2.1060e+000	7.7922e+004
Cs-134	5.6612e+002	2.0946e+013	1.3970e+004	5.1689e+008
Cs-136	1.7997e+002	6.6588e+012	4.4410e+003	1.6432e+008
Cs-137	4.2591e+002	1.5759e+013	1.0510e+004	3.8887e+008
I-131	3.2431e+003	1.2000e+014	8.0030e+004	2.9611e+009
I-132	3.9004e+003	1.4432e+014	9.6250e+004	3.5613e+009
I-133	6.3501e+003	2.3495e+014	1.5670e+005	5.7979e+009
I-134	1.5403e+003	5.6992e+013	3.8010e+004	1.4064e+009
I-135	5.2235e+003	1.9327e+014	1.2890e+005	4.7693e+009
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009
Kr-87	2.4837e+003	9.1897e+013	6.1290e+004	2.2677e+009
Kr-88	6.3055e+003	2.3330e+014	1.5560e+005	5.7572e+009
La-140	9.6325e+000	3.5640e+011	2.3770e+002	8.7949e+006
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 4RS24.MS5
 Run Date: September 25, 2005
 Run Time: 2:08:15 PM
 Duration: 00:00:34

EC-RADN-1134
 Page 77

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	2.6754e+000	9.8989e+010	6.6020e+001	2.4427e+006
La-142	1.5172e+000	5.6137e+010	3.7440e+001	1.3853e+006
Mo-99	5.2924e+001	1.9582e+012	1.3060e+003	4.8322e+007
Nb-95	4.1091e+000	1.5204e+011	1.0140e+002	3.7518e+006
Nd-147	1.5456e+000	5.7186e+010	3.8140e+001	1.4112e+006
Np-239	1.1075e+002	4.0978e+012	2.7330e+003	1.0112e+008
Pr-143	3.4526e+000	1.2775e+011	8.5200e+001	3.1524e+006
Pr-144	7.9769e+000	2.9514e+011	1.9684e+002	7.2832e+006
Pu-238	2.4387e-002	9.0233e+008	6.0180e-001	2.2267e+004
Pu-239	2.5903e-003	9.5840e+007	6.3920e-002	2.3650e+003
Pu-240	4.1658e-003	1.5414e+008	1.0280e-001	3.8036e+003
Pu-241	1.0273e+000	3.8009e+010	2.5350e+001	9.3795e+005
Rb-86	5.3248e+000	1.9702e+011	1.3140e+002	4.8618e+006
Rh-103m	4.5874e+001	1.6973e+012	1.1320e+003	4.1885e+007
Rh-105	2.9582e+001	1.0945e+012	7.3000e+002	2.7010e+007
Rh-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Ru-103	4.5995e+001	1.7018e+012	1.1350e+003	4.1995e+007
Ru-105	2.3293e+001	8.6184e+011	5.7480e+002	2.1268e+007
Ru-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Sb-127	4.9520e+001	1.8322e+012	1.2220e+003	4.5214e+007
Sb-129	1.3482e+002	4.9884e+012	3.3270e+003	1.2310e+008
Sr-89	2.1988e+002	8.1356e+012	5.4260e+003	2.0076e+008
Sr-90	2.8055e+001	1.0380e+012	6.9230e+002	2.5615e+007
Sr-91	2.4245e+002	8.9708e+012	5.9830e+003	2.2137e+008
Sr-92	1.7855e+002	6.6063e+012	4.4060e+003	1.6302e+008
Tc-99m	4.7778e+001	1.7678e+012	1.1790e+003	4.3623e+007
Te-127	4.9804e+001	1.8427e+012	1.2290e+003	4.5473e+007
Te-127m	8.5019e+000	3.1457e+011	2.0980e+002	7.7626e+006
Te-129	1.5508e+002	5.7381e+012	3.8270e+003	1.4160e+008
Te-129m	3.5608e+001	1.3175e+012	8.7870e+002	3.2512e+007
Te-131m	1.0982e+002	4.0633e+012	2.7100e+003	1.0027e+008
Te-132	8.1007e+002	2.9973e+013	1.9990e+004	7.3963e+008
Xe-133	2.9116e+004	1.0773e+015	7.1850e+005	2.6584e+010
Xe-135	1.0488e+004	3.8804e+014	2.5880e+005	9.5756e+009
Y-90	5.0979e-001	1.8862e+010	1.2580e+001	4.6546e+005
Y-91	2.9019e+000	1.0737e+011	7.1610e+001	2.6496e+006
Y-92	2.9100e+001	1.0767e+012	7.1810e+002	2.6570e+007
Y-93	1.9942e+000	7.3785e+010	4.9210e+001	1.8208e+006
Zr-95	4.1051e+000	1.5189e+011	1.0130e+002	3.7481e+006
Zr-97	3.7456e+000	1.3859e+011	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.929e+08	0.000e+00	1.658e-25	0.000e+00	1.422e-26
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 4RS24.MS5
 Run Date: September 25, 2005
 Run Time: 2:08:15 PM
 Duration: 00:00:34

EC-RADN-1134
 Page 78

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	3.454e+11	1.285e-312	8.993e-22	4.452e-314	3.115e-23
0.03	5.766e+14	5.731e-96	3.252e-17	5.680e-98	3.223e-19
0.04	8.808e+11	9.342e-46	5.038e-19	4.132e-48	2.228e-21
0.05	3.940e+12	5.661e-26	1.871e-17	1.508e-28	4.983e-20
0.06	9.403e+11	5.280e-18	4.659e-14	1.049e-20	9.254e-17
0.08	3.991e+14	3.138e-08	2.734e-04	4.965e-11	4.326e-07
0.1	4.958e+12	2.739e-07	1.763e-03	4.190e-10	2.698e-06
0.15	9.230e+13	3.115e-03	8.599e+00	5.129e-06	1.416e-02
0.2	4.460e+14	2.741e-01	3.577e+02	4.838e-04	6.313e-01
0.3	4.204e+13	7.232e-01	3.186e+02	1.372e-03	6.044e-01
0.4	1.757e+14	2.544e+01	5.235e+03	4.957e-02	1.020e+01
0.5	2.755e+14	1.913e+02	2.258e+04	3.755e-01	4.433e+01
0.6	2.737e+14	6.496e+02	5.022e+04	1.268e+00	9.803e+01
0.8	3.506e+14	5.324e+03	2.212e+05	1.013e+01	4.207e+02
1.0	1.844e+14	1.100e+04	2.951e+05	2.028e+01	5.440e+02
1.5	1.932e+14	1.150e+05	1.543e+06	1.935e+02	2.596e+03
2.0	1.757e+14	4.409e+05	3.975e+06	6.819e+02	6.146e+03
3.0	1.468e+13	2.100e+05	1.181e+06	2.850e+02	1.603e+03
4.0	1.474e+09	5.965e+01	2.541e+02	7.379e-02	3.143e-01
TOTALS:	3.211e+15	7.832e+05	7.294e+06	1.193e+03	1.146e+04

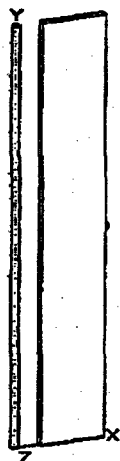
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 4RS36.MS5
Run Date: September 25, 2005
Run Time: 2:08:49 PM
Duration: 00:00:34

EC-RADN-1134
Page 79

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 4 in Reactor Coolant Steam Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 4.6 cm 1.8 in

Dose Points
1 X Y Z
128.63 cm 304.8 cm 0 cm
4 ft 2.6 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.05e+04 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	91.44 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.11 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	5.4424e-004	2.0137e+007	1.3430e-002	4.9691e+002
Ba-137m	4.0291e+002	1.4908e+013	9.9425e+003	3.6787e+008
Ba-139	1.5282e+002	5.6542e+012	3.7710e+003	1.3953e+008
Ba-140	4.1780e+002	1.5459e+013	1.0310e+004	3.8147e+008
Ce-141	9.6204e+000	3.5595e+011	2.3740e+002	8.7838e+006
Ce-143	8.5667e+000	3.1697e+011	2.1140e+002	7.8218e+006
Ce-144	8.0926e+000	2.9943e+011	1.9970e+002	7.3889e+006
Cm-242	1.4236e-001	5.2673e+009	3.5130e+000	1.2998e+005
Cm-244	8.3479e-003	3.0887e+008	2.0600e-001	7.6220e+003
Co-58	1.5849e-001	5.8641e+009	3.9110e+000	1.4471e+005
Co-60	8.5343e-002	3.1577e+009	2.1060e+000	7.7922e+004
Cs-134	5.6612e+002	2.0946e+013	1.3970e+004	5.1689e+008
Cs-136	1.7997e+002	6.6588e+012	4.4410e+003	1.6432e+008
Cs-137	4.2591e+002	1.5759e+013	1.0510e+004	3.8887e+008
I-131	3.2431e+003	1.2000e+014	8.0030e+004	2.9611e+009
I-132	3.9004e+003	1.4432e+014	9.6250e+004	3.5613e+009
I-133	6.3501e+003	2.3495e+014	1.5670e+005	5.7979e+009
I-134	1.5403e+003	5.6992e+013	3.8010e+004	1.4064e+009
I-135	5.2235e+003	1.9327e+014	1.2890e+005	4.7693e+009
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009
Kr-87	2.4837e+003	9.1897e+013	6.1290e+004	2.2677e+009
Kr-88	6.3055e+003	2.3330e+014	1.5560e+005	5.7572e+009
La-140	2.6325e+000	7.5434e+011	2.3770e+002	8.7949e+006
Kr-85	2.0388e+002	7.5434e+012	5.0310e+003	1.8615e+008
Kr-85m	2.7110e+003	1.0031e+014	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 4RS36.MS5
 Run Date: September 25, 2005
 Run Time: 2:08:49 PM
 Duration: 00:00:34

EC-RADN-1134
 Page 80

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	2.6754e+000	9.8989e+010	6.6020e+001	2.4427e+006
La-142	1.5172e+000	5.6137e+010	3.7440e+001	1.3853e+006
Mo-99	5.2924e+001	1.9582e+012	1.3060e+003	4.8322e+007
Nb-95	4.1091e+000	1.5204e+011	1.0140e+002	3.7518e+006
Nd-147	1.5456e+000	5.7186e+010	3.8140e+001	1.4112e+006
Np-239	1.1075e+002	4.0978e+012	2.7330e+003	1.0112e+008
Pr-143	3.4526e+000	1.2775e+011	8.5200e+001	3.1524e+006
Pr-144	7.9769e+000	2.9514e+011	1.9684e+002	7.2832e+006
Pu-238	2.4387e-002	9.0233e+008	6.0180e-001	2.2267e+004
Pu-239	2.5903e-003	9.5840e+007	6.3920e-002	2.3650e+003
Pu-240	4.1658e-003	1.5414e+008	1.0280e-001	3.8036e+003
Pu-241	1.0273e+000	3.8009e+010	2.5350e+001	9.3795e+005
Rb-86	5.3248e+000	1.9702e+011	1.3140e+002	4.8618e+006
Rh-103m	4.5874e+001	1.6973e+012	1.1320e+003	4.1885e+007
Rh-105	2.9582e+001	1.0945e+012	7.3000e+002	2.7010e+007
Rh-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Ru-103	4.5995e+001	1.7018e+012	1.1350e+003	4.1995e+007
Ru-105	2.3293e+001	8.6184e+011	5.7480e+002	2.1268e+007
Ru-106	1.8341e+001	6.7862e+011	4.5260e+002	1.6746e+007
Sb-127	4.9520e+001	1.8322e+012	1.2220e+003	4.5214e+007
Sb-129	1.3482e+002	4.9884e+012	3.3270e+003	1.2310e+008
Sr-89	2.1988e+002	8.1356e+012	5.4260e+003	2.0076e+008
Sr-90	2.8055e+001	1.0380e+012	6.9230e+002	2.5615e+007
Sr-91	2.4245e+002	8.9708e+012	5.9830e+003	2.2137e+008
Sr-92	1.7855e+002	6.6063e+012	4.4060e+003	1.6302e+008
Tc-99m	4.7778e+001	1.7678e+012	1.1790e+003	4.3623e+007
Te-127	4.9804e+001	1.8427e+012	1.2290e+003	4.5473e+007
Te-127m	8.5019e+000	3.1457e+011	2.0980e+002	7.7626e+006
Te-129	1.5508e+002	5.7381e+012	3.8270e+003	1.4160e+008
Te-129m	3.5608e+001	1.3175e+012	8.7870e+002	3.2512e+007
Te-131m	1.0982e+002	4.0633e+012	2.7100e+003	1.0027e+008
Te-132	8.1007e+002	2.9973e+013	1.9990e+004	7.3963e+008
Xe-133	2.9116e+004	1.0773e+015	7.1850e+005	2.6584e+010
Xe-135	1.0488e+004	3.8804e+014	2.5880e+005	9.5756e+009
Y-90	5.0979e-001	1.8862e+010	1.2580e+001	4.6546e+005
Y-91	2.9019e+000	1.0737e+011	7.1610e+001	2.6496e+006
Y-92	2.9100e+001	1.0767e+012	7.1810e+002	2.6570e+007
Y-93	1.9942e+000	7.3785e+010	4.9210e+001	1.8208e+006
Zr-95	4.1051e+000	1.5189e+011	1.0130e+002	3.7481e+006
Zr-97	3.7456e+000	1.3859e+011	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.929e+08	0.000e+00	1.177e-25	0.000e+00	1.009e-26
		<u>Results</u>	<u>Results</u>	<u>Results</u>	<u>Results</u>
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 4RS36.MS5
 Run Date: September 25, 2005
 Run Time: 2:08:49 PM
 Duration: 00:00:34

EC-RADN-1134
 Page 81

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	3.454e+11	0.000e+00	6.383e-22	0.000e+00	2.211e-23
0.03	5.766e+14	1.137e-131	2.308e-17	1.127e-133	2.287e-19
0.04	8.808e+11	1.287e-63	3.576e-19	5.693e-66	1.581e-21
0.05	3.940e+12	1.640e-37	1.328e-17	4.370e-40	3.537e-20
0.06	9.403e+11	9.815e-27	1.572e-17	1.950e-29	3.122e-20
0.08	3.991e+14	1.203e-14	3.396e-10	1.904e-17	5.375e-13
0.1	4.958e+12	8.898e-13	1.928e-08	1.361e-15	2.950e-11
0.15	9.230e+13	8.954e-08	8.471e-04	1.475e-10	1.395e-06
0.2	4.460e+14	2.273e-05	9.465e-02	4.011e-08	1.670e-04
0.3	4.204e+13	2.131e-04	2.490e-01	4.043e-07	4.723e-04
0.4	1.757e+14	1.707e-02	8.219e+00	3.327e-05	1.601e-02
0.5	2.755e+14	2.352e-01	5.976e+01	4.617e-04	1.173e-01
0.6	2.737e+14	1.281e+00	1.997e+02	2.500e-03	3.897e-01
0.8	3.506e+14	2.129e+01	1.637e+03	4.050e-02	3.114e+00
1.0	1.844e+14	7.362e+01	3.428e+03	1.357e-01	6.319e+00
1.5	1.932e+14	1.799e+03	3.821e+04	3.027e+00	6.429e+01
2.0	1.757e+14	1.154e+04	1.547e+05	1.785e+01	2.393e+02
3.0	1.468e+13	9.976e+03	7.799e+04	1.353e+01	1.058e+02
4.0	1.474e+09	3.962e+00	2.250e+01	4.902e-03	2.784e-02
TOTALS:	3.211e+15	2.342e+04	2.763e+05	3.459e+01	4.193e+02

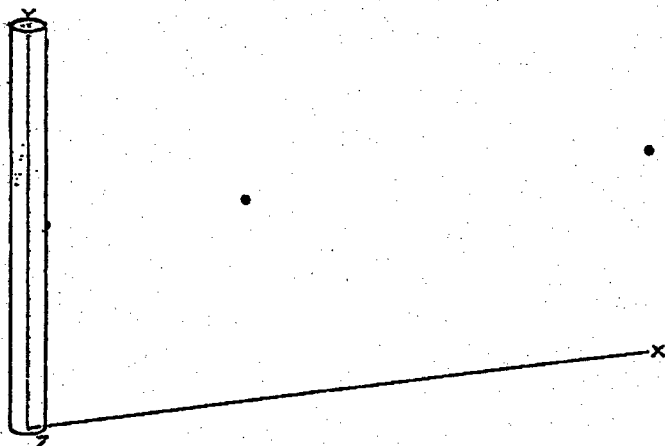
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 20RSUN.MS5
Run Date: September 25, 2005
Run Time: 2:06:09 PM
Duration: 00:01:32

EC-RADN-1134
Page 82

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 20 in Reactor Coolant Steam Unshielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 24.45 cm 9.6 in

Dose Points

	X	Y	Z
# 1	26.4 cm	304.8 cm	0 cm
	10.4 in	10 ft 0.0 in	0.0 in
# 2	331.2 cm	304.8 cm	0 cm
	10 ft 10.4 in	10 ft 0.0 in	0.0 in
# 3	940.9 cm	304.8 cm	0 cm
	30 ft 10.4 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.14e+06 cm ³	Water	0.035
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.95 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5375e-002	5.6889e+008	1.3430e-002	4.9691e+002
Ba-137m	1.1383e+004	4.2116e+014	9.9425e+003	3.6787e+008
Ba-139	4.3173e+003	1.5974e+014	3.7710e+003	1.3953e+008
Ba-140	1.1804e+004	4.3673e+014	1.0310e+004	3.8147e+008
Ce-141	2.7179e+002	1.0056e+013	2.3740e+002	8.7838e+006
Ce-143	2.4202e+002	8.9549e+012	2.1140e+002	7.8218e+006
Ce-144	2.2863e+002	8.4593e+012	1.9970e+002	7.3889e+006
Cm-242	4.0219e+000	1.4881e+011	3.5130e+000	1.2998e+005
Cm-244	2.3584e-001	8.7261e+009	2.0600e-001	7.6220e+003
Co-58	4.4775e+000	1.6567e+011	3.9110e+000	1.4471e+005
Co-60	2.4111e+000	8.9210e+010	2.1060e+000	7.7922e+004
Cs-134	1.5994e+004	5.9177e+014	1.3970e+004	5.1689e+008
Cs-136	5.0843e+003	1.8812e+014	4.4410e+003	1.6432e+008
Cs-137	1.2032e+004	4.4520e+014	1.0510e+004	3.8887e+008
I-131	9.1623e+004	3.3901e+015	8.0030e+004	2.9611e+009
I-132	1.1019e+005	4.0771e+015	9.6250e+004	3.5613e+009
I-133	1.7940e+005	6.6378e+015	1.5670e+005	5.7979e+009
I-134	4.3516e+004	1.6101e+015	3.8010e+004	1.4064e+009
I-135	1.4757e+005	5.4602e+015	1.2890e+005	4.7693e+009
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6940e+004	6.8338e+015	1.5890e+005	5.7579e+009
I-134m	4.3516e+004	1.6101e+015	3.8010e+004	1.4064e+009

Page : 2
 DOS File: 20RSUN.MS5
 Run Date: September 25, 2005
 Run Time: 2:06:09 PM
 Duration: 00:01:32

EC-RADN-1134
 Page 83

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Kr-87	7.0168e+004	2.5962e+015	6.1290e+004	2.2677e+009
Kr-88	1.7814e+005	6.5912e+015	1.5560e+005	5.7572e+009
La-140	2.7213e+002	1.0069e+013	2.3770e+002	8.7949e+006
La-141	7.5584e+001	2.7966e+012	6.6020e+001	2.4427e+006
La-142	4.2864e+001	1.5860e+012	3.7440e+001	1.3853e+006
Mo-99	1.4952e+003	5.5322e+013	1.3060e+003	4.8322e+007
Nb-95	1.1609e+002	4.2953e+012	1.0140e+002	3.7518e+006
Nd-147	4.3665e+001	1.6156e+012	3.8140e+001	1.4112e+006
Np-239	3.1289e+003	1.1577e+014	2.7330e+003	1.0112e+008
Pr-143	9.7542e+001	3.6091e+012	8.5200e+001	3.1524e+006
Pr-144	2.2536e+002	8.3383e+012	1.9684e+002	7.2832e+006
Pu-238	6.8898e-001	2.5492e+010	6.0180e-001	2.2267e+004
Pu-239	7.3179e-002	2.7076e+009	6.3920e-002	2.3650e+003
Pu-240	1.1769e-001	4.3546e+009	1.0280e-001	3.8036e+003
Pu-241	2.9022e+001	1.0738e+012	2.5350e+001	9.3795e+005
Rb-86	1.5043e+002	5.5661e+012	1.3140e+002	4.8618e+006
Rh-103m	1.2960e+003	4.7952e+013	1.1320e+003	4.1885e+007
Rh-105	8.3575e+002	3.0923e+013	7.3000e+002	2.7010e+007
Rh-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Ru-103	1.2994e+003	4.8078e+013	1.1350e+003	4.1995e+007
Ru-105	6.5807e+002	2.4348e+013	5.7480e+002	2.1268e+007
Ru-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Sb-127	1.3990e+003	5.1764e+013	1.2220e+003	4.5214e+007
Sb-129	3.8090e+003	1.4093e+014	3.3270e+003	1.2310e+008
Sr-89	6.2120e+003	2.2984e+014	5.4260e+003	2.0076e+008
Sr-90	7.9259e+002	2.9326e+013	6.9230e+002	2.5615e+007
Sr-91	6.8497e+003	2.5344e+014	5.9830e+003	2.2137e+008
Sr-92	5.0443e+003	1.8664e+014	4.4060e+003	1.6302e+008
Tc-99m	1.3498e+003	4.9942e+013	1.1790e+003	4.3623e+007
Te-127	1.4070e+003	5.2060e+013	1.2290e+003	4.5473e+007
Te-127m	2.4019e+002	8.8871e+012	2.0980e+002	7.7626e+006
Te-129	4.3814e+003	1.6211e+014	3.8270e+003	1.4160e+008
Te-129m	1.0060e+003	3.7222e+013	8.7870e+002	3.2512e+007
Te-131m	3.1026e+003	1.1480e+014	2.7100e+003	1.0027e+008
Te-132	2.2886e+004	8.4677e+014	1.9990e+004	7.3963e+008
Xe-133	8.2258e+005	3.0436e+016	7.1850e+005	2.6584e+010
Xe-135	2.9629e+005	1.0963e+016	2.5880e+005	9.5756e+009
Y-90	1.4402e+001	5.3289e+011	1.2580e+001	4.6546e+005
Y-91	8.1983e+001	3.0334e+012	7.1610e+001	2.6496e+006
Y-92	8.2212e+002	3.0419e+013	7.1810e+002	2.6570e+007
Y-93	5.6339e+001	2.0845e+012	4.9210e+001	1.8208e+006
Zr-95	1.1597e+002	4.2911e+012	1.0130e+002	3.7481e+006
Zr-97	1.0582e+002	3.9153e+012	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results - Dose Point # 1 - (26.4,304.8,0) cm

Circumferential	25
Y Direction (axial)	25

Page : 3
 DOS File: 20RSUN.MS5
 Run Date: September 25, 2005
 Run Time: 2:06:09 PM
 Duration: 00:01:32

EC-RADN-1134
 Page 84

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	5.449e+09	4.236e-184	2.449e-23	3.634e-185	2.101e-24
0.02	9.759e+12	1.180e-78	1.329e-19	4.088e-80	4.602e-21
0.03	1.629e+16	2.005e-18	4.809e-15	1.987e-20	4.766e-17
0.04	2.488e+13	2.841e-06	3.974e-04	1.256e-08	1.757e-06
0.05	1.113e+14	5.534e+00	1.022e+03	1.474e-02	2.722e+00
0.06	2.656e+13	5.529e+02	8.263e+04	1.098e+00	1.641e+02
0.08	1.128e+16	4.297e+07	2.795e+09	6.800e+04	4.424e+06
0.1	1.401e+14	4.438e+06	1.354e+08	6.790e+03	2.072e+05
0.15	2.608e+15	5.955e+08	6.131e+09	9.806e+05	1.010e+07
0.2	1.260e+16	6.197e+09	4.028e+10	1.094e+07	7.109e+07
0.3	1.188e+15	1.265e+09	4.999e+09	2.399e+06	9.483e+06
0.4	4.964e+15	8.405e+09	2.633e+10	1.638e+07	5.131e+07
0.5	7.784e+15	1.850e+10	4.965e+10	3.632e+07	9.746e+07
0.6	7.733e+15	2.406e+10	5.798e+10	4.697e+07	1.132e+08
0.8	9.905e+15	4.672e+10	9.672e+10	8.887e+07	1.840e+08
1.0	5.209e+15	3.373e+10	6.351e+10	6.217e+07	1.171e+08
1.5	5.459e+15	6.187e+10	1.002e+11	1.041e+08	1.686e+08
2.0	4.964e+15	8.209e+10	1.229e+11	1.269e+08	1.901e+08
3.0	4.147e+14	1.135e+10	1.560e+10	1.540e+07	2.117e+07
4.0	4.163e+10	1.597e+06	2.093e+06	1.975e+03	2.590e+03
TOTALS:	9.070e+16	2.948e+11	5.873e+11	5.116e+08	1.038e+09

Results - Dose Point # 2 - (331.2,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	5.449e+09	7.738e-185	8.210e-25	6.638e-186	7.042e-26
0.02	9.759e+12	1.239e-79	4.454e-21	4.292e-81	1.543e-22
0.03	1.629e+16	1.647e-19	1.618e-16	1.633e-21	1.604e-18
0.04	2.488e+13	2.209e-07	3.088e-05	9.768e-10	1.366e-07
0.05	1.113e+14	4.156e-01	7.668e+01	1.107e-03	2.043e-01
0.06	2.656e+13	4.022e+01	5.972e+03	7.989e-02	1.186e+01
0.08	1.128e+16	2.899e+06	1.804e+08	4.587e+03	2.855e+05
0.1	1.401e+14	2.783e+05	7.722e+06	4.258e+02	1.181e+04
0.15	2.608e+15	3.335e+07	2.908e+08	5.492e+04	4.789e+05
0.2	1.260e+16	3.297e+08	1.786e+09	5.819e+05	3.152e+06
0.3	1.188e+15	6.426e+07	2.117e+08	1.219e+05	4.016e+05
0.4	4.964e+15	4.166e+08	1.100e+09	8.118e+05	2.143e+06
0.5	7.784e+15	9.013e+08	2.057e+09	1.769e+06	4.037e+06
0.6	7.733e+15	1.156e+09	2.389e+09	2.256e+06	4.664e+06
0.8	9.905e+15	2.195e+09	3.952e+09	4.175e+06	7.517e+06
1.0	5.209e+15	1.557e+09	2.579e+09	2.870e+06	4.754e+06
1.5	5.459e+15	2.765e+09	4.017e+09	4.653e+06	6.759e+06
2.0	4.964e+15	3.595e+09	4.887e+09	5.559e+06	7.557e+06
3.0	4.147e+14	4.853e+08	6.149e+08	6.584e+05	8.342e+05
4.0	4.163e+10	6.741e+04	8.224e+04	8.340e+01	1.017e+02
TOTALS:	9.070e+16	1.350e+10	2.407e+10	2.352e+07	4.260e+07

Results - Dose Point # 3 - (940.9,304.8,0) cm

TOTALS: 9.070e+16 1.350e+10 2.407e+10 2.352e+07 4.260e+07

Page : 4
 DOS File: 20RSUN.MS5
 Run Date: September 25, 2005
 Run Time: 2:06:09 PM
 Duration: 00:01:32

EC-RADN-1134
 Page 85

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.015	5.449e+09	8.808e-186	1.215e-25	7.555e-187	1.042e-26
0.02	9.759e+12	2.564e-80	6.593e-22	8.883e-82	2.284e-23
0.03	1.629e+16	4.500e-20	2.390e-17	4.460e-22	2.369e-19
0.04	2.488e+13	5.940e-08	8.305e-06	2.627e-10	3.673e-08
0.05	1.113e+14	1.004e-01	1.824e+01	2.674e-04	4.860e-02
0.06	2.656e+13	8.631e+00	1.239e+03	1.714e-02	2.461e+00
0.08	1.128e+16	5.252e+05	3.105e+07	8.311e+02	4.913e+04
0.1	1.401e+14	4.622e+04	1.223e+06	7.072e+01	1.871e+03
0.15	2.608e+15	5.132e+06	4.379e+07	8.452e+03	7.212e+04
0.2	1.260e+16	4.974e+07	2.667e+08	8.779e+04	4.707e+05
0.3	1.188e+15	9.597e+06	3.150e+07	1.820e+04	5.976e+04
0.4	4.964e+15	6.208e+07	1.635e+08	1.210e+05	3.186e+05
0.5	7.784e+15	1.342e+08	3.056e+08	2.634e+05	5.998e+05
0.6	7.733e+15	1.720e+08	3.548e+08	3.357e+05	6.926e+05
0.8	9.905e+15	3.265e+08	5.867e+08	6.210e+05	1.116e+06
1.0	5.209e+15	2.315e+08	3.828e+08	4.267e+05	7.056e+05
1.5	5.459e+15	4.112e+08	5.963e+08	6.918e+05	1.003e+06
2.0	4.964e+15	5.346e+08	7.253e+08	8.266e+05	1.122e+06
3.0	4.147e+14	7.223e+07	9.129e+07	9.800e+04	1.239e+05
4.0	4.163e+10	1.004e+04	1.222e+04	1.242e+01	1.511e+01
TOTALS:	9.070e+16	2.009e+09	3.581e+09	3.500e+06	6.335e+06

MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 20RS6.MS5
 Run Date: September 25, 2005
 Run Time: 2:05:36 PM
 Duration: 00:00:32

EC-RADN-1134
 Page 86

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 20 in Reactor Coolant Steam Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 24.45 cm 9.6 in

Dose Points
 # 1 X 72.12 cm Y 304.8 cm Z 0 cm
 2 ft 4.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.14e+06 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	15.24 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.95 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5375e-002	5.6889e+008	1.3430e-002	4.9691e+002
Ba-137m	1.1383e+004	4.2116e+014	9.9425e+003	3.6787e+008
Ba-139	4.3173e+003	1.5974e+014	3.7710e+003	1.3953e+008
Ba-140	1.1804e+004	4.3673e+014	1.0310e+004	3.8147e+008
Ce-141	2.7179e+002	1.0056e+013	2.3740e+002	8.7838e+006
Ce-143	2.4202e+002	8.9549e+012	2.1140e+002	7.8218e+006
Ce-144	2.2863e+002	8.4593e+012	1.9970e+002	7.3889e+006
Cm-242	4.0219e+000	1.4881e+011	3.5130e+000	1.2998e+005
Cm-244	2.3584e-001	8.7261e+009	2.0600e-001	7.6220e+003
Co-58	4.4775e+000	1.6567e+011	3.9110e+000	1.4471e+005
Co-60	2.4111e+000	8.9210e+010	2.1060e+000	7.7922e+004
Cs-134	1.5994e+004	5.9177e+014	1.3970e+004	5.1689e+008
Cs-136	5.0843e+003	1.8812e+014	4.4410e+003	1.6432e+008
Cs-137	1.2032e+004	4.4520e+014	1.0510e+004	3.8887e+008
I-131	9.1623e+004	3.3901e+015	8.0030e+004	2.9611e+009
I-132	1.1019e+005	4.0771e+015	9.6250e+004	3.5613e+009
I-133	1.7940e+005	6.6378e+015	1.5670e+005	5.7979e+009
I-134	4.3516e+004	1.6101e+015	3.8010e+004	1.4064e+009
I-135	1.4757e+005	5.4602e+015	1.2890e+005	4.7693e+009
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009
Kr-87	7.0168e+004	2.5962e+015	6.1290e+004	2.2677e+009
Kr-88	1.7814e+005	6.5912e+015	1.5560e+005	5.7572e+009
La-140	2.7213e+003	1.0069e+013	3.3370e+003	8.7949e+006
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 20RS6.MS5
 Run Date: September 25, 2005
 Run Time: 2:05:36 PM
 Duration: 00:00:32

EC-RADN-1134
 Page 87

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	7.5584e+001	2.7966e+012	6.6020e+001	2.4427e+006
La-142	4.2864e+001	1.5860e+012	3.7440e+001	1.3853e+006
Mo-99	1.4952e+003	5.5322e+013	1.3060e+003	4.8322e+007
Nb-95	1.1609e+002	4.2953e+012	1.0140e+002	3.7518e+006
Nd-147	4.3665e+001	1.6156e+012	3.8140e+001	1.4112e+006
Np-239	3.1289e+003	1.1577e+014	2.7330e+003	1.0112e+008
Pr-143	9.7542e+001	3.6091e+012	8.5200e+001	3.1524e+006
Pr-144	2.2536e+002	8.3383e+012	1.9684e+002	7.2832e+006
Pu-238	6.8898e-001	2.5492e+010	6.0180e-001	2.2267e+004
Pu-239	7.3179e-002	2.7076e+009	6.3920e-002	2.3650e+003
Pu-240	1.1769e-001	4.3546e+009	1.0280e-001	3.8036e+003
Pu-241	2.9022e+001	1.0738e+012	2.5350e+001	9.3795e+005
Rb-86	1.5043e+002	5.5661e+012	1.3140e+002	4.8618e+006
Rh-103m	1.2960e+003	4.7952e+013	1.1320e+003	4.1885e+007
Rh-105	8.3575e+002	3.0923e+013	7.3000e+002	2.7010e+007
Rh-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Ru-103	1.2994e+003	4.8078e+013	1.1350e+003	4.1995e+007
Ru-105	6.5807e+002	2.4348e+013	5.7480e+002	2.1268e+007
Ru-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Sb-127	1.3990e+003	5.1764e+013	1.2220e+003	4.5214e+007
Sb-129	3.8090e+003	1.4093e+014	3.3270e+003	1.2310e+008
Sr-89	6.2120e+003	2.2984e+014	5.4260e+003	2.0076e+008
Sr-90	7.9259e+002	2.9326e+013	6.9230e+002	2.5615e+007
Sr-91	6.8497e+003	2.5344e+014	5.9830e+003	2.2137e+008
Sr-92	5.0443e+003	1.8664e+014	4.4060e+003	1.6302e+008
Tc-99m	1.3498e+003	4.9942e+013	1.1790e+003	4.3623e+007
Te-127	1.4070e+003	5.2060e+013	1.2290e+003	4.5473e+007
Te-127m	2.4019e+002	8.8871e+012	2.0980e+002	7.7626e+006
Te-129	4.3814e+003	1.6211e+014	3.8270e+003	1.4160e+008
Te-129m	1.0060e+003	3.7222e+013	8.7870e+002	3.2512e+007
Te-131m	3.1026e+003	1.1480e+014	2.7100e+003	1.0027e+008
Te-132	2.2886e+004	8.4677e+014	1.9990e+004	7.3963e+008
Xe-133	8.2258e+005	3.0436e+016	7.1850e+005	2.6584e+010
Xe-135	2.9629e+005	1.0963e+016	2.5880e+005	9.5756e+009
Y-90	1.4402e+001	5.3289e+011	1.2580e+001	4.6546e+005
Y-91	8.1983e+001	3.0334e+012	7.1610e+001	2.6496e+006
Y-92	8.2212e+002	3.0419e+013	7.1810e+002	2.6570e+007
Y-93	5.6339e+001	2.0845e+012	4.9210e+001	1.8208e+006
Zr-95	1.1597e+002	4.2911e+012	1.0130e+002	3.7481e+006
Zr-97	1.0582e+002	3.9153e+012	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.449e+09	1.258e-309	6.893e-24	1.079e-310	5.912e-25
<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>

Page : 3
 DOS File: 20RS6.MS5
 Run Date: September 25, 2005
 Run Time: 2:05:36 PM
 Duration: 00:00:32

EC-RADN-1134
 Page 88

<u>Energy</u> MeV	<u>Activity</u> photons/sec	<u>Fluence Rate</u> MeV/cm ² /sec		<u>Exposure Rate</u> mR/hr	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	9.759e+12	1.504e-133	3.739e-20	5.210e-135	1.295e-21
0.03	1.629e+16	1.066e-36	1.352e-15	1.057e-38	1.340e-17
0.04	2.488e+13	1.161e-15	3.988e-13	5.134e-18	1.764e-15
0.05	1.113e+14	3.068e-06	2.000e-03	8.172e-09	5.328e-06
0.06	2.656e+13	7.266e-03	5.025e+00	1.443e-05	9.981e-03
0.08	1.128e+16	7.250e+03	3.313e+06	1.147e+01	5.242e+03
0.1	1.401e+14	2.014e+03	5.784e+05	3.081e+00	8.849e+02
0.15	2.608e+15	7.325e+05	8.956e+07	1.206e+03	1.475e+05
0.2	1.260e+16	1.262e+07	8.724e+08	2.228e+04	1.540e+06
0.3	1.188e+15	4.847e+06	1.624e+08	9.195e+03	3.080e+05
0.4	4.964e+15	4.913e+07	1.025e+09	9.573e+04	1.997e+06
0.5	7.784e+15	1.481e+08	2.200e+09	2.907e+05	4.318e+06
0.6	7.733e+15	2.465e+08	2.840e+09	4.812e+05	5.544e+06
0.8	9.905e+15	6.947e+08	5.496e+09	1.321e+06	1.045e+07
1.0	5.209e+15	6.592e+08	4.013e+09	1.215e+06	7.398e+06
1.5	5.459e+15	1.907e+09	7.734e+09	3.209e+06	1.301e+07
2.0	4.964e+15	3.353e+09	1.079e+10	5.185e+06	1.668e+07
3.0	4.147e+14	6.463e+08	1.595e+09	8.769e+05	2.164e+06
4.0	4.163e+10	1.101e+05	2.334e+05	1.362e+02	2.887e+02
TOTALS:	9.070e+16	7.723e+09	3.682e+10	1.271e+07	6.357e+07

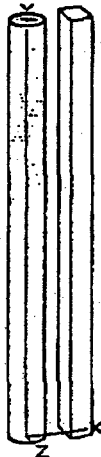
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 20RS12.MS5
Run Date: September 25, 2005
Run Time: 2:03:40 PM
Duration: 00:00:33

EC-RADN-1134
Page 89

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 20 in Reactor Coolant Steam Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 24.45 cm 9.6 in

Dose Points
1 X 87.36 cm 304.8 cm Z 0 cm
2 ft 10.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.14e+06 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	30.48 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.95 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5375e-002	5.6889e+008	1.3430e-002	4.9691e+002
Ba-137m	1.1383e+004	4.2116e+014	9.9425e+003	3.6787e+008
Ba-139	4.3173e+003	1.5974e+014	3.7710e+003	1.3953e+008
Ba-140	1.1804e+004	4.3673e+014	1.0310e+004	3.8147e+008
Ce-141	2.7179e+002	1.0056e+013	2.3740e+002	8.7838e+006
Ce-143	2.4202e+002	8.9549e+012	2.1140e+002	7.8218e+006
Ce-144	2.2863e+002	8.4593e+012	1.9970e+002	7.3889e+006
Cm-242	4.0219e+000	1.4881e+011	3.5130e+000	1.2998e+005
Cm-244	2.3584e-001	8.7261e+009	2.0600e-001	7.6220e+003
Co-58	4.4775e+000	1.6567e+011	3.9110e+000	1.4471e+005
Co-60	2.4111e+000	8.9210e+010	2.1060e+000	7.7922e+004
Cs-134	1.5994e+004	5.9177e+014	1.3970e+004	5.1689e+008
Cs-136	5.0843e+003	1.8812e+014	4.4410e+003	1.6432e+008
Cs-137	1.2032e+004	4.4520e+014	1.0510e+004	3.8887e+008
I-131	9.1623e+004	3.3901e+015	8.0030e+004	2.9611e+009
I-132	1.1019e+005	4.0771e+015	9.6250e+004	3.5613e+009
I-133	1.7940e+005	6.6378e+015	1.5670e+005	5.7979e+009
I-134	4.3516e+004	1.6101e+015	3.8010e+004	1.4064e+009
I-135	1.4757e+005	5.4602e+015	1.2890e+005	4.7693e+009
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009
Kr-87	7.0168e+004	2.5962e+015	6.1290e+004	2.2677e+009
Kr-88	1.7814e+005	6.5912e+015	1.5560e+005	5.7572e+009
La-140	3.7398e+003	1.0069e+013	2.3770e+003	8.7949e+006
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 20RS12.MS5
 Run Date: September 25, 2005
 Run Time: 2:03:40 PM
 Duration: 00:00:33

EC-RADN-1134
 Page 90

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	7.5584e+001	2.7966e+012	6.6020e+001	2.4427e+006
La-142	4.2864e+001	1.5860e+012	3.7440e+001	1.3853e+006
Mo-99	1.4952e+003	5.5322e+013	1.3060e+003	4.8322e+007
Nb-95	1.1609e+002	4.2953e+012	1.0140e+002	3.7518e+006
Nd-147	4.3665e+001	1.6156e+012	3.8140e+001	1.4112e+006
Np-239	3.1289e+003	1.1577e+014	2.7330e+003	1.0112e+008
Pr-143	9.7542e+001	3.6091e+012	8.5200e+001	3.1524e+006
Pr-144	2.2536e+002	8.3383e+012	1.9684e+002	7.2832e+006
Pu-238	6.8898e-001	2.5492e+010	6.0180e-001	2.2267e+004
Pu-239	7.3179e-002	2.7076e+009	6.3920e-002	2.3650e+003
Pu-240	1.1769e-001	4.3546e+009	1.0280e-001	3.8036e+003
Pu-241	2.9022e+001	1.0738e+012	2.5350e+001	9.3795e+005
Rb-86	1.5043e+002	5.5661e+012	1.3140e+002	4.8618e+006
Rh-103m	1.2960e+003	4.7952e+013	1.1320e+003	4.1885e+007
Rh-105	8.3575e+002	3.0923e+013	7.3000e+002	2.7010e+007
Rh-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Ru-103	1.2994e+003	4.8078e+013	1.1350e+003	4.1995e+007
Ru-105	6.5807e+002	2.4348e+013	5.7480e+002	2.1268e+007
Ru-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Sb-127	1.3990e+003	5.1764e+013	1.2220e+003	4.5214e+007
Sb-129	3.8090e+003	1.4093e+014	3.3270e+003	1.2310e+008
Sr-89	6.2120e+003	2.2984e+014	5.4260e+003	2.0076e+008
Sr-90	7.9259e+002	2.9326e+013	6.9230e+002	2.5615e+007
Sr-91	6.8497e+003	2.5344e+014	5.9830e+003	2.2137e+008
Sr-92	5.0443e+003	1.8664e+014	4.4060e+003	1.6302e+008
Tc-99m	1.3498e+003	4.9942e+013	1.1790e+003	4.3623e+007
Te-127	1.4070e+003	5.2060e+013	1.2290e+003	4.5473e+007
Te-127m	2.4019e+002	8.8871e+012	2.0980e+002	7.7626e+006
Te-129	4.3814e+003	1.6211e+014	3.8270e+003	1.4160e+008
Te-129m	1.0060e+003	3.7222e+013	8.7870e+002	3.2512e+007
Te-131m	3.1026e+003	1.1480e+014	2.7100e+003	1.0027e+008
Te-132	2.2886e+004	8.4677e+014	1.9990e+004	7.3963e+008
Xe-133	8.2258e+005	3.0436e+016	7.1850e+005	2.6584e+010
Xe-135	2.9629e+005	1.0963e+016	2.5880e+005	9.5756e+009
Y-90	1.4402e+001	5.3289e+011	1.2580e+001	4.6546e+005
Y-91	8.1983e+001	3.0334e+012	7.1610e+001	2.6496e+006
Y-92	8.2212e+002	3.0419e+013	7.1810e+002	2.6570e+007
Y-93	5.6339e+001	2.0845e+012	4.9210e+001	1.8208e+006
Zr-95	1.1597e+002	4.2911e+012	1.0130e+002	3.7481e+006
Zr-97	1.0582e+002	3.9153e+012	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.449e+09	0.000e+00	5.463e-24	0.000e+00	4.686e-25
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 20RS12.MS5
 Run Date: September 25, 2005
 Run Time: 2:03:40 PM
 Duration: 00:00:33

EC-RADN-1134
 Page 91

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	9.759e+12	2.623e-188	2.964e-20	9.086e-190	1.027e-21
0.03	1.629e+16	1.266e-54	1.072e-15	1.255e-56	1.062e-17
0.04	2.488e+13	1.151e-24	1.660e-17	5.089e-27	7.342e-20
0.05	1.113e+14	4.367e-12	6.818e-09	1.163e-14	1.816e-11
0.06	2.656e+13	2.588e-07	5.066e-04	5.141e-10	1.006e-06
0.08	1.128e+16	3.636e+00	5.564e+03	5.755e-03	8.805e+00
0.1	1.401e+14	2.904e+00	3.083e+03	4.443e-03	4.717e+00
0.15	2.608e+15	3.104e+03	1.464e+06	5.112e+00	2.411e+03
0.2	1.260e+16	9.069e+04	2.278e+07	1.601e+02	4.020e+04
0.3	1.188e+15	6.582e+04	6.906e+06	1.249e+02	1.310e+04
0.4	4.964e+15	1.010e+06	5.835e+07	1.969e+03	1.137e+05
0.5	7.784e+15	4.136e+06	1.549e+08	8.119e+03	3.040e+05
0.6	7.733e+15	8.745e+06	2.344e+08	1.707e+04	4.575e+05
0.8	9.905e+15	3.528e+07	5.846e+08	6.710e+04	1.112e+06
1.0	5.209e+15	4.350e+07	5.097e+08	8.018e+04	9.395e+05
1.5	5.459e+15	1.942e+08	1.332e+09	3.267e+05	2.241e+06
2.0	4.964e+15	4.445e+08	2.238e+09	6.873e+05	3.461e+06
3.0	4.147e+14	1.166e+08	4.095e+08	1.581e+05	5.556e+05
4.0	4.163e+10	2.365e+04	6.722e+04	2.926e+01	8.316e+01
TOTALS:	9.070e+16	8.480e+08	5.553e+09	1.347e+06	9.240e+06

MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

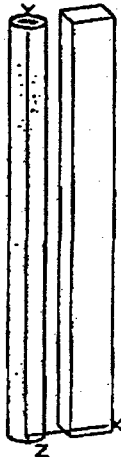
Page : 1
 DOS File: 20RS24.MS5
 Run Date: September 25, 2005
 Run Time: 2:04:15 PM
 Duration: 00:00:43

EC-RADN-1134
 Page 92

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737

Description: 20 in Reactor Coolant Steam Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 24.45 cm 9.6 in

Dose Points
 # 1 X Y Z
 117.84 cm 304.8 cm 0 cm
 3 ft 10.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.14e+06 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	60.96 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.95 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5375e-002	5.6889e+008	1.3430e-002	4.9691e+002
Ba-137m	1.1383e+004	4.2116e+014	9.9425e+003	3.6787e+008
Ba-139	4.3173e+003	1.5974e+014	3.7710e+003	1.3953e+008
Ba-140	1.1804e+004	4.3673e+014	1.0310e+004	3.8147e+008
Ce-141	2.7179e+002	1.0056e+013	2.3740e+002	8.7838e+006
Ce-143	2.4202e+002	8.9549e+012	2.1140e+002	7.8218e+006
Ce-144	2.2863e+002	8.4593e+012	1.9970e+002	7.3889e+006
Cm-242	4.0219e+000	1.4881e+011	3.5130e+000	1.2998e+005
Cm-244	2.3584e-001	8.7261e+009	2.0600e-001	7.6220e+003
Co-58	4.4775e+000	1.6567e+011	3.9110e+000	1.4471e+005
Co-60	2.4111e+000	8.9210e+010	2.1060e+000	7.7922e+004
Cs-134	1.5994e+004	5.9177e+014	1.3970e+004	5.1689e+008
Cs-136	5.0843e+003	1.8812e+014	4.4410e+003	1.6432e+008
Cs-137	1.2032e+004	4.4520e+014	1.0510e+004	3.8887e+008
I-131	9.1623e+004	3.3901e+015	8.0030e+004	2.9611e+009
I-132	1.1019e+005	4.0771e+015	9.6250e+004	3.5613e+009
I-133	1.7940e+005	6.6378e+015	1.5670e+005	5.7979e+009
I-134	4.3516e+004	1.6101e+015	3.8010e+004	1.4064e+009
I-135	1.4757e+005	5.4602e+015	1.2890e+005	4.7693e+009
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009
Kr-87	7.0168e+004	2.5962e+015	6.1290e+004	2.2677e+009
Kr-88	1.7814e+005	6.5912e+015	1.5560e+005	5.7572e+009
La-140	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 20RS24.MS5
 Run Date: September 25, 2005
 Run Time: 2:04:15 PM
 Duration: 00:00:43

EC-RADN-1134
 Page 93

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
La-141	7.5584e+001	2.7966e+012	6.6020e+001	2.4427e+006
La-142	4.2864e+001	1.5860e+012	3.7440e+001	1.3853e+006
Mo-99	1.4952e+003	5.5322e+013	1.3060e+003	4.8322e+007
Nb-95	1.1609e+002	4.2953e+012	1.0140e+002	3.7518e+006
Nd-147	4.3665e+001	1.6156e+012	3.8140e+001	1.4112e+006
Np-239	3.1289e+003	1.1577e+014	2.7330e+003	1.0112e+008
Pr-143	9.7542e+001	3.6091e+012	8.5200e+001	3.1524e+006
Pr-144	2.2536e+002	8.3383e+012	1.9684e+002	7.2832e+006
Pu-238	6.8898e-001	2.5492e+010	6.0180e-001	2.2267e+004
Pu-239	7.3179e-002	2.7076e+009	6.3920e-002	2.3650e+003
Pu-240	1.1769e-001	4.3546e+009	1.0280e-001	3.8036e+003
Pu-241	2.9022e+001	1.0738e+012	2.5350e+001	9.3795e+005
Rb-86	1.5043e+002	5.5661e+012	1.3140e+002	4.8618e+006
Rh-103m	1.2960e+003	4.7952e+013	1.1320e+003	4.1885e+007
Rh-105	8.3575e+002	3.0923e+013	7.3000e+002	2.7010e+007
Rh-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Ru-103	1.2994e+003	4.8078e+013	1.1350e+003	4.1995e+007
Ru-105	6.5807e+002	2.4348e+013	5.7480e+002	2.1268e+007
Ru-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Sb-127	1.3990e+003	5.1764e+013	1.2220e+003	4.5214e+007
Sb-129	3.8090e+003	1.4093e+014	3.3270e+003	1.2310e+008
Sr-89	6.2120e+003	2.2984e+014	5.4260e+003	2.0076e+008
Sr-90	7.9259e+002	2.9326e+013	6.9230e+002	2.5615e+007
Sr-91	6.8497e+003	2.5344e+014	5.9830e+003	2.2137e+008
Sr-92	5.0443e+003	1.8664e+014	4.4060e+003	1.6302e+008
Tc-99m	1.3498e+003	4.9942e+013	1.1790e+003	4.3623e+007
Te-127	1.4070e+003	5.2060e+013	1.2290e+003	4.5473e+007
Te-127m	2.4019e+002	8.8871e+012	2.0980e+002	7.7626e+006
Te-129	4.3814e+003	1.6211e+014	3.8270e+003	1.4160e+008
Te-129m	1.0060e+003	3.7222e+013	8.7870e+002	3.2512e+007
Te-131m	3.1026e+003	1.1480e+014	2.7100e+003	1.0027e+008
Te-132	2.2886e+004	8.4677e+014	1.9990e+004	7.3963e+008
Xe-133	8.2258e+005	3.0436e+016	7.1850e+005	2.6584e+010
Xe-135	2.9629e+005	1.0963e+016	2.5880e+005	9.5756e+009
Y-90	1.4402e+001	5.3289e+011	1.2580e+001	4.6546e+005
Y-91	8.1983e+001	3.0334e+012	7.1610e+001	2.6496e+006
Y-92	8.2212e+002	3.0419e+013	7.1810e+002	2.6570e+007
Y-93	5.6339e+001	2.0845e+012	4.9210e+001	1.8208e+006
Zr-95	1.1597e+002	4.2911e+012	1.0130e+002	3.7481e+006
Zr-97	1.0582e+002	3.9153e+012	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
MeV	photons/sec	MeV/cm ² /sec	MeV/cm ² /sec	mR/hr	mR/hr
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	5.449e+09	0.000e+00	3.749e-24	0.000e+00	3.216e-25
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 20RS24.MS5
 Run Date: September 25, 2005
 Run Time: 2:04:15 PM
 Duration: 00:00:43

EC-RADN-1134
 Page 94

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	9.759e+12	9.731e-298	2.034e-20	3.371e-299	7.046e-22
0.03	1.629e+16	2.237e-90	7.354e-16	2.217e-92	7.289e-18
0.04	2.488e+13	1.413e-42	1.139e-17	6.250e-45	5.039e-20
0.05	1.113e+14	1.124e-23	4.231e-16	2.994e-26	1.127e-18
0.06	2.656e+13	4.246e-16	3.501e-12	8.434e-19	6.955e-15
0.08	1.128e+16	1.219e-06	1.007e-02	1.928e-09	1.593e-05
0.1	1.401e+14	8.201e-06	5.105e-02	1.255e-08	7.810e-05
0.15	2.608e+15	7.717e-02	2.106e+02	1.271e-04	3.468e-01
0.2	1.260e+16	6.499e+00	8.442e+03	1.147e-02	1.490e+01
0.3	1.188e+15	1.679e+01	7.392e+03	3.184e-02	1.402e+01
0.4	4.964e+15	5.879e+02	1.210e+05	1.145e+00	2.359e+02
0.5	7.784e+15	4.416e+03	5.219e+05	8.669e+00	1.024e+03
0.6	7.733e+15	1.499e+04	1.161e+06	2.927e+01	2.266e+03
0.8	9.905e+15	1.230e+05	5.118e+06	2.339e+02	9.735e+03
1.0	5.209e+15	2.544e+05	6.835e+06	4.689e+02	1.260e+04
1.5	5.459e+15	2.666e+06	3.583e+07	4.486e+03	6.029e+04
2.0	4.964e+15	1.025e+07	9.252e+07	1.585e+04	1.431e+05
3.0	4.147e+14	4.902e+06	2.760e+07	6.651e+03	3.745e+04
4.0	4.163e+10	1.397e+03	5.954e+03	1.728e+00	7.365e+00
TOTALS:	9.070e+16	1.822e+07	1.697e+08	2.773e+04	2.667e+05

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

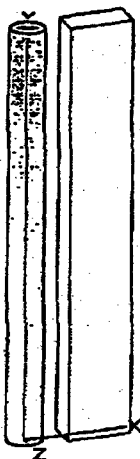
Page : 1
DOS File: 20RS36.MS5
Run Date: September 25, 2005
Run Time: 2:04:58 PM
Duration: 00:00:37

EC-RADN-1134
Page 95

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737

Description: 20 in Reactor Coolant Steam Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height 609.6 cm 20 ft 0.0 in
Radius 24.45 cm 9.6 in

Dose Points

	X	Y	Z
# 1	148.32 cm	304.8 cm	0 cm
	4 ft 10.4 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.14e+06 cm ³	Water	0.035
Transition	30.48 cm	Air	0.00122
Shield 2	91.44 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.95 cm	Iron	7.86

Source Input

Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Excluded

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	1.5375e-002	5.6889e+008	1.3430e-002	4.9691e+002
Ba-137m	1.1383e+004	4.2116e+014	9.9425e+003	3.6787e+008
Ba-139	4.3173e+003	1.5974e+014	3.7710e+003	1.3953e+008
Ba-140	1.1804e+004	4.3673e+014	1.0310e+004	3.8147e+008
Ce-141	2.7179e+002	1.0056e+013	2.3740e+002	8.7838e+006
Ce-143	2.4202e+002	8.9549e+012	2.1140e+002	7.8218e+006
Ce-144	2.2863e+002	8.4593e+012	1.9970e+002	7.3889e+006
Cm-242	4.0219e+000	1.4881e+011	3.5130e+000	1.2998e+005
Cm-244	2.3584e-001	8.7261e+009	2.0600e-001	7.6220e+003
Co-58	4.4775e+000	1.6567e+011	3.9110e+000	1.4471e+005
Co-60	2.4111e+000	8.9210e+010	2.1060e+000	7.7922e+004
Cs-134	1.5994e+004	5.9177e+014	1.3970e+004	5.1689e+008
Cs-136	5.0843e+003	1.8812e+014	4.4410e+003	1.6432e+008
Cs-137	1.2032e+004	4.4520e+014	1.0510e+004	3.8887e+008
I-131	9.1623e+004	3.3901e+015	8.0030e+004	2.9611e+009
I-132	1.1019e+005	4.0771e+015	9.6250e+004	3.5613e+009
I-133	1.7940e+005	6.6378e+015	1.5670e+005	5.7979e+009
I-134	4.3516e+004	1.6101e+015	3.8010e+004	1.4064e+009
I-135	1.4757e+005	5.4602e+015	1.2890e+005	4.7693e+009
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009
Kr-87	7.0168e+004	2.5962e+015	6.1290e+004	2.2677e+009
Kr-88	1.7814e+005	6.5912e+015	1.5560e+005	5.7572e+009
La-140	2.7213e+002	1.0069e+013	2.3770e+002	8.7949e+006
Kr-85	5.7598e+003	2.1311e+014	5.0310e+003	1.8615e+008
Kr-85m	7.6591e+004	2.8339e+015	6.6900e+004	2.4753e+009

Page : 2
 DOS File: 20RS36.MS5
 Run Date: September 25, 2005
 Run Time: 2:04:58 PM
 Duration: 00:00:37

EC-RADN-1134
 Page 96

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-141	7.5584e+001	2.7966e+012	6.6020e+001	2.4427e+006
La-142	4.2864e+001	1.5860e+012	3.7440e+001	1.3853e+006
Mo-99	1.4952e+003	5.5322e+013	1.3060e+003	4.8322e+007
Nb-95	1.1609e+002	4.2953e+012	1.0140e+002	3.7518e+006
Nd-147	4.3665e+001	1.6156e+012	3.8140e+001	1.4112e+006
Np-239	3.1289e+003	1.1577e+014	2.7330e+003	1.0112e+008
Pr-143	9.7542e+001	3.6091e+012	8.5200e+001	3.1524e+006
Pr-144	2.2536e+002	8.3383e+012	1.9684e+002	7.2832e+006
Pu-238	6.8898e-001	2.5492e+010	6.0180e-001	2.2267e+004
Pu-239	7.3179e-002	2.7076e+009	6.3920e-002	2.3650e+003
Pu-240	1.1769e-001	4.3546e+009	1.0280e-001	3.8036e+003
Pu-241	2.9022e+001	1.0738e+012	2.5350e+001	9.3795e+005
Rb-86	1.5043e+002	5.5661e+012	1.3140e+002	4.8618e+006
Rh-103m	1.2960e+003	4.7952e+013	1.1320e+003	4.1885e+007
Rh-105	8.3575e+002	3.0923e+013	7.3000e+002	2.7010e+007
Rh-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Ru-103	1.2994e+003	4.8078e+013	1.1350e+003	4.1995e+007
Ru-105	6.5807e+002	2.4348e+013	5.7480e+002	2.1268e+007
Ru-106	5.1816e+002	1.9172e+013	4.5260e+002	1.6746e+007
Sb-127	1.3990e+003	5.1764e+013	1.2220e+003	4.5214e+007
Sb-129	3.8090e+003	1.4093e+014	3.3270e+003	1.2310e+008
Sr-89	6.2120e+003	2.2984e+014	5.4260e+003	2.0076e+008
Sr-90	7.9259e+002	2.9326e+013	6.9230e+002	2.5615e+007
Sr-91	6.8497e+003	2.5344e+014	5.9830e+003	2.2137e+008
Sr-92	5.0443e+003	1.8664e+014	4.4060e+003	1.6302e+008
Tc-99m	1.3498e+003	4.9942e+013	1.1790e+003	4.3623e+007
Te-127	1.4070e+003	5.2060e+013	1.2290e+003	4.5473e+007
Te-127m	2.4019e+002	8.8871e+012	2.0980e+002	7.7626e+006
Te-129	4.3814e+003	1.6211e+014	3.8270e+003	1.4160e+008
Te-129m	1.0060e+003	3.7222e+013	8.7870e+002	3.2512e+007
Te-131m	3.1026e+003	1.1480e+014	2.7100e+003	1.0027e+008
Te-132	2.2886e+004	8.4677e+014	1.9990e+004	7.3963e+008
Xe-133	8.2258e+005	3.0436e+016	7.1850e+005	2.6584e+010
Xe-135	2.9629e+005	1.0963e+016	2.5880e+005	9.5756e+009
Y-90	1.4402e+001	5.3289e+011	1.2580e+001	4.6546e+005
Y-91	8.1983e+001	3.0334e+012	7.1610e+001	2.6496e+006
Y-92	8.2212e+002	3.0419e+013	7.1810e+002	2.6570e+007
Y-93	5.6339e+001	2.0845e+012	4.9210e+001	1.8208e+006
Zr-95	1.1597e+002	4.2911e+012	1.0130e+002	3.7481e+006
Zr-97	1.0582e+002	3.9153e+012	9.2430e+001	3.4199e+006

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.449e+09	0.000e+00	2.764e-24	0.000e+00	2.371e-25
Energy	Activity	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate

Page : 3
 DOS File: 20RS36.MS5
 Run Date: September 25, 2005
 Run Time: 2:04:58 PM
 Duration: 00:00:37

EC-RADN-1134
 Page 97

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	9.759e+12	0.000e+00	1.500e-20	0.000e+00	5.195e-22
0.03	1.629e+16	4.596e-126	5.422e-16	4.555e-128	5.374e-18
0.04	2.488e+13	2.015e-60	8.401e-18	8.910e-63	3.716e-20
0.05	1.113e+14	3.387e-35	3.120e-16	9.023e-38	8.310e-19
0.06	2.656e+13	8.213e-25	3.693e-16	1.631e-27	7.335e-19
0.08	1.128e+16	4.865e-13	1.323e-08	7.699e-16	2.094e-11
0.1	1.401e+14	2.777e-11	5.877e-07	4.248e-14	8.991e-10
0.15	2.608e+15	2.314e-06	2.169e-02	3.811e-09	3.572e-05
0.2	1.260e+16	5.621e-04	2.332e+00	9.921e-07	4.116e-03
0.3	1.188e+15	5.159e-03	6.024e+00	9.787e-06	1.143e-02
0.4	4.964e+15	4.115e-01	1.981e+02	8.017e-04	3.860e-01
0.5	7.784e+15	5.662e+00	1.439e+03	1.111e-02	2.825e+00
0.6	7.733e+15	3.082e+01	4.808e+03	6.016e-02	9.385e+00
0.8	9.905e+15	5.126e+02	3.945e+04	9.750e-01	7.504e+01
1.0	5.209e+15	1.774e+03	8.268e+04	3.270e+00	1.524e+02
1.5	5.459e+15	4.344e+04	9.238e+05	7.309e+01	1.554e+03
2.0	4.964e+15	2.794e+05	3.749e+06	4.320e+02	5.797e+03
3.0	4.147e+14	2.424e+05	1.897e+06	3.289e+02	2.573e+03
4.0	4.163e+10	9.658e+01	5.487e+02	1.195e-01	6.788e-01
TOTALS:	9.070e+16	5.676e+05	6.698e+06	8.384e+02	1.016e+04

PP&L CALCULATION SHEET

Dept.
Date

Designed By T.F.Mackay
Checked By

PROJECT
Impact Of AST On Current
NUREG-0737 Radiological
Evaluations That Use
TID14844 DBA-LOCA
Releases

Calc. No. EC-RADN-1134

Sh. No. 98

ATTACHMENT 3
MICROSHIELD COMPUTER CODE OUTPUTS
AST SUPPRESSION POOL LIQUID

33 PAGES

MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 3SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:55 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 99

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 3 in Suppression Pool Unshielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 3.9 cm 1.5 in

Dose Points

	X	Y	Z
# 1	5.45 cm	304.8 cm	0 cm
	2.1 in	10 ft 0.0 in	0.0 in
# 2	310.25 cm	304.8 cm	0 cm
	10 ft 2.1 in	10 ft 0.0 in	0.0 in
# 3	919.85 cm	304.8 cm	0 cm
	30 ft 2.1 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.91e+04 cm ³	Water	1
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	3.9586e-005	1.4647e+006	1.3590e-003	5.0283e+001
Ba-137m	3.1855e+001	1.1786e+012	1.0936e+003	4.0462e+007
Ba-139	1.1116e+001	4.1128e+011	3.8160e+002	1.4119e+007
Ba-140	3.0381e+001	1.1241e+012	1.0430e+003	3.8591e+007
Ce-141	6.9968e-001	2.5888e+010	2.4020e+001	8.8874e+005
Ce-143	6.2307e-001	2.3053e+010	2.1390e+001	7.9143e+005
Ce-144	5.8840e-001	2.1771e+010	2.0200e+001	7.4740e+005
Cm-242	1.0355e-002	3.8315e+008	3.5550e-001	1.3154e+004
Cm-244	6.0705e-004	2.2461e+007	2.0840e-002	7.7108e+002
Co-58	1.1526e-002	4.2647e+008	3.9570e-001	1.4641e+004
Co-60	6.2074e-003	2.2967e+008	2.1310e-001	7.8847e+003
Cs-134	4.4713e+001	1.6544e+012	1.5350e+003	5.6795e+007
Cs-136	1.4218e+001	5.2606e+011	4.8810e+002	1.8060e+007
Cs-137	3.3673e+001	1.2459e+012	1.1560e+003	4.2772e+007
I-131	2.4789e+002	9.1718e+012	8.5100e+003	3.1487e+008
I-132	2.8916e+002	1.0699e+013	9.9270e+003	3.6730e+008
I-133	4.8529e+002	1.7956e+013	1.6660e+004	6.1642e+008
I-134	1.1777e+002	4.3574e+012	4.0430e+003	1.4959e+008
I-135	3.9936e+002	1.4776e+013	1.3710e+004	5.0727e+008
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005
I-133	4.8329e+002	1.7956e+013	1.6660e+004	6.1642e+008
I-134	1.1777e+002	4.3574e+012	4.0430e+003	1.4959e+008

Page : 2
 DOS File: 3SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:55 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 100

Nuclide	curies	becquerels	$\mu\text{Ci/cm}^3$	Bq/cm ³
La-142	1.1037e-001	4.0837e+009	3.7890e+000	1.4019e+005
Mo-99	3.8508e+000	1.4248e+011	1.3220e+002	4.8914e+006
Nb-95	2.9886e-001	1.1058e+010	1.0260e+001	3.7962e+005
Nd-147	1.1241e-001	4.1591e+009	3.8590e+000	1.4278e+005
Np-239	8.0571e+000	2.9811e+011	2.7660e+002	1.0234e+007
Pr-143	2.5118e-001	9.2936e+009	8.6230e+000	3.1905e+005
Pr-144	5.7999e-001	2.1460e+010	1.9911e+001	7.3671e+005
Pu-238	1.7737e-003	6.5625e+007	6.0890e-002	2.2529e+003
Pu-239	1.8841e-003	6.9710e+007	6.4680e-002	2.3932e+003
Pu-240	3.0294e-004	1.1209e+007	1.0400e-002	3.8480e+002
Pu-241	7.4716e-002	2.7645e+009	2.5650e+000	9.4905e+004
Rb-86	4.2091e-001	1.5574e+010	1.4450e+001	5.3465e+005
Rh-103m	3.3381e+000	1.2351e+011	1.1460e+002	4.2401e+006
Rh-105	2.1518e+000	7.9615e+010	7.3870e+001	2.7332e+006
Rh-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Ru-103	3.3469e+000	1.2384e+011	1.1490e+002	4.2513e+006
Ru-105	1.6941e+000	6.2683e+010	5.8160e+001	2.1519e+006
Ru-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Sb-127	3.6032e+000	1.3332e+011	1.2370e+002	4.5769e+006
Sb-129	9.8048e+000	3.6278e+011	3.3660e+002	1.2454e+007
Sr-89	1.5992e+001	5.9170e+011	5.4900e+002	2.0313e+007
Sr-90	2.0405e+000	7.5498e+010	7.0050e+001	2.5919e+006
Sr-91	1.7635e+001	6.5248e+011	6.0540e+002	2.2400e+007
Sr-92	1.2986e+001	4.8047e+011	4.4580e+002	1.6495e+007
Tc-99m	3.4751e+000	1.2858e+011	1.1930e+002	4.4141e+006
Te-127	3.6207e+000	1.3397e+011	1.2430e+002	4.5991e+006
Te-127m	6.1841e-001	2.2881e+010	2.1230e+001	7.8551e+005
Te-129	1.1279e+001	4.1731e+011	3.8720e+002	1.4326e+007
Te-129m	2.5899e+000	9.5824e+010	8.8910e+001	3.2897e+006
Te-131m	7.9901e+000	2.9563e+011	2.7430e+002	1.0149e+007
Te-132	5.8899e+001	2.1792e+012	2.0220e+003	7.4814e+007
Y-90	3.8567e-002	1.4270e+009	1.3240e+000	4.8988e+004
Y-91	2.1133e-001	7.8192e+009	7.2550e+000	2.6844e+005
Y-92	2.2997e+000	8.5090e+010	7.8950e+001	2.9212e+006
Y-93	1.4503e-001	5.3662e+009	4.9790e+000	1.8422e+005
Zr-95	2.9857e-001	1.1047e+010	1.0250e+001	3.7925e+005
Zr-97	2.7241e-001	1.0079e+010	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results - Dose Point # 1 - (5.45,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec	Fluence Rate MeV/cm ² /sec	Exposure Rate mR/hr	Exposure Rate mR/hr
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	1.403e+07	1.531e-116	2.951e-25	1.313e-117	2.531e-26
0.02	2.513e+10	1.549e-49	1.601e-21	5.365e-51	5.546e-23
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	1.403e+07	1.531e-116	2.951e-25	1.313e-117	2.531e-26

Page : 3
 DOS File: 3SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:55 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 101

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.03	2.614e+12	8.444e-12	2.970e-10	8.369e-14	2.943e-12
0.04	6.695e+10	6.853e-04	5.277e-02	3.031e-06	2.334e-04
0.05	2.865e+11	1.301e+01	1.262e+03	3.465e-02	3.361e+00
0.06	7.359e+10	1.807e+02	1.455e+04	3.588e-01	2.890e+01
0.08	2.866e+11	2.425e+04	9.294e+05	3.838e+01	1.471e+03
0.1	3.273e+11	1.226e+05	2.397e+06	1.876e+02	3.667e+03
0.15	6.072e+11	9.810e+05	7.697e+06	1.615e+03	1.267e+04
0.2	2.585e+12	7.787e+06	4.116e+07	1.374e+04	7.265e+04
0.3	2.086e+12	1.243e+07	4.255e+07	2.358e+04	8.071e+04
0.4	9.229e+12	8.468e+07	2.357e+08	1.650e+05	4.592e+05
0.5	2.082e+13	2.634e+08	6.378e+08	5.171e+05	1.252e+06
0.6	1.949e+13	3.189e+08	7.009e+08	6.225e+05	1.368e+06
0.8	2.336e+13	5.700e+08	1.093e+09	1.084e+06	2.078e+06
1.0	1.249e+13	4.138e+08	7.288e+08	7.627e+05	1.343e+06
1.5	1.128e+13	6.424e+08	9.882e+08	1.081e+06	1.663e+06
2.0	2.347e+12	1.937e+08	2.774e+08	2.995e+05	4.290e+05
3.0	2.089e+09	2.843e+05	3.758e+05	3.857e+02	5.099e+02
4.0	1.072e+08	2.049e+04	2.590e+04	2.535e+01	3.204e+01
TOTALS:	1.080e+14	2.509e+09	4.757e+09	4.571e+06	8.764e+06

Results - Dose Point # 2 - (310.25,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.015	1.403e+07	1.360e-110	2.351e-27	1.166e-111	2.017e-28
0.02	2.513e+10	5.738e-48	1.276e-23	1.988e-49	4.420e-25
0.03	2.614e+12	1.617e-12	5.154e-11	1.603e-14	5.108e-13
0.04	6.695e+10	3.371e-05	2.303e-03	1.491e-07	1.018e-05
0.05	2.865e+11	3.729e-01	3.108e+01	9.934e-04	8.279e-02
0.06	7.359e+10	3.918e+00	2.659e+02	7.782e-03	5.282e-01
0.08	2.866e+11	3.946e+02	1.260e+04	6.245e-01	1.994e+01
0.1	3.273e+11	1.740e+03	2.846e+04	2.662e+00	4.354e+01
0.15	6.072e+11	1.221e+04	8.098e+04	2.010e+01	1.334e+02
0.2	2.585e+12	9.269e+04	4.164e+05	1.636e+02	7.350e+02
0.3	2.086e+12	1.427e+05	4.206e+05	2.707e+02	7.978e+02
0.4	9.229e+12	9.537e+05	2.312e+06	1.858e+03	4.505e+03
0.5	2.082e+13	2.927e+06	6.226e+06	5.746e+03	1.222e+04
0.6	1.949e+13	3.506e+06	6.819e+06	6.844e+03	1.331e+04
0.8	2.336e+13	6.160e+06	1.056e+07	1.172e+04	2.008e+04
1.0	1.249e+13	4.411e+06	7.006e+06	8.130e+03	1.291e+04
1.5	1.128e+13	6.677e+06	9.391e+06	1.123e+04	1.580e+04
2.0	2.347e+12	1.979e+06	2.617e+06	3.061e+03	4.047e+03
3.0	2.089e+09	2.844e+03	3.515e+03	3.859e+00	4.769e+00
4.0	1.072e+08	2.025e+02	2.411e+02	2.505e-01	2.983e-01
TOTALS:	1.080e+14	2.687e+07	4.589e+07	4.905e+04	8.461e+04

Results - Dose Point # 3 - (919.85,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec <u>No Buildup</u>	MeV/cm ² /sec <u>With Buildup</u>	mR/hr <u>No Buildup</u>	mR/hr <u>With Buildup</u>
0.015	1.403e+07	1.891e-111	3.268e-28	1.622e-112	2.803e-29

Page : 4
 DOS File: 3SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:55 AM
 Duration: 00:01:32

EC-RADN-1134
 Page 102

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	2.513e+10	1.206e-48	1.773e-24	4.179e-50	6.143e-26
0.03	2.614e+12	4.110e-13	1.315e-11	4.073e-15	1.303e-13
0.04	6.695e+10	7.920e-06	5.378e-04	3.503e-08	2.379e-06
0.05	2.865e+11	7.667e-02	6.233e+00	2.042e-04	1.660e-02
0.06	7.359e+10	7.191e-01	4.687e+01	1.428e-03	9.309e-02
0.08	2.866e+11	6.316e+01	1.923e+03	9.995e-02	3.043e+00
0.1	3.273e+11	2.615e+02	4.115e+03	4.001e-01	6.296e+00
0.15	6.072e+11	1.741e+03	1.140e+04	2.867e+00	1.877e+01
0.2	2.585e+12	1.305e+04	5.830e+04	2.303e+01	1.029e+02
0.3	2.086e+12	1.996e+04	5.873e+04	3.787e+01	1.114e+02
0.4	9.229e+12	1.333e+05	3.226e+05	2.596e+02	6.285e+02
0.5	2.082e+13	4.089e+05	8.683e+05	8.026e+02	1.704e+03
0.6	1.949e+13	4.897e+05	9.507e+05	9.558e+02	1.856e+03
0.8	2.336e+13	8.601e+05	1.472e+06	1.636e+03	2.799e+03
1.0	1.249e+13	6.158e+05	9.763e+05	1.135e+03	1.800e+03
1.5	1.128e+13	9.320e+05	1.309e+06	1.568e+03	2.202e+03
2.0	2.347e+12	2.763e+05	3.646e+05	4.273e+02	5.638e+02
3.0	2.089e+09	3.972e+02	4.898e+02	5.389e-01	6.645e-01
4.0	1.072e+08	2.829e+01	3.360e+01	3.500e-02	4.157e-02
TOTALS:	1.080e+14	3.752e+06	6.398e+06	6.849e+03	1.180e+04

MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 3SP6.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:22 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 103

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 3 in Suppression Pool Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 3.9 cm 1.5 in

Dose Points
 # 1 X 51.17 cm Y 304.8 cm Z 0 cm
 1 ft 8.1 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.91e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	15.24 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	3.9586e-005	1.4647e+006	1.3590e-003	5.0283e+001
Ba-137m	3.1855e+001	1.1786e+012	1.0936e+003	4.0462e+007
Ba-139	1.1116e+001	4.1128e+011	3.8160e+002	1.4119e+007
Ba-140	3.0381e+001	1.1241e+012	1.0430e+003	3.8591e+007
Ce-141	6.9968e-001	2.5888e+010	2.4020e+001	8.8874e+005
Ce-143	6.2307e-001	2.3053e+010	2.1390e+001	7.9143e+005
Ce-144	5.8840e-001	2.1771e+010	2.0200e+001	7.4740e+005
Cm-242	1.0355e-002	3.8315e+008	3.5550e-001	1.3154e+004
Cm-244	6.0705e-004	2.2461e+007	2.0840e-002	7.7108e+002
Co-58	1.1526e-002	4.2647e+008	3.9570e-001	1.4641e+004
Co-60	6.2074e-003	2.2967e+008	2.1310e-001	7.8847e+003
Cs-134	4.4713e+001	1.6544e+012	1.5350e+003	5.6795e+007
Cs-136	1.4218e+001	5.2606e+011	4.8810e+002	1.8060e+007
Cs-137	3.3673e+001	1.2459e+012	1.1560e+003	4.2772e+007
I-131	2.4789e+002	9.1718e+012	8.5100e+003	3.1487e+008
I-132	2.8916e+002	1.0699e+013	9.9270e+003	3.6730e+008
I-133	4.8529e+002	1.7956e+013	1.6660e+004	6.1642e+008
I-134	1.1777e+002	4.3574e+012	4.0430e+003	1.4959e+008
I-135	3.9936e+002	1.4776e+013	1.3710e+004	5.0727e+008
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005
La-142	1.1037e-001	4.0837e+009	3.7890e+000	1.4019e+005
Mo-99	3.8508e+000	1.4248e+011	1.3220e+002	4.8914e+006
Nh-95	7.3586e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-140	7.3586e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 3SP6.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:22 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 104

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Nd-147	1.1241e-001	4.1591e+009	3.8590e+000	1.4278e+005
Np-239	8.0571e+000	2.9811e+011	2.7660e+002	1.0234e+007
Pr-143	2.5118e-001	9.2936e+009	8.6230e+000	3.1905e+005
Pr-144	5.7999e-001	2.1460e+010	1.9911e+001	7.3671e+005
Pu-238	1.7737e-003	6.5625e+007	6.0890e-002	2.2529e+003
Pu-239	1.8841e-003	6.9710e+007	6.4680e-002	2.3932e+003
Pu-240	3.0294e-004	1.1209e+007	1.0400e-002	3.8480e+002
Pu-241	7.4716e-002	2.7645e+009	2.5650e+000	9.4905e+004
Rb-86	4.2091e-001	1.5574e+010	1.4450e+001	5.3465e+005
Rh-103m	3.3381e+000	1.2351e+011	1.1460e+002	4.2401e+006
Rh-105	2.1518e+000	7.9615e+010	7.3870e+001	2.7332e+006
Rh-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Ru-103	3.3469e+000	1.2384e+011	1.1490e+002	4.2513e+006
Ru-105	1.6941e+000	6.2683e+010	5.8160e+001	2.1519e+006
Ru-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Sb-127	3.6032e+000	1.3332e+011	1.2370e+002	4.5769e+006
Sb-129	9.8048e+000	3.6278e+011	3.3660e+002	1.2454e+007
Sr-89	1.5992e+001	5.9170e+011	5.4900e+002	2.0313e+007
Sr-90	2.0405e+000	7.5498e+010	7.0050e+001	2.5919e+006
Sr-91	1.7635e+001	6.5248e+011	6.0540e+002	2.2400e+007
Sr-92	1.2986e+001	4.8047e+011	4.4580e+002	1.6495e+007
Tc-99m	3.4751e+000	1.2858e+011	1.1930e+002	4.4141e+006
Te-127	3.6207e+000	1.3397e+011	1.2430e+002	4.5991e+006
Te-127m	6.1841e-001	2.2881e+010	2.1230e+001	7.8551e+005
Te-129	1.1279e+001	4.1731e+011	3.8720e+002	1.4326e+007
Te-129m	2.5899e+000	9.5824e+010	8.8910e+001	3.2897e+006
Te-131m	7.9901e+000	2.9563e+011	2.7430e+002	1.0149e+007
Te-132	5.8899e+001	2.1792e+012	2.0220e+003	7.4814e+007
Y-90	3.8567e-002	1.4270e+009	1.3240e+000	4.8988e+004
Y-91	2.1133e-001	7.8192e+009	7.2550e+000	2.6844e+005
Y-92	2.2997e+000	8.5090e+010	7.8950e+001	2.9212e+006
Y-93	1.4503e-001	5.3662e+009	4.9790e+000	1.8422e+005
Zr-95	2.9857e-001	1.1047e+010	1.0250e+001	3.7925e+005
Zr-97	2.7241e-001	1.0079e+010	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	1.403e+07	2.719e-235	2.581e-26	2.332e-236	2.213e-27
0.02	2.513e+10	9.244e-102	1.400e-22	3.202e-103	4.851e-24
0.03	2.614e+12	1.264e-29	3.155e-19	1.253e-31	3.126e-21
0.04	6.695e+10	2.145e-13	4.878e-11	9.485e-16	2.157e-13
0.05	2.865e+11	3.388e-06	1.396e-03	9.024e-09	3.719e-06
0.03	2.614e+12	1.264e-29	3.155e-19	1.253e-31	3.126e-21
0.04	6.695e+10	2.145e-13	4.878e-11	9.485e-16	2.157e-13

Page : 3
 DOS File: 3SP6.MS5
 Run Date: September 21, 2005
 Run Time: 10:46:22 AM
 Duration: 00:00:32

EC-RADN-1134
 Page 105

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.06	7.359e+10	8.851e-04	3.999e-01	1.758e-06	7.944e-04
0.08	2.866e+11	1.272e+00	4.278e+02	2.013e-03	6.770e-01
0.1	3.273e+11	1.650e+01	3.800e+03	2.525e-02	5.814e+00
0.15	6.072e+11	3.555e+02	3.845e+04	5.854e-01	6.331e+01
0.2	2.585e+12	4.706e+03	2.982e+05	8.306e+00	5.263e+02
0.3	2.086e+12	1.423e+04	4.483e+05	2.699e+01	8.503e+02
0.4	9.229e+12	1.481e+05	2.936e+06	2.886e+02	5.721e+03
0.5	2.082e+13	6.316e+05	8.970e+06	1.240e+03	1.761e+04
0.6	1.949e+13	9.797e+05	1.084e+07	1.912e+03	2.116e+04
0.8	2.336e+13	2.544e+06	1.944e+07	4.839e+03	3.698e+04
1.0	1.249e+13	2.430e+06	1.435e+07	4.479e+03	2.645e+04
1.5	1.128e+13	5.961e+06	2.358e+07	1.003e+04	3.968e+04
2.0	2.347e+12	2.382e+06	7.501e+06	3.684e+03	1.160e+04
3.0	2.089e+09	4.872e+03	1.180e+04	6.610e+00	1.601e+01
4.0	1.072e+08	4.249e+02	8.848e+02	5.256e-01	1.095e+00
TOTALS:	1.080e+14	1.510e+07	8.842e+07	2.652e+04	1.607e+05

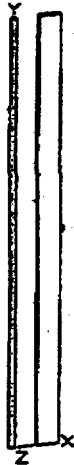
MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 3SP12.MS5
 Run Date: September 21, 2005
 Run Time: 10:44:40 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 106

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 3 in Suppression Pool Shielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 3.9 cm 1.5 in

Dose Points
 # 1 X 66.41 cm Y 304.8 cm Z 0 cm
 2 ft 2.1 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.91e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	30.48 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	3.9586e-005	1.4647e+006	1.3590e-003	5.0283e+001
Ba-137m	3.1855e+001	1.1786e+012	1.0936e+003	4.0462e+007
Ba-139	1.1116e+001	4.1128e+011	3.8160e+002	1.4119e+007
Ba-140	3.0381e+001	1.1241e+012	1.0430e+003	3.8591e+007
Ce-141	6.9968e-001	2.5888e+010	2.4020e+001	8.8874e+005
Ce-143	6.2307e-001	2.3053e+010	2.1390e+001	7.9143e+005
Ce-144	5.8840e-001	2.1771e+010	2.0200e+001	7.4740e+005
Cm-242	1.0355e-002	3.8315e+008	3.5550e-001	1.3154e+004
Cm-244	6.0705e-004	2.2461e+007	2.0840e-002	7.7108e+002
Co-58	1.1526e-002	4.2647e+008	3.9570e-001	1.4641e+004
Co-60	6.2074e-003	2.2967e+008	2.1310e-001	7.8847e+003
Cs-134	4.4713e+001	1.6544e+012	1.5350e+003	5.6795e+007
Cs-136	1.4218e+001	5.2606e+011	4.8810e+002	1.8060e+007
Cs-137	3.3673e+001	1.2459e+012	1.1560e+003	4.2772e+007
I-131	2.4789e+002	9.1718e+012	8.5100e+003	3.1487e+008
I-132	2.8916e+002	1.0699e+013	9.9270e+003	3.6730e+008
I-133	4.8529e+002	1.7956e+013	1.6660e+004	6.1642e+008
I-134	1.1777e+002	4.3574e+012	4.0430e+003	1.4959e+008
I-135	3.9936e+002	1.4776e+013	1.3710e+004	5.0727e+008
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005
La-142	1.1037e-001	4.0837e+009	3.7890e+000	1.4019e+005
Mo-99	3.8508e+000	1.4248e+011	1.3220e+002	4.8914e+006
Nb-95	2.9886e-001	1.1058e+010	1.0260e+001	3.7962e+005
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 3SP12.MS5
 Run Date: September 21, 2005
 Run Time: 10:44:40 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 107

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Nd-147	1.1241e-001	4.1591e+009	3.8590e+000	1.4278e+005
Np-239	8.0571e+000	2.9811e+011	2.7660e+002	1.0234e+007
Pr-143	2.5118e-001	9.2936e+009	8.6230e+000	3.1905e+005
Pr-144	5.7999e-001	2.1460e+010	1.9911e+001	7.3671e+005
Pu-238	1.7737e-003	6.5625e+007	6.0890e-002	2.2529e+003
Pu-239	1.8841e-003	6.9710e+007	6.4680e-002	2.3932e+003
Pu-240	3.0294e-004	1.1209e+007	1.0400e-002	3.8480e+002
Pu-241	7.4716e-002	2.7645e+009	2.5650e+000	9.4905e+004
Rb-86	4.2091e-001	1.5574e+010	1.4450e+001	5.3465e+005
Rh-103m	3.3381e+000	1.2351e+011	1.1460e+002	4.2401e+006
Rh-105	2.1518e+000	7.9615e+010	7.3870e+001	2.7332e+006
Rh-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Ru-103	3.3469e+000	1.2384e+011	1.1490e+002	4.2513e+006
Ru-105	1.6941e+000	6.2683e+010	5.8160e+001	2.1519e+006
Ru-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Sb-127	3.6032e+000	1.3332e+011	1.2370e+002	4.5769e+006
Sb-129	9.8048e+000	3.6278e+011	3.3660e+002	1.2454e+007
Sr-89	1.5992e+001	5.9170e+011	5.4900e+002	2.0313e+007
Sr-90	2.0405e+000	7.5498e+010	7.0050e+001	2.5919e+006
Sr-91	1.7635e+001	6.5248e+011	6.0540e+002	2.2400e+007
Sr-92	1.2986e+001	4.8047e+011	4.4580e+002	1.6495e+007
Tc-99m	3.4751e+000	1.2858e+011	1.1930e+002	4.4141e+006
Te-127	3.6207e+000	1.3397e+011	1.2430e+002	4.5991e+006
Te-127m	6.1841e-001	2.2881e+010	2.1230e+001	7.8551e+005
Te-129	1.1279e+001	4.1731e+011	3.8720e+002	1.4326e+007
Te-129m	2.5899e+000	9.5824e+010	8.8910e+001	3.2897e+006
Te-131m	7.9901e+000	2.9563e+011	2.7430e+002	1.0149e+007
Te-132	5.8899e+001	2.1792e+012	2.0220e+003	7.4814e+007
Y-90	3.8567e-002	1.4270e+009	1.3240e+000	4.8988e+004
Y-91	2.1133e-001	7.8192e+009	7.2550e+000	2.6844e+005
Y-92	2.2997e+000	8.5090e+010	7.8950e+001	2.9212e+006
Y-93	1.4503e-001	5.3662e+009	4.9790e+000	1.8422e+005
Zr-95	2.9857e-001	1.1047e+010	1.0250e+001	3.7925e+005
Zr-97	2.7241e-001	1.0079e+010	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	1.403e+07	0.000e+00	1.920e-26	0.000e+00	1.646e-27
0.02	2.513e+10	1.437e-156	1.042e-22	4.979e-158	3.608e-24
0.03	2.614e+12	1.354e-47	2.347e-19	1.342e-49	2.326e-21
0.04	6.695e+10	1.935e-22	1.388e-19	8.560e-25	6.140e-22
0.05	2.865e+11	4.407e-12	4.952e-09	1.174e-14	1.319e-11
0.03	2.614e+12	1.354e-47	2.347e-19	1.342e-49	2.326e-21
0.04	6.695e+10	1.935e-22	1.388e-19	8.560e-25	6.140e-22

Page : 3
 DOS File: 3SP12.MS5
 Run Date: September 21, 2005
 Run Time: 10:44:40 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 108

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.06	7.359e+10	2.897e-08	4.170e-05	5.754e-11	8.282e-08
0.08	2.866e+11	5.926e-04	7.303e-01	9.377e-07	1.156e-03
0.1	3.273e+11	2.227e-02	2.027e+01	3.406e-05	3.101e-02
0.15	6.072e+11	1.421e+00	6.165e+02	2.340e-03	1.015e+00
0.2	2.585e+12	3.195e+01	7.563e+03	5.640e-02	1.335e+01
0.3	2.086e+12	1.827e+02	1.837e+04	3.465e-01	3.484e+01
0.4	9.229e+12	2.879e+03	1.605e+05	5.609e+00	3.127e+02
0.5	2.082e+13	1.666e+04	6.049e+05	3.271e+01	1.187e+03
0.6	1.949e+13	3.281e+04	8.548e+05	6.404e+01	1.668e+03
0.8	2.336e+13	1.219e+05	1.971e+06	2.318e+02	3.748e+03
1.0	1.249e+13	1.512e+05	1.733e+06	2.786e+02	3.194e+03
1.5	1.128e+13	5.713e+05	3.849e+06	9.612e+02	6.476e+03
2.0	2.347e+12	2.971e+05	1.472e+06	4.594e+02	2.276e+03
3.0	2.089e+09	8.252e+02	2.857e+03	1.120e+00	3.877e+00
4.0	1.072e+08	8.561e+01	2.399e+02	1.059e-01	2.968e-01
TOTALS:	1.080e+14	1.195e+06	1.067e+07	2.035e+03	1.892e+04

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 3SP24.MS5
Run Date: September 21, 2005
Run Time: 10:45:13 AM
Duration: 00:00:34

EC-RADN-1134
Page 109

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 3 in Suppression Pool Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 3.9 cm 1.5 in

Dose Points
1 X Y Z
96.89 cm 304.8 cm 0 cm
3 ft 2.1 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.91e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	60.96 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

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

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	3.9586e-005	1.4647e+006	1.3590e-003	5.0283e+001
Ba-137m	3.1855e+001	1.1786e+012	1.0936e+003	4.0462e+007
Ba-139	1.1116e+001	4.1128e+011	3.8160e+002	1.4119e+007
Ba-140	3.0381e+001	1.1241e+012	1.0430e+003	3.8591e+007
Ce-141	6.9968e-001	2.5888e+010	2.4020e+001	8.8874e+005
Ce-143	6.2307e-001	2.3053e+010	2.1390e+001	7.9143e+005
Ce-144	5.8840e-001	2.1771e+010	2.0200e+001	7.4740e+005
Cm-242	1.0355e-002	3.8315e+008	3.5550e-001	1.3154e+004
Cm-244	6.0705e-004	2.2461e+007	2.0840e-002	7.7108e+002
Co-58	1.1526e-002	4.2647e+008	3.9570e-001	1.4641e+004
Co-60	6.2074e-003	2.2967e+008	2.1310e-001	7.8847e+003
Cs-134	4.4713e+001	1.6544e+012	1.5350e+003	5.6795e+007
Cs-136	1.4218e+001	5.2606e+011	4.8810e+002	1.8060e+007
Cs-137	3.3673e+001	1.2459e+012	1.1560e+003	4.2772e+007
I-131	2.4789e+002	9.1718e+012	8.5100e+003	3.1487e+008
I-132	2.8916e+002	1.0699e+013	9.9270e+003	3.6730e+008
I-133	4.8529e+002	1.7956e+013	1.6660e+004	6.1642e+008
I-134	1.1777e+002	4.3574e+012	4.0430e+003	1.4959e+008
I-135	3.9936e+002	1.4776e+013	1.3710e+004	5.0727e+008
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005
La-142	1.1037e-001	4.0837e+009	3.7890e+000	1.4019e+005
Mo-99	3.8508e+000	1.4248e+011	1.3220e+002	4.8914e+006
Nb-95	7.9886e-001	2.9258e+010	2.9260e+001	3.7962e+005
La-140	7.3586e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 3SP24.MS5
 Run Date: September 21, 2005
 Run Time: 10:45:13 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 110

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Nd-147	1.1241e-001	4.1591e+009	3.8590e+000	1.4278e+005
Np-239	8.0571e+000	2.9811e+011	2.7660e+002	1.0234e+007
Pr-143	2.5118e-001	9.2936e+009	8.6230e+000	3.1905e+005
Pr-144	5.7999e-001	2.1460e+010	1.9911e+001	7.3671e+005
Pu-238	1.7737e-003	6.5625e+007	6.0890e-002	2.2529e+003
Pu-239	1.8841e-003	6.9710e+007	6.4680e-002	2.3932e+003
Pu-240	3.0294e-004	1.1209e+007	1.0400e-002	3.8480e+002
Pu-241	7.4716e-002	2.7645e+009	2.5650e+000	9.4905e+004
Rb-86	4.2091e-001	1.5574e+010	1.4450e+001	5.3465e+005
Rh-103m	3.3381e+000	1.2351e+011	1.1460e+002	4.2401e+006
Rh-105	2.1518e+000	7.9615e+010	7.3870e+001	2.7332e+006
Rh-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Ru-103	3.3469e+000	1.2384e+011	1.1490e+002	4.2513e+006
Ru-105	1.6941e+000	6.2683e+010	5.8160e+001	2.1519e+006
Ru-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Sb-127	3.6032e+000	1.3332e+011	1.2370e+002	4.5769e+006
Sb-129	9.8048e+000	3.6278e+011	3.3660e+002	1.2454e+007
Sr-89	1.5992e+001	5.9170e+011	5.4900e+002	2.0313e+007
Sr-90	2.0405e+000	7.5498e+010	7.0050e+001	2.5919e+006
Sr-91	1.7635e+001	6.5248e+011	6.0540e+002	2.2400e+007
Sr-92	1.2986e+001	4.8047e+011	4.4580e+002	1.6495e+007
Tc-99m	3.4751e+000	1.2858e+011	1.1930e+002	4.4141e+006
Te-127	3.6207e+000	1.3397e+011	1.2430e+002	4.5991e+006
Te-127m	6.1841e-001	2.2881e+010	2.1230e+001	7.8551e+005
Te-129	1.1279e+001	4.1731e+011	3.8720e+002	1.4326e+007
Te-129m	2.5899e+000	9.5824e+010	8.8910e+001	3.2897e+006
Te-131m	7.9901e+000	2.9563e+011	2.7430e+002	1.0149e+007
Te-132	5.8899e+001	2.1792e+012	2.0220e+003	7.4814e+007
Y-90	3.8567e-002	1.4270e+009	1.3240e+000	4.8988e+004
Y-91	2.1133e-001	7.8192e+009	7.2550e+000	2.6844e+005
Y-92	2.2997e+000	8.5090e+010	7.8950e+001	2.9212e+006
Y-93	1.4503e-001	5.3662e+009	4.9790e+000	1.8422e+005
Zr-95	2.9857e-001	1.1047e+010	1.0250e+001	3.7925e+005
Zr-97	2.7241e-001	1.0079e+010	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	1.403e+07	0.000e+00	1.225e-26	0.000e+00	1.051e-27
0.02	2.513e+10	4.666e-266	6.647e-23	1.616e-267	2.303e-24
0.03	2.614e+12	2.138e-83	1.497e-19	2.119e-85	1.484e-21
0.04	6.695e+10	2.148e-40	3.891e-20	9.499e-43	1.721e-22
0.05	2.865e+11	1.025e-23	1.382e-18	2.731e-26	3.681e-21
0.03	2.614e+12	2.138e-83	1.497e-19	2.119e-85	1.484e-21
0.04	6.695e+10	2.148e-40	3.891e-20	9.499e-43	1.721e-22

Page : 3
 DOS File: 3SP24.MS5
 Run Date: September 21, 2005
 Run Time: 10:45:13 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 111

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.06	7.359e+10	4.317e-17	2.958e-13	8.574e-20	5.876e-16
0.08	2.866e+11	1.820e-10	1.301e-06	2.881e-13	2.059e-09
0.1	3.273e+11	5.795e-08	3.262e-04	8.866e-11	4.990e-07
0.15	6.072e+11	3.274e-05	8.468e-02	5.391e-08	1.394e-04
0.2	2.585e+12	2.126e-03	2.659e+00	3.752e-06	4.694e-03
0.3	2.086e+12	4.327e-02	1.856e+01	8.208e-05	3.520e-02
0.4	9.229e+12	1.556e+00	3.134e+02	3.031e-03	6.107e-01
0.5	2.082e+13	1.652e+01	1.916e+03	3.243e-02	3.761e+00
0.6	1.949e+13	5.224e+01	3.974e+03	1.020e-01	7.756e+00
0.8	2.336e+13	3.945e+02	1.617e+04	7.503e-01	3.075e+01
1.0	1.249e+13	8.206e+02	2.175e+04	1.513e+00	4.009e+01
1.5	1.128e+13	7.280e+03	9.674e+04	1.225e+01	1.628e+02
2.0	2.347e+12	6.354e+03	5.677e+04	9.826e+00	8.778e+01
3.0	2.089e+09	3.218e+01	1.794e+02	4.366e-02	2.434e-01
4.0	1.072e+08	4.685e+00	1.978e+01	5.796e-03	2.447e-02
TOTALS:	1.080e+14	1.496e+04	1.978e+05	2.452e+01	3.338e+02

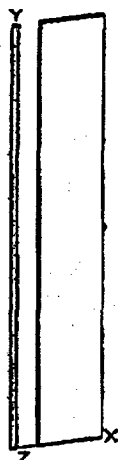
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 3SP36.MS5
Run Date: September 21, 2005
Run Time: 10:45:47 AM
Duration: 00:00:34

EC-RADN-1134
Page 112

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 3 in Suppression Pool Shielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 3.9 cm 1.5 in

Dose Points
1 X Y Z
127.37 cm 304.8 cm 0 cm
4 ft 2.1 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.91e+04 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	91.44 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	3.9586e-005	1.4647e+006	1.3590e-003	5.0283e+001
Ba-137m	3.1855e+001	1.1786e+012	1.0936e+003	4.0462e+007
Ba-139	1.1116e+001	4.1128e+011	3.8160e+002	1.4119e+007
Ba-140	3.0381e+001	1.1241e+012	1.0430e+003	3.8591e+007
Ce-141	6.9968e-001	2.5888e+010	2.4020e+001	8.8874e+005
Ce-143	6.2307e-001	2.3053e+010	2.1390e+001	7.9143e+005
Ce-144	5.8840e-001	2.1771e+010	2.0200e+001	7.4740e+005
Cm-242	1.0355e-002	3.8315e+008	3.5550e-001	1.3154e+004
Cm-244	6.0705e-004	2.2461e+007	2.0840e-002	7.7108e+002
Co-58	1.1526e-002	4.2647e+008	3.9570e-001	1.4641e+004
Co-60	6.2074e-003	2.2967e+008	2.1310e-001	7.8847e+003
Cs-134	4.4713e+001	1.6544e+012	1.5350e+003	5.6795e+007
Cs-136	1.4218e+001	5.2606e+011	4.8810e+002	1.8060e+007
Cs-137	3.3673e+001	1.2459e+012	1.1560e+003	4.2772e+007
I-131	2.4789e+002	9.1718e+012	8.5100e+003	3.1487e+008
I-132	2.8916e+002	1.0699e+013	9.9270e+003	3.6730e+008
I-133	4.8529e+002	1.7956e+013	1.6660e+004	6.1642e+008
I-134	1.1777e+002	4.3574e+012	4.0430e+003	1.4959e+008
I-135	3.9936e+002	1.4776e+013	1.3710e+004	5.0727e+008
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
La-141	1.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005
La-142	1.1037e-001	4.0837e+009	3.7890e+000	1.4019e+005
Mo-99	3.8508e+000	1.4248e+011	1.3220e+002	4.8914e+006
Nh-95	2.9886e-001	1.1058e+010	1.0260e+001	3.7962e+005
La-140	7.3580e-001	2.7224e+010	2.5260e+001	9.3462e+005
Ko-137	2.9458e-001	7.1995e+009	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 3SP36.MS5
 Run Date: September 21, 2005
 Run Time: 10:45:47 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 113

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
Nd-147	1.1241e-001	4.1591e+009	3.8590e+000	1.4278e+005
Np-239	8.0571e+000	2.9811e+011	2.7660e+002	1.0234e+007
Pr-143	2.5118e-001	9.2936e+009	8.6230e+000	3.1905e+005
Pr-144	5.7999e-001	2.1460e+010	1.9911e+001	7.3671e+005
Pu-238	1.7737e-003	6.5625e+007	6.0890e-002	2.2529e+003
Pu-239	1.8841e-003	6.9710e+007	6.4680e-002	2.3932e+003
Pu-240	3.0294e-004	1.1209e+007	1.0400e-002	3.8480e+002
Pu-241	7.4716e-002	2.7645e+009	2.5650e+000	9.4905e+004
Rb-86	4.2091e-001	1.5574e+010	1.4450e+001	5.3465e+005
Rh-103m	3.3381e+000	1.2351e+011	1.1460e+002	4.2401e+006
Rh-105	2.1518e+000	7.9615e+010	7.3870e+001	2.7332e+006
Rh-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Ru-103	3.3469e+000	1.2384e+011	1.1490e+002	4.2513e+006
Ru-105	1.6941e+000	6.2683e+010	5.8160e+001	2.1519e+006
Ru-106	1.3341e+000	4.9362e+010	4.5800e+001	1.6946e+006
Sb-127	3.6032e+000	1.3332e+011	1.2370e+002	4.5769e+006
Sb-129	9.8048e+000	3.6278e+011	3.3660e+002	1.2454e+007
Sr-89	1.5992e+001	5.9170e+011	5.4900e+002	2.0313e+007
Sr-90	2.0405e+000	7.5498e+010	7.0050e+001	2.5919e+006
Sr-91	1.7635e+001	6.5248e+011	6.0540e+002	2.2400e+007
Sr-92	1.2986e+001	4.8047e+011	4.4580e+002	1.6495e+007
Tc-99m	3.4751e+000	1.2858e+011	1.1930e+002	4.4141e+006
Te-127	3.6207e+000	1.3397e+011	1.2430e+002	4.5991e+006
Te-127m	6.1841e-001	2.2881e+010	2.1230e+001	7.8551e+005
Te-129	1.1279e+001	4.1731e+011	3.8720e+002	1.4326e+007
Te-129m	2.5899e+000	9.5824e+010	8.8910e+001	3.2897e+006
Te-131m	7.9901e+000	2.9563e+011	2.7430e+002	1.0149e+007
Te-132	5.8899e+001	2.1792e+012	2.0220e+003	7.4814e+007
Y-90	3.8567e-002	1.4270e+009	1.3240e+000	4.8988e+004
Y-91	2.1133e-001	7.8192e+009	7.2550e+000	2.6844e+005
Y-92	2.2997e+000	8.5090e+010	7.8950e+001	2.9212e+006
Y-93	1.4503e-001	5.3662e+009	4.9790e+000	1.8422e+005
Zr-95	2.9857e-001	1.1047e+010	1.0250e+001	3.7925e+005
Zr-97	2.7241e-001	1.0079e+010	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.403e+07	0.000e+00	8.667e-27	0.000e+00	7.434e-28
0.02	2.513e+10	0.000e+00	4.704e-23	0.000e+00	1.629e-24
0.03	2.614e+12	4.138e-119	1.060e-19	4.101e-121	1.050e-21
0.04	6.695e+10	2.888e-58	2.753e-20	1.277e-60	1.218e-22
0.05	2.865e+11	2.914e-35	9.778e-19	7.763e-38	2.605e-21
0.03	2.614e+12	4.138e-119	1.060e-19	4.101e-121	1.050e-21
0.04	6.695e+10	2.888e-58	2.753e-20	1.277e-60	1.218e-22

Page : 3
 DOS File: 3SP36.MS5
 Run Date: September 21, 2005
 Run Time: 10:45:47 AM
 Duration: 00:00:34

EC-RADN-1134
 Page 114

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>		<u>Exposure Rate</u> <u>mR/hr</u>	
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.06	7.359e+10	7.895e-26	1.246e-18	1.568e-28	2.475e-21
0.08	2.866e+11	6.897e-17	1.693e-12	1.091e-19	2.680e-15
0.1	3.273e+11	1.866e-13	3.682e-09	2.855e-16	5.633e-12
0.15	6.072e+11	9.354e-10	8.425e-06	1.540e-12	1.387e-08
0.2	2.585e+12	1.753e-07	7.068e-04	3.094e-10	1.248e-06
0.3	2.086e+12	1.269e-05	1.454e-02	2.407e-08	2.758e-05
0.4	9.229e+12	1.039e-03	4.928e-01	2.025e-06	9.602e-04
0.5	2.082e+13	2.023e-02	5.072e+00	3.970e-05	9.957e-03
0.6	1.949e+13	1.025e-01	1.581e+01	2.002e-04	3.085e-02
0.8	2.336e+13	1.571e+00	1.196e+02	2.987e-03	2.275e-01
1.0	1.249e+13	5.468e+00	2.524e+02	1.008e-02	4.653e-01
1.5	1.128e+13	1.134e+02	2.392e+03	1.908e-01	4.024e+00
2.0	2.347e+12	1.656e+02	2.206e+03	2.561e-01	3.411e+00
3.0	2.089e+09	1.522e+00	1.182e+01	2.065e-03	1.604e-02
4.0	1.072e+08	3.098e-01	1.748e+00	3.833e-04	2.162e-03
TOTALS:	1.080e+14	2.880e+02	5.005e+03	4.626e-01	8.188e+00

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24SPUN.MS5
Run Date: September 21, 2005
Run Time: 10:39:09 AM
Duration: 00:01:39

EC-RADN-1134
Page 115

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Suppression Pool Unshielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 28.735 cm 11.3 in

Dose Points

	X	Y	Z
# 1	31.48 cm	304.8 cm	0 cm
	1 ft 0.4 in	10 ft 0.0 in	0.0 in
# 2	336.28 cm	304.8 cm	0 cm
	11 ft 0.4 in	10 ft 0.0 in	0.0 in
# 3	945.88 cm	304.8 cm	0 cm
	31 ft 0.4 in	10 ft 0.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.58e+06 cm ³	Water	1
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	1.745 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.1490e-003	7.9513e+007	1.3590e-003	5.0283e+001
Ba-137m	1.7293e+003	6.3983e+013	1.0936e+003	4.0462e+007
Ba-139	6.0343e+002	2.2327e+013	3.8160e+002	1.4119e+007
Ba-140	1.6493e+003	6.1024e+013	1.0430e+003	3.8591e+007
Ce-141	3.7983e+001	1.4054e+012	2.4020e+001	8.8874e+005
Ce-143	3.3824e+001	1.2515e+012	2.1390e+001	7.9143e+005
Ce-144	3.1942e+001	1.1819e+012	2.0200e+001	7.4740e+005
Cm-242	5.6216e-001	2.0800e+010	3.5550e-001	1.3153e+004
Cm-244	3.2955e-002	1.2193e+009	2.0840e-002	7.7108e+002
Co-58	6.2572e-001	2.3152e+010	3.9570e-001	1.4641e+004
Co-60	3.3698e-001	1.2468e+010	2.1310e-001	7.8847e+003
Cs-134	2.4273e+003	8.9811e+013	1.5350e+003	5.6795e+007
Cs-136	7.7184e+002	2.8558e+013	4.8810e+002	1.8060e+007
Cs-137	1.8280e+003	6.7636e+013	1.1560e+003	4.2772e+007
I-131	1.3457e+004	4.9791e+014	8.5100e+003	3.1487e+008
I-132	1.5698e+004	5.8081e+014	9.9270e+003	3.6730e+008
I-133	2.6345e+004	9.7475e+014	1.6660e+004	6.1642e+008
I-134	6.3932e+003	2.3655e+014	4.0430e+003	1.4959e+008
I-135	2.1680e+004	8.0215e+014	1.3710e+004	5.0727e+008
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005
I-133	2.6345e+004	9.7475e+014	1.6660e+004	6.1642e+008
I-134	6.3932e+003	2.3655e+014	4.0430e+003	1.4959e+008

Page : 2
 DOS File: 24SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:39:09 AM
 Duration: 00:01:39

EC-RADN-1134
 Page 116

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>μCi/cm³</u>	<u>Bq/cm³</u>
La-142	5.9916e+000	2.2169e+011	3.7890e+000	1.4019e+005
Mo-99	2.0905e+002	7.7348e+012	1.3220e+002	4.8914e+006
Nb-95	1.6224e+001	6.0030e+011	1.0260e+001	3.7962e+005
Nd-147	6.1023e+000	2.2578e+011	3.8590e+000	1.4278e+005
Np-239	4.3739e+002	1.6183e+013	2.7660e+002	1.0234e+007
Pr-143	1.3636e+001	5.0452e+011	8.6230e+000	3.1905e+005
Pr-144	3.1486e+001	1.1650e+012	1.9911e+001	7.3671e+005
Pu-238	9.6286e-002	3.5626e+009	6.0890e-002	2.2529e+003
Pu-239	1.0228e-001	3.7843e+009	6.4680e-002	2.3932e+003
Pu-240	1.6446e-002	6.0849e+008	1.0400e-002	3.8480e+002
Pu-241	4.0561e+000	1.5007e+011	2.5650e+000	9.4905e+004
Rb-86	2.2850e+001	8.4545e+011	1.4450e+001	5.3465e+005
Rh-103m	1.8121e+002	6.7049e+012	1.1460e+002	4.2401e+006
Rh-105	1.1681e+002	4.3220e+012	7.3870e+001	2.7332e+006
Rh-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Ru-103	1.8169e+002	6.7226e+012	1.1490e+002	4.2513e+006
Ru-105	9.1969e+001	3.4029e+012	5.8160e+001	2.1519e+006
Ru-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Sb-127	1.9561e+002	7.2375e+012	1.2370e+002	4.5769e+006
Sb-129	5.3227e+002	1.9694e+013	3.3660e+002	1.2454e+007
Sr-89	8.6814e+002	3.2121e+013	5.4900e+002	2.0313e+007
Sr-90	1.1077e+002	4.0985e+012	7.0050e+001	2.5919e+006
Sr-91	9.5733e+002	3.5421e+013	6.0540e+002	2.2400e+007
Sr-92	7.0495e+002	2.6083e+013	4.4580e+002	1.6495e+007
Tc-99m	1.8865e+002	6.9801e+012	1.1930e+002	4.4141e+006
Te-127	1.9656e+002	7.2726e+012	1.2430e+002	4.5991e+006
Te-127m	3.3571e+001	1.2421e+012	2.1230e+001	7.8551e+005
Te-129	6.1228e+002	2.2654e+013	3.8720e+002	1.4326e+007
Te-129m	1.4059e+002	5.2020e+012	8.8910e+001	3.2897e+006
Te-131m	4.3375e+002	1.6049e+013	2.7430e+002	1.0149e+007
Te-132	3.1974e+003	1.1830e+014	2.0220e+003	7.4814e+007
Y-90	2.0937e+000	7.7465e+010	1.3240e+000	4.8988e+004
Y-91	1.1472e+001	4.2448e+011	7.2550e+000	2.6843e+005
Y-92	1.2484e+002	4.6192e+012	7.8950e+001	2.9212e+006
Y-93	7.8733e+000	2.9131e+011	4.9790e+000	1.8422e+005
Zr-95	1.6208e+001	5.9971e+011	1.0250e+001	3.7925e+005
Zr-97	1.4788e+001	5.4717e+011	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results - Dose Point # 1 - (31.48,304.8,0) cm

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	7.616e+08	0.000e+00	2.816e-24	0.000e+00	2.415e-25
0.02	1.364e+12	3.824e-154	1.528e-20	1.324e-155	5.293e-22
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	7.616e+08	0.000e+00	2.816e-24	0.000e+00	2.415e-25

Page : 3
 DOS File: 24SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:39:09 AM
 Duration: 00:01:39

EC-RADN-1134
 Page 117

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.03	1.419e+14	7.807e-45	3.442e-17	7.737e-47	3.411e-19
0.04	3.634e+12	1.656e-18	6.663e-16	7.325e-21	2.947e-18
0.05	1.555e+13	1.743e-07	1.212e-04	4.643e-10	3.228e-07
0.06	3.995e+12	2.589e-03	1.592e+00	5.143e-06	3.162e-03
0.08	1.556e+13	1.047e+02	2.859e+04	1.657e-01	4.525e+01
0.1	1.777e+13	4.453e+03	5.612e+05	6.812e+00	8.586e+02
0.15	3.296e+13	2.003e+05	7.907e+06	3.299e+02	1.302e+04
0.2	1.403e+14	2.714e+06	6.164e+07	4.789e+03	1.088e+05
0.3	1.132e+14	6.695e+06	8.350e+07	1.270e+04	1.584e+05
0.4	5.010e+14	5.733e+07	5.121e+08	1.117e+05	9.977e+05
0.5	1.130e+15	2.096e+08	1.484e+09	4.113e+05	2.913e+06
0.6	1.058e+15	2.879e+08	1.716e+09	5.619e+05	3.349e+06
0.8	1.268e+15	6.257e+08	2.901e+09	1.190e+06	5.518e+06
1.0	6.783e+14	5.276e+08	2.055e+09	9.726e+05	3.788e+06
1.5	6.122e+14	1.066e+09	3.146e+09	1.793e+06	5.292e+06
2.0	1.274e+14	3.805e+08	9.579e+08	5.884e+05	1.481e+06
3.0	1.134e+11	6.865e+05	1.432e+06	9.314e+02	1.943e+03
4.0	5.819e+09	5.587e+04	1.043e+05	6.912e+01	1.290e+02
TOTALS:	5.861e+15	3.165e+09	1.293e+10	5.648e+06	2.362e+07

Results - Dose Point # 2 - (336.28,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	7.616e+08	0.000e+00	1.119e-25	0.000e+00	9.599e-27
0.02	1.364e+12	1.323e-150	6.073e-22	4.581e-152	2.104e-23
0.03	1.419e+14	1.583e-44	1.368e-18	1.569e-46	1.356e-20
0.04	3.634e+12	5.666e-19	2.099e-16	2.506e-21	9.284e-19
0.05	1.555e+13	3.035e-08	1.897e-05	8.085e-11	5.053e-08
0.06	3.995e+12	3.232e-04	1.777e-01	6.420e-07	3.529e-04
0.08	1.556e+13	9.597e+00	2.403e+03	1.519e-02	3.802e+00
0.1	1.777e+13	3.590e+02	4.269e+04	5.492e-01	6.531e+01
0.15	3.296e+13	1.446e+04	5.504e+05	2.382e+01	9.064e+02
0.2	1.403e+14	1.893e+05	4.139e+06	3.340e+02	7.306e+03
0.3	1.132e+14	4.552e+05	5.433e+06	8.635e+02	1.031e+04
0.4	5.010e+14	3.852e+06	3.281e+07	7.505e+03	6.394e+04
0.5	1.130e+15	1.396e+07	9.412e+07	2.740e+04	1.847e+05
0.6	1.058e+15	1.904e+07	1.079e+08	3.717e+04	2.106e+05
0.8	1.268e+15	4.089e+07	1.800e+08	7.777e+04	3.423e+05
1.0	6.783e+14	3.412e+07	1.261e+08	6.289e+04	2.325e+05
1.5	6.122e+14	6.744e+07	1.889e+08	1.135e+05	3.178e+05
2.0	1.274e+14	2.370e+07	5.663e+07	3.665e+04	8.757e+04
3.0	1.134e+11	4.186e+04	8.300e+04	5.679e+01	1.126e+02
4.0	5.819e+09	3.361e+03	5.976e+03	4.158e+00	7.393e+00
TOTALS:	5.861e+15	2.037e+08	7.967e+08	3.641e+05	1.458e+06

Results - Dose Point # 3 - (945.88,304.8,0) cm

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec No Buildup	MeV/cm ² /sec With Buildup	mR/hr No Buildup	mR/hr With Buildup
0.015	7.616e+08	0.000e+00	1.681e-26	0.000e+00	1.442e-27

Page : 4
 DOS File: 24SPUN.MS5
 Run Date: September 21, 2005
 Run Time: 10:39:09 AM
 Duration: 00:01:39

EC-RADN-1134
 Page 118

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.02	1.364e+12	2.747e-151	9.125e-23	9.516e-153	3.161e-24
0.03	1.419e+14	4.415e-45	2.055e-19	4.376e-47	2.037e-21
0.04	3.634e+12	1.659e-19	6.165e-17	7.338e-22	2.726e-19
0.05	1.555e+13	8.527e-09	5.322e-06	2.272e-11	1.418e-08
0.06	3.995e+12	8.380e-05	4.545e-02	1.665e-07	9.027e-05
0.08	1.556e+13	2.119e+00	5.114e+02	3.354e-03	8.092e-01
0.1	1.777e+13	7.132e+01	8.108e+03	1.091e-01	1.240e+01
0.15	3.296e+13	2.576e+03	9.447e+04	4.243e+00	1.556e+02
0.2	1.403e+14	3.262e+04	6.928e+05	5.757e+01	1.223e+03
0.3	1.132e+14	7.683e+04	8.943e+05	1.457e+02	1.696e+03
0.4	5.010e+14	6.450e+05	5.368e+06	1.257e+03	1.046e+04
0.5	1.130e+15	2.327e+06	1.534e+07	4.567e+03	3.010e+04
0.6	1.058e+15	3.163e+06	1.753e+07	6.174e+03	3.422e+04
0.8	1.268e+15	6.755e+06	2.910e+07	1.285e+04	5.535e+04
1.0	6.783e+14	5.612e+06	2.032e+07	1.034e+04	3.745e+04
1.5	6.122e+14	1.100e+07	3.021e+07	1.851e+04	5.082e+04
2.0	1.274e+14	3.844e+06	9.014e+06	5.945e+03	1.394e+04
3.0	1.134e+11	6.743e+03	1.314e+04	9.148e+00	1.782e+01
4.0	5.819e+09	5.392e+02	9.434e+02	6.670e-01	1.167e+00
TOTALS:	5.861e+15	3.346e+07	1.286e+08	5.986e+04	2.354e+05

MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

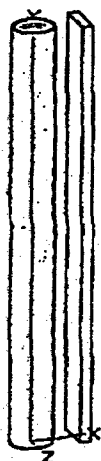
Page : 1
DOS File: 24SP6.MS5
Run Date: September 21, 2005
Run Time: 10:38:35 AM
Duration: 00:00:33

EC-RADN-1134
Page 119

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737

Description: 24 in Suppression Pool Unshielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 28.735 cm 11.3 in

Dose Points
1 X 77.2 cm Y 304.8 cm Z 0 cm
2 ft 6.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.58e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	15.24 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.745 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.1490e-003	7.9513e+007	1.3590e-003	5.0283e+001
Ba-137m	1.7293e+003	6.3983e+013	1.0936e+003	4.0462e+007
Ba-139	6.0343e+002	2.2327e+013	3.8160e+002	1.4119e+007
Ba-140	1.6493e+003	6.1024e+013	1.0430e+003	3.8591e+007
Ce-141	3.7983e+001	1.4054e+012	2.4020e+001	8.8874e+005
Ce-143	3.3824e+001	1.2515e+012	2.1390e+001	7.9143e+005
Ce-144	3.1942e+001	1.1819e+012	2.0200e+001	7.4740e+005
Cm-242	5.6216e-001	2.0800e+010	3.5550e-001	1.3153e+004
Cm-244	3.2955e-002	1.2193e+009	2.0840e-002	7.7108e+002
Co-58	6.2572e-001	2.3152e+010	3.9570e-001	1.4641e+004
Co-60	3.3698e-001	1.2468e+010	2.1310e-001	7.8847e+003
Cs-134	2.4273e+003	8.9811e+013	1.5350e+003	5.6795e+007
Cs-136	7.7184e+002	2.8558e+013	4.8810e+002	1.8060e+007
Cs-137	1.8280e+003	6.7636e+013	1.1560e+003	4.2772e+007
I-131	1.3457e+004	4.9791e+014	8.5100e+003	3.1487e+008
I-132	1.5698e+004	5.8081e+014	9.9270e+003	3.6730e+008
I-133	2.6345e+004	9.7475e+014	1.6660e+004	6.1642e+008
I-134	6.3932e+003	2.3655e+014	4.0430e+003	1.4959e+008
I-135	2.1680e+004	8.0215e+014	1.3710e+004	5.0727e+008
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005
La-142	5.9916e+000	2.2169e+011	3.7890e+000	1.4019e+005
Mo-99	2.0905e+002	7.7348e+012	1.3220e+002	4.8914e+006
Nb-95	1.6224e+001	6.0030e+011	1.0260e+001	3.7962e+005
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 24SP6.MS5
 Run Date: September 21, 2005
 Run Time: 10:38:35 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 120

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Nd-147	6.1023e+000	2.2578e+011	3.8590e+000	1.4278e+005
Np-239	4.3739e+002	1.6183e+013	2.7660e+002	1.0234e+007
Pr-143	1.3636e+001	5.0452e+011	8.6230e+000	3.1905e+005
Pr-144	3.1486e+001	1.1650e+012	1.9911e+001	7.3671e+005
Pu-238	9.6286e-002	3.5626e+009	6.0890e-002	2.2529e+003
Pu-239	1.0228e-001	3.7843e+009	6.4680e-002	2.3932e+003
Pu-240	1.6446e-002	6.0849e+008	1.0400e-002	3.8480e+002
Pu-241	4.0561e+000	1.5007e+011	2.5650e+000	9.4905e+004
Rb-86	2.2850e+001	8.4545e+011	1.4450e+001	5.3465e+005
Rh-103m	1.8121e+002	6.7049e+012	1.1460e+002	4.2401e+006
Rh-105	1.1681e+002	4.3220e+012	7.3870e+001	2.7332e+006
Rh-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Ru-103	1.8169e+002	6.7226e+012	1.1490e+002	4.2513e+006
Ru-105	9.1969e+001	3.4029e+012	5.8160e+001	2.1519e+006
Ru-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Sb-127	1.9561e+002	7.2375e+012	1.2370e+002	4.5769e+006
Sb-129	5.3227e+002	1.9694e+013	3.3660e+002	1.2454e+007
Sr-89	8.6814e+002	3.2121e+013	5.4900e+002	2.0313e+007
Sr-90	1.1077e+002	4.0985e+012	7.0050e+001	2.5919e+006
Sr-91	9.5733e+002	3.5421e+013	6.0540e+002	2.2400e+007
Sr-92	7.0495e+002	2.6083e+013	4.4580e+002	1.6495e+007
Tc-99m	1.8865e+002	6.9801e+012	1.1930e+002	4.4141e+006
Te-127	1.9656e+002	7.2726e+012	1.2430e+002	4.5991e+006
Te-127m	3.3571e+001	1.2421e+012	2.1230e+001	7.8551e+005
Te-129	6.1228e+002	2.2654e+013	3.8720e+002	1.4326e+007
Te-129m	1.4059e+002	5.2020e+012	8.8910e+001	3.2897e+006
Te-131m	4.3375e+002	1.6049e+013	2.7430e+002	1.0149e+007
Te-132	3.1974e+003	1.1830e+014	2.0220e+003	7.4814e+007
Y-90	2.0937e+000	7.7465e+010	1.3240e+000	4.8988e+004
Y-91	1.1472e+001	4.2448e+011	7.2550e+000	2.6843e+005
Y-92	1.2484e+002	4.6192e+012	7.8950e+001	2.9212e+006
Y-93	7.8733e+000	2.9131e+011	4.9790e+000	1.8422e+005
Zr-95	1.6208e+001	5.9971e+011	1.0250e+001	3.7925e+005
Zr-97	1.4788e+001	5.4717e+011	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	7.616e+08	0.000e+00	8.930e-25	0.000e+00	7.659e-26
0.02	1.364e+12	1.814e-204	4.846e-21	6.284e-206	1.679e-22
0.03	1.419e+14	1.186e-61	1.092e-17	1.175e-63	1.082e-19
0.04	3.634e+12	3.081e-27	2.836e-18	1.362e-29	1.254e-20
0.05	1.555e+13	2.373e-13	3.588e-10	6.321e-16	9.558e-13
0.03	1.419e+14	1.186e-61	1.092e-17	1.175e-63	1.082e-19
0.04	3.634e+12	3.081e-27	2.836e-18	1.362e-29	1.254e-20

Page : 3
 DOS File: 24SP6.MS5
 Run Date: September 21, 2005
 Run Time: 10:38:35 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 121

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.06	3.995e+12	6.259e-08	1.032e-04	1.243e-10	2.049e-07
0.08	1.556e+13	2.521e-02	2.539e+01	3.990e-05	4.017e-02
0.1	1.777e+13	2.654e+00	1.588e+03	4.060e-03	2.429e+00
0.15	3.296e+13	3.121e+02	7.347e+04	5.140e-01	1.210e+02
0.2	1.403e+14	7.003e+03	8.974e+05	1.236e+01	1.584e+03
0.3	1.132e+14	3.266e+04	1.919e+06	6.194e+01	3.640e+03
0.4	5.010e+14	4.278e+05	1.507e+07	8.336e+02	2.937e+04
0.5	1.130e+15	2.145e+06	5.223e+07	4.211e+03	1.025e+05
0.6	1.058e+15	3.777e+06	6.917e+07	7.373e+03	1.350e+05
0.8	1.268e+15	1.193e+07	1.446e+08	2.269e+04	2.750e+05
1.0	6.783e+14	1.322e+07	1.193e+08	2.437e+04	2.199e+05
1.5	6.122e+14	4.205e+07	2.391e+08	7.075e+04	4.022e+05
2.0	1.274e+14	1.983e+07	8.626e+07	3.067e+04	1.334e+05
3.0	1.134e+11	4.958e+04	1.572e+05	6.726e+01	2.133e+02
4.0	5.819e+09	4.862e+03	1.278e+04	6.014e+00	1.581e+01
TOTALS:	5.861e+15	9.348e+07	7.288e+08	1.610e+05	1.303e+06

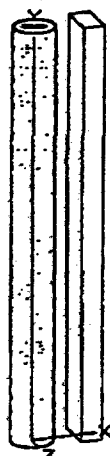
MicroShield v5.01 (5.01-00076)
Pennsylvania Power & Light Co.

Page : 1
DOS File: 24SP12.MS5
Run Date: September 21, 2005
Run Time: 10:36:51 AM
Duration: 00:00:33

EC-RADN-1134
Page 122

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: NUREG-0737
Description: 24 in Suppression Pool Unshielded = 2 hour
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
Height 609.6 cm 20 ft 0.0 in
Radius 28.735 cm 11.3 in

Dose Points
1 X 92.44 cm Y 304.8 cm Z 0 cm
3 ft 0.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.58e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	30.48 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.745 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.1490e-003	7.9513e+007	1.3590e-003	5.0283e+001
Ba-137m	1.7293e+003	6.3983e+013	1.0936e+003	4.0462e+007
Ba-139	6.0343e+002	2.2327e+013	3.8160e+002	1.4119e+007
Ba-140	1.6493e+003	6.1024e+013	1.0430e+003	3.8591e+007
Ce-141	3.7983e+001	1.4054e+012	2.4020e+001	8.8874e+005
Ce-143	3.3824e+001	1.2515e+012	2.1390e+001	7.9143e+005
Ce-144	3.1942e+001	1.1819e+012	2.0200e+001	7.4740e+005
Cm-242	5.6216e-001	2.0800e+010	3.5550e-001	1.3153e+004
Cm-244	3.2955e-002	1.2193e+009	2.0840e-002	7.7108e+002
Co-58	6.2572e-001	2.3152e+010	3.9570e-001	1.4641e+004
Co-60	3.3698e-001	1.2468e+010	2.1310e-001	7.8847e+003
Cs-134	2.4273e+003	8.9811e+013	1.5350e+003	5.6795e+007
Cs-136	7.7184e+002	2.8558e+013	4.8810e+002	1.8060e+007
Cs-137	1.8280e+003	6.7636e+013	1.1560e+003	4.2772e+007
I-131	1.3457e+004	4.9791e+014	8.5100e+003	3.1487e+008
I-132	1.5698e+004	5.8081e+014	9.9270e+003	3.6730e+008
I-133	2.6345e+004	9.7475e+014	1.6660e+004	6.1642e+008
I-134	6.3932e+003	2.3655e+014	4.0430e+003	1.4959e+008
I-135	2.1680e+004	8.0215e+014	1.3710e+004	5.0727e+008
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005
La-142	5.9916e+000	2.2169e+011	3.7890e+000	1.4019e+005
Mo-99	2.0905e+002	7.7348e+012	1.3220e+002	4.8914e+006
Nb-95	1.6224e+001	6.0030e+011	1.0260e+001	3.7962e+005
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 24SP12.MS5
 Run Date: September 21, 2005
 Run Time: 10:36:51 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 123

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Nd-147	6.1023e+000	2.2578e+011	3.8590e+000	1.4278e+005
Np-239	4.3739e+002	1.6183e+013	2.7660e+002	1.0234e+007
Pr-143	1.3636e+001	5.0452e+011	8.6230e+000	3.1905e+005
Pr-144	3.1486e+001	1.1650e+012	1.9911e+001	7.3671e+005
Pu-238	9.6286e-002	3.5626e+009	6.0890e-002	2.2529e+003
Pu-239	1.0228e-001	3.7843e+009	6.4680e-002	2.3932e+003
Pu-240	1.6446e-002	6.0849e+008	1.0400e-002	3.8480e+002
Pu-241	4.0561e+000	1.5007e+011	2.5650e+000	9.4905e+004
Rb-86	2.2850e+001	8.4545e+011	1.4450e+001	5.3465e+005
Rh-103m	1.8121e+002	6.7049e+012	1.1460e+002	4.2401e+006
Rh-105	1.1681e+002	4.3220e+012	7.3870e+001	2.7332e+006
Rh-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Ru-103	1.8169e+002	6.7226e+012	1.1490e+002	4.2513e+006
Ru-105	9.1969e+001	3.4029e+012	5.8160e+001	2.1519e+006
Ru-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Sb-127	1.9561e+002	7.2375e+012	1.2370e+002	4.5769e+006
Sb-129	5.3227e+002	1.9694e+013	3.3660e+002	1.2454e+007
Sr-89	8.6814e+002	3.2121e+013	5.4900e+002	2.0313e+007
Sr-90	1.1077e+002	4.0985e+012	7.0050e+001	2.5919e+006
Sr-91	9.5733e+002	3.5421e+013	6.0540e+002	2.2400e+007
Sr-92	7.0495e+002	2.6083e+013	4.4580e+002	1.6495e+007
Tc-99m	1.8865e+002	6.9801e+012	1.1930e+002	4.4141e+006
Te-127	1.9656e+002	7.2726e+012	1.2430e+002	4.5991e+006
Te-127m	3.3571e+001	1.2421e+012	2.1230e+001	7.8551e+005
Te-129	6.1228e+002	2.2654e+013	3.8720e+002	1.4326e+007
Te-129m	1.4059e+002	5.2020e+012	8.8910e+001	3.2897e+006
Te-131m	4.3375e+002	1.6049e+013	2.7430e+002	1.0149e+007
Te-132	3.1974e+003	1.1830e+014	2.0220e+003	7.4814e+007
Y-90	2.0937e+000	7.7465e+010	1.3240e+000	4.8988e+004
Y-91	1.1472e+001	4.2448e+011	7.2550e+000	2.6843e+005
Y-92	1.2484e+002	4.6192e+012	7.8950e+001	2.9212e+006
Y-93	7.8733e+000	2.9131e+011	4.9790e+000	1.8422e+005
Zr-95	1.6208e+001	5.9971e+011	1.0250e+001	3.7925e+005
Zr-97	1.4788e+001	5.4717e+011	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	7.616e+08	0.000e+00	7.152e-25	0.000e+00	6.135e-26
0.02	1.364e+12	3.498e-259	3.881e-21	1.212e-260	1.344e-22
0.03	1.419e+14	1.420e-79	8.743e-18	1.407e-81	8.665e-20
0.04	3.634e+12	3.269e-36	2.272e-18	1.446e-38	1.005e-20
0.05	1.555e+13	3.628e-19	1.053e-15	9.663e-22	2.804e-18
0.03	1.419e+14	1.420e-79	8.743e-18	1.407e-81	8.665e-20
0.04	3.634e+12	3.269e-36	2.272e-18	1.446e-38	1.005e-20

Page : 3
 DOS File: 24SP12.MS5
 Run Date: September 21, 2005
 Run Time: 10:36:51 AM
 Duration: 00:00:33

EC-RADN-1134
 Page 124

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.06	3.995e+12	2.376e-12	9.106e-09	4.718e-15	1.809e-11
0.08	1.556e+13	1.340e-05	3.718e-02	2.121e-08	5.884e-05
0.1	1.777e+13	4.041e-03	7.309e+00	6.183e-06	1.118e-02
0.15	3.296e+13	1.390e+00	1.033e+03	2.289e-03	1.701e+00
0.2	1.403e+14	5.280e+01	2.021e+04	9.319e-02	3.567e+01
0.3	1.132e+14	4.653e+02	7.161e+04	8.826e-01	1.358e+02
0.4	5.010e+14	9.239e+03	7.605e+05	1.800e+01	1.482e+03
0.5	1.130e+15	6.296e+04	3.293e+06	1.236e+02	6.463e+03
0.6	1.058e+15	1.409e+05	5.196e+06	2.750e+02	1.014e+04
0.8	1.268e+15	6.375e+05	1.416e+07	1.213e+03	2.693e+04
1.0	6.783e+14	9.189e+05	1.420e+07	1.694e+03	2.617e+04
1.5	6.122e+14	4.512e+06	3.938e+07	7.591e+03	6.626e+04
2.0	1.274e+14	2.771e+06	1.735e+07	4.286e+03	2.683e+04
3.0	1.134e+11	9.420e+03	3.983e+04	1.278e+01	5.404e+01
4.0	5.819e+09	1.099e+03	3.686e+03	1.360e+00	4.560e+00
TOTALS:	5.861e+15	9.064e+06	9.447e+07	1.521e+04	1.645e+05

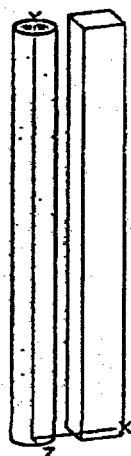
MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 24SP24.MS5
 Run Date: September 21, 2005
 Run Time: 10:37:24 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 125

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 24 in Suppression Pool Unshielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 28.735 cm 11.3 in

Dose Points
 # 1 X Y Z
 122.92 cm 304.8 cm 0 cm
 4 ft 0.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.58e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	60.96 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.745 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.1490e-003	7.9513e+007	1.3590e-003	5.0283e+001
Ba-137m	1.7293e+003	6.3983e+013	1.0936e+003	4.0462e+007
Ba-139	6.0343e+002	2.2327e+013	3.8160e+002	1.4119e+007
Ba-140	1.6493e+003	6.1024e+013	1.0430e+003	3.8591e+007
Ce-141	3.7983e+001	1.4054e+012	2.4020e+001	8.8874e+005
Ce-143	3.3824e+001	1.2515e+012	2.1390e+001	7.9143e+005
Ce-144	3.1942e+001	1.1819e+012	2.0200e+001	7.4740e+005
Cm-242	5.6216e-001	2.0800e+010	3.5550e-001	1.3153e+004
Cm-244	3.2955e-002	1.2193e+009	2.0840e-002	7.7108e+002
Co-58	6.2572e-001	2.3152e+010	3.9570e-001	1.4641e+004
Co-60	3.3698e-001	1.2468e+010	2.1310e-001	7.8847e+003
Cs-134	2.4273e+003	8.9811e+013	1.5350e+003	5.6795e+007
Cs-136	7.7184e+002	2.8558e+013	4.8810e+002	1.8060e+007
Cs-137	1.8280e+003	6.7636e+013	1.1560e+003	4.2772e+007
I-131	1.3457e+004	4.9791e+014	8.5100e+003	3.1487e+008
I-132	1.5698e+004	5.8081e+014	9.9270e+003	3.6730e+008
I-133	2.6345e+004	9.7475e+014	1.6660e+004	6.1642e+008
I-134	6.3932e+003	2.3655e+014	4.0430e+003	1.4959e+008
I-135	2.1680e+004	8.0215e+014	1.3710e+004	5.0727e+008
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005
La-142	5.9916e+000	2.2169e+011	3.7890e+000	1.4019e+005
Mo-99	2.0905e+002	7.7348e+012	1.3220e+002	4.8914e+006
Nb-95	1.6224e+001	6.0030e+011	1.0260e+001	3.7962e+005
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 24SP24.MS5
 Run Date: September 21, 2005
 Run Time: 10:37:24 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 126

Nuclide	curies	becquerels	$\mu\text{Ci/cm}^3$	Bq/cm ³
Nd-147	6.1023e+000	2.2578e+011	3.8590e+000	1.4278e+005
Np-239	4.3739e+002	1.6183e+013	2.7660e+002	1.0234e+007
Pr-143	1.3636e+001	5.0452e+011	8.6230e+000	3.1905e+005
Pr-144	3.1486e+001	1.1650e+012	1.9911e+001	7.3671e+005
Pu-238	9.6286e-002	3.5626e+009	6.0890e-002	2.2529e+003
Pu-239	1.0228e-001	3.7843e+009	6.4680e-002	2.3932e+003
Pu-240	1.6446e-002	6.0849e+008	1.0400e-002	3.8480e+002
Pu-241	4.0561e+000	1.5007e+011	2.5650e+000	9.4905e+004
Rb-86	2.2850e+001	8.4545e+011	1.4450e+001	5.3465e+005
Rh-103m	1.8121e+002	6.7049e+012	1.1460e+002	4.2401e+006
Rh-105	1.1681e+002	4.3220e+012	7.3870e+001	2.7332e+006
Rh-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Ru-103	1.8169e+002	6.7226e+012	1.1490e+002	4.2513e+006
Ru-105	9.1969e+001	3.4029e+012	5.8160e+001	2.1519e+006
Ru-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Sb-127	1.9561e+002	7.2375e+012	1.2370e+002	4.5769e+006
Sb-129	5.3227e+002	1.9694e+013	3.3660e+002	1.2454e+007
Sr-89	8.6814e+002	3.2121e+013	5.4900e+002	2.0313e+007
Sr-90	1.1077e+002	4.0985e+012	7.0050e+001	2.5919e+006
Sr-91	9.5733e+002	3.5421e+013	6.0540e+002	2.2400e+007
Sr-92	7.0495e+002	2.6083e+013	4.4580e+002	1.6495e+007
Tc-99m	1.8865e+002	6.9801e+012	1.1930e+002	4.4141e+006
Te-127	1.9656e+002	7.2726e+012	1.2430e+002	4.5991e+006
Te-127m	3.3571e+001	1.2421e+012	2.1230e+001	7.8551e+005
Te-129	6.1228e+002	2.2654e+013	3.8720e+002	1.4326e+007
Te-129m	1.4059e+002	5.2020e+012	8.8910e+001	3.2897e+006
Te-131m	4.3375e+002	1.6049e+013	2.7430e+002	1.0149e+007
Te-132	3.1974e+003	1.1830e+014	2.0220e+003	7.4814e+007
Y-90	2.0937e+000	7.7465e+010	1.3240e+000	4.8988e+004
Y-91	1.1472e+001	4.2448e+011	7.2550e+000	2.6843e+005
Y-92	1.2484e+002	4.6192e+012	7.8950e+001	2.9212e+006
Y-93	7.8733e+000	2.9131e+011	4.9790e+000	1.8422e+005
Zr-95	1.6208e+001	5.9971e+011	1.0250e+001	3.7925e+005
Zr-97	1.4788e+001	5.4717e+011	9.3520e+000	3.4602e+005

Buildup
 The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	7.616e+08	0.000e+00	4.974e-25	0.000e+00	4.266e-26
0.02	1.364e+12	0.000e+00	2.699e-21	0.000e+00	9.350e-23
0.03	1.419e+14	2.552e-115	6.080e-18	2.529e-117	6.026e-20
0.04	3.634e+12	4.344e-54	1.580e-18	1.921e-56	6.987e-21
0.05	1.555e+13	9.956e-31	5.611e-17	2.652e-33	1.495e-19
0.03	1.419e+14	2.552e-115	6.080e-18	2.529e-117	6.026e-20
0.04	3.634e+12	4.344e-54	1.580e-18	1.921e-56	6.987e-21

Page : 3
 DOS File: 24SP24.MS5
 Run Date: September 21, 2005
 Run Time: 10:37:24 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 127

<u>Energy</u>	<u>Activity</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
<u>MeV</u>	<u>photons/sec</u>	<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.06	3.995e+12	4.121e-21	1.147e-16	8.186e-24	2.279e-19
0.08	1.556e+13	4.724e-12	5.874e-08	7.476e-15	9.295e-11
0.1	1.777e+13	1.196e-08	1.067e-04	1.830e-11	1.632e-07
0.15	3.296e+13	3.604e-05	1.326e-01	5.936e-08	2.184e-04
0.2	1.403e+14	3.942e-03	6.732e+00	6.958e-06	1.188e-02
0.3	1.132e+14	1.237e-01	6.934e+01	2.346e-04	1.315e-01
0.4	5.010e+14	5.608e+00	1.442e+03	1.093e-02	2.810e+00
0.5	1.130e+15	7.019e+01	1.021e+04	1.378e-01	2.004e+01
0.6	1.058e+15	2.524e+02	2.388e+04	4.927e-01	4.661e+01
0.8	1.268e+15	2.325e+03	1.164e+05	4.423e+00	2.214e+02
1.0	6.783e+14	5.627e+03	1.799e+05	1.037e+01	3.317e+02
1.5	6.122e+14	6.497e+04	1.021e+06	1.093e+02	1.718e+03
2.0	1.274e+14	6.706e+04	6.984e+05	1.037e+02	1.080e+03
3.0	1.134e+11	4.160e+02	2.655e+03	5.644e-01	3.602e+00
4.0	5.819e+09	6.814e+01	3.253e+02	8.430e-02	4.024e-01
TOTALS:	5.861e+15	1.408e+05	2.054e+06	2.291e+02	3.424e+03

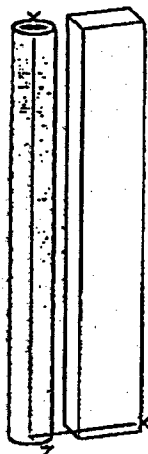
MicroShield v5.01 (5.01-00076)
 Pennsylvania Power & Light Co.

Page : 1
 DOS File: 24SP36.MS5
 Run Date: September 21, 2005
 Run Time: 10:38:00 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 128

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: NUREG-0737
 Description: 24 in Suppression Pool Unshielded = 2 hour
 Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions
 Height 609.6 cm 20 ft 0.0 in
 Radius 28.735 cm 11.3 in

Dose Points
 # 1 X 153.4 cm 304.8 cm Z 0 cm
 5 ft 0.4 in 10 ft 0.0 in 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.58e+06 cm ³	Water	1
Transition	30.48 cm	Air	0.00122
Shield 2	91.44 cm	Concrete	2.35
Air Gap		Air	0.00122
Wall Clad	1.745 cm	Iron	7.86

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

Library : Grove

Nuclide	curies	becquerels	μCi/cm ³	Bq/cm ³
Am-241	2.1490e-003	7.9513e+007	1.3590e-003	5.0283e+001
Ba-137m	1.7293e+003	6.3983e+013	1.0936e+003	4.0462e+007
Ba-139	6.0343e+002	2.2327e+013	3.8160e+002	1.4119e+007
Ba-140	1.6493e+003	6.1024e+013	1.0430e+003	3.8591e+007
Ce-141	3.7983e+001	1.4054e+012	2.4020e+001	8.8874e+005
Ce-143	3.3824e+001	1.2515e+012	2.1390e+001	7.9143e+005
Ce-144	3.1942e+001	1.1819e+012	2.0200e+001	7.4740e+005
Cm-242	5.6216e-001	2.0800e+010	3.5550e-001	1.3153e+004
Cm-244	3.2955e-002	1.2193e+009	2.0840e-002	7.7108e+002
Co-58	6.2572e-001	2.3152e+010	3.9570e-001	1.4641e+004
Co-60	3.3698e-001	1.2468e+010	2.1310e-001	7.8847e+003
Cs-134	2.4273e+003	8.9811e+013	1.5350e+003	5.6795e+007
Cs-136	7.7184e+002	2.8558e+013	4.8810e+002	1.8060e+007
Cs-137	1.8280e+003	6.7636e+013	1.1560e+003	4.2772e+007
I-131	1.3457e+004	4.9791e+014	8.5100e+003	3.1487e+008
I-132	1.5698e+004	5.8081e+014	9.9270e+003	3.6730e+008
I-133	2.6345e+004	9.7475e+014	1.6660e+004	6.1642e+008
I-134	6.3932e+003	2.3655e+014	4.0430e+003	1.4959e+008
I-135	2.1680e+004	8.0215e+014	1.3710e+004	5.0727e+008
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005
La-142	5.9916e+000	2.2169e+011	3.7890e+000	1.4019e+005
Mo-99	2.0905e+002	7.7348e+012	1.3220e+002	4.8914e+006
Nb-95	1.6224e+001	6.0030e+011	1.0260e+001	3.7962e+005
La-140	3.9944e+001	1.4779e+012	2.5260e+001	9.3462e+005
La-141	1.0563e+001	3.9084e+011	6.6800e+000	2.4716e+005

Page : 2
 DOS File: 24SP36.MS5
 Run Date: September 21, 2005
 Run Time: 10:38:00 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 129

Nuclide	curies	becquerels	$\mu\text{Ci/cm}^3$	Bq/cm ³
Nd-147	6.1023e+000	2.2578e+011	3.8590e+000	1.4278e+005
Np-239	4.3739e+002	1.6183e+013	2.7660e+002	1.0234e+007
Pr-143	1.3636e+001	5.0452e+011	8.6230e+000	3.1905e+005
Pr-144	3.1486e+001	1.1650e+012	1.9911e+001	7.3671e+005
Pu-238	9.6286e-002	3.5626e+009	6.0890e-002	2.2529e+003
Pu-239	1.0228e-001	3.7843e+009	6.4680e-002	2.3932e+003
Pu-240	1.6446e-002	6.0849e+008	1.0400e-002	3.8480e+002
Pu-241	4.0561e+000	1.5007e+011	2.5650e+000	9.4905e+004
Rb-86	2.2850e+001	8.4545e+011	1.4450e+001	5.3465e+005
Rh-103m	1.8121e+002	6.7049e+012	1.1460e+002	4.2401e+006
Rh-105	1.1681e+002	4.3220e+012	7.3870e+001	2.7332e+006
Rh-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Ru-103	1.8169e+002	6.7226e+012	1.1490e+002	4.2513e+006
Ru-105	9.1969e+001	3.4029e+012	5.8160e+001	2.1519e+006
Ru-106	7.2424e+001	2.6797e+012	4.5800e+001	1.6946e+006
Sb-127	1.9561e+002	7.2375e+012	1.2370e+002	4.5769e+006
Sb-129	5.3227e+002	1.9694e+013	3.3660e+002	1.2454e+007
Sr-89	8.6814e+002	3.2121e+013	5.4900e+002	2.0313e+007
Sr-90	1.1077e+002	4.0985e+012	7.0050e+001	2.5919e+006
Sr-91	9.5733e+002	3.5421e+013	6.0540e+002	2.2400e+007
Sr-92	7.0495e+002	2.6083e+013	4.4580e+002	1.6495e+007
Tc-99m	1.8865e+002	6.9801e+012	1.1930e+002	4.4141e+006
Te-127	1.9656e+002	7.2726e+012	1.2430e+002	4.5991e+006
Te-127m	3.3571e+001	1.2421e+012	2.1230e+001	7.8551e+005
Te-129	6.1228e+002	2.2654e+013	3.8720e+002	1.4326e+007
Te-129m	1.4059e+002	5.2020e+012	8.8910e+001	3.2897e+006
Te-131m	4.3375e+002	1.6049e+013	2.7430e+002	1.0149e+007
Te-132	3.1974e+003	1.1830e+014	2.0220e+003	7.4814e+007
Y-90	2.0937e+000	7.7465e+010	1.3240e+000	4.8988e+004
Y-91	1.1472e+001	4.2448e+011	7.2550e+000	2.6843e+005
Y-92	1.2484e+002	4.6192e+012	7.8950e+001	2.9212e+006
Y-93	7.8733e+000	2.9131e+011	4.9790e+000	1.8422e+005
Zr-95	1.6208e+001	5.9971e+011	1.0250e+001	3.7925e+005
Zr-97	1.4788e+001	5.4717e+011	9.3520e+000	3.4602e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	25
Circumferential	25
Y Direction (axial)	25

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec No Buildup	Fluence Rate MeV/cm ² /sec With Buildup	Exposure Rate	
				mR/hr No Buildup	mR/hr With Buildup
0.015	7.616e+08	0.000e+00	3.697e-25	0.000e+00	3.171e-26
0.02	1.364e+12	0.000e+00	2.006e-21	0.000e+00	6.949e-23
0.03	1.419e+14	5.382e-151	4.519e-18	5.334e-153	4.479e-20
0.04	3.634e+12	6.436e-72	1.174e-18	2.846e-74	5.193e-21
0.05	1.555e+13	3.086e-42	4.170e-17	8.222e-45	1.111e-19
0.03	1.419e+14	5.382e-151	4.519e-18	5.334e-153	4.479e-20
0.04	3.634e+12	6.436e-72	1.174e-18	2.846e-74	5.193e-21

Page : 3
 DOS File: 24SP36.MS5
 Run Date: September 21, 2005
 Run Time: 10:38:00 AM
 Duration: 00:00:35

EC-RADN-1134
 Page 130

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>No Buildup</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
0.06	3.995e+12	8.184e-30	5.314e-17	1.625e-32	1.056e-19
0.08	1.556e+13	1.932e-18	7.038e-14	3.058e-21	1.114e-16
0.1	1.777e+13	4.141e-14	1.111e-09	6.335e-17	1.700e-12
0.15	3.296e+13	1.103e-09	1.298e-05	1.817e-12	2.137e-08
0.2	1.403e+14	3.480e-07	1.785e-03	6.142e-10	3.150e-06
0.3	1.132e+14	3.882e-05	5.407e-02	7.364e-08	1.026e-04
0.4	5.010e+14	4.010e-03	2.268e+00	7.814e-06	4.418e-03
0.5	1.130e+15	9.198e-02	2.721e+01	1.805e-04	5.342e-02
0.6	1.058e+15	5.305e-01	9.544e+01	1.035e-03	1.863e-01
0.8	1.268e+15	9.915e+00	8.734e+02	1.886e-02	1.661e+00
1.0	6.783e+14	4.017e+01	2.124e+03	7.404e-02	3.916e+00
1.5	6.122e+14	1.084e+03	2.581e+04	1.824e+00	4.342e+01
2.0	1.274e+14	1.873e+03	2.795e+04	2.897e+00	4.323e+01
3.0	1.134e+11	2.109e+01	1.814e+02	2.861e-02	2.461e-01
4.0	5.819e+09	4.831e+00	2.994e+01	5.976e-03	3.704e-02
TOTALS:	5.861e+15	3.034e+03	5.710e+04	4.850e+00	9.276e+01