IMPACT CALCULATIONS

Spreadsheet Description

The spreadsheet ~~"radionuclides.xls"~~ "radionuclides-rev.xls" contains the basic data, calculations, and results that support the transportation impact analysis for the *Draft Environmental Impact Statement for Early Site Permit*. The spreadsheet includes several worksheets that were created for different purposes. Each of these worksheets is described below.

"All Data"

This worksheet provides the basic data used to determine radionuclide inventories used in the RADTRAN 5 calculations. The data was taken from the *Early Site Permit Environmental Report Sections and Supporting Documentation*, U.S. DOE, dated May 15, 2003 and supplemented by the RAIs issued to the applicant. The worksheet also includes the inhalation dose conversion factors (rem per curie inhaled) from the FGR-13 database available from the EPA, dated April 2002. These data were cut and pasted in reactor-specific worksheets for further calculations.

"ABWR," "AP-1000," "ABWR-Rev," "PBMR," and "MHR."

These worksheets contain the inventory data (Ci/MTU) that were input to the RADTRAN computer code for each reactor type. The input data to these worksheets were taken from the "All Data" worksheet. A screening analysis was conducted to identify the radionuclides most likely to contribute to the RADTRAN calculated health consequences of radioactive releases. The screening analysis was conducted by multiplying the radionuclide inventory in Ci/MTU by each radionuclide's inhalation dose conversion factor (rem/Ci), summing the product across the radionuclides, calculating the fractional contribution of each radionuclide to the sum, and then sorting the radionuclide values in descending order. The radionuclides that contribute 99.999% of the sum were included in the RADTRAN calculations. The formulae that were used are as follows:

$$IDF_i = I_i \times DCF_i$$

$$F_i = \frac{IDF_i}{\sum_i IDF_i}$$

Where

IDF = Inhalation dose factor
DCF = Dose conversion factor (rem/Ci) from FGR-13 database
I = Inventory (Ci/MTU) for each radionuclide in DOE 2003 Environmental Report and subsequent RAIs.
F = Fractional contribution to total inhalation dose
i = subscript denoting radionuclide

This worksheet was prepared to assist in creating a table that could be inserted into the Word document that describes the transportation impact analysis. The radionuclides that contribute 99.999% of the total inhalation dose were cut and past from their respective reactor-specific worksheets into this table. No calculations were performed using this table.

"RADTRAN"

This worksheet documents most of the RADTRAN 5 input parameters used in the calculations and their sources. The following RADTRAN parameters are included in this worksheet:

- Radionuclide libraries for Cm-243, Cm-245, and Am-242m. These radionuclides were included in the list of radionuclides that contribute to the 99.999% of inhalation dose determined above but are not included in RADTRAN's radionuclide database. Included are each radiouclide's half-life (RADTRAN parameter TBHLF), photon energy (PHTENG), clouddose (immersion dose) factor (CLDOSF), ground dose factor (GRDOSF), inhalation dose conversion factor values (RPCVAL) for total effective dose equivalent (EDE-50) and unit doses to specific organs (gonads, lung, and marrow). Data sources are provided.
- Severity Fractions (SEVFRAC): These are conditional probabilities, given an accident occurs, that the accident will subject the shipping cask to specified impact and thermal conditions. They are taken directly from Sprung et al. (2000), NUREG/CR-6672.
- Release Fractions (RELFRAC): These are release fractions for several radionuclide physical and chemical groups (gases, particulates, semi-volatiles) that correspond to the severity fractions described above. They are taken directly from Sprung et al. (2000), NUREG/CR-6672.

"Fresh Fuel"

This worksheet contains the calculations used to determine the number of shipments of fresh fuel to each reactor type, including the initial core load and annual refueling quantities. The basic data were taken from WASH-1238 and the Environmental Report (DOE 2003). The results were determined in several different ways, depending on which data was presented in doe (2003). For example, the ABWR data was given in MTU of fresh fuel for the initial core load and annual refueling ad the fresh fuel shipping capacity was given in units of MTU. Thus, the number of shipments was determined by dividing the fresh fuel requirements by the fresh fuel shipment capacity. For the ACR-700, fresh fuel requirements and shipment capacities were expressed in units of fuel assemblies of fuel bundles. The number of shipments was determined by dividing the fresh fuel requirements in bundles by the shipment capacity in bundles.

Total fresh fuel shipments are the sum of the initial core load plus 40 years of refueling.

The formula for calculating the number of shipments normalized to 1000 MWe electric generation capacity is as follows:

$$Net\ MWe_i = Total\ MWe_i \times Capacity\ Factor_i$$

$$N_i = \frac{1{,}000}{Net\ MWe_i} \times Total\ Shipments_i$$

where:

Net MWe = Net electrical generation
Total MWe = Total electrical generation capacity (100% availability)
Capacity Factor = Fraction of year reactor is down for refueling, maintenance
N = Normalized shipments to 1,000 MWe
Total Shipments = Shipments required to transport initial core plus 40 years of refueling
I = subscript denoting reactor type.

This worksheet also includes the calculated annual doses for shipping fresh fuel to each reactor site. This is the product of the annual number of shipments (normalized shipments to 1000 MWe divided by 41 years) and the radiation dose per shipment determined using RADTRAN 5. Input values for this RADTRAN run are documented in the transportation analysis write-up.

"Radwaste"

This worksheet calculates the annual radioactive solid waste shipping requirements for each reactor type. The raw data (e.g., waste volumes generated per year) were taken from DOE (2003) and normalized to 1,000 MWe electric generation capacity. The following assumptions were made about solid waste shipments:

- Solid waste shipment capacities were determined using WASH-1238 reference LWR data. In WASH-1238, the annual shipments were determined to be 46 and the annual solid waste generation quantity was 3,800 ft^3 (108 m^3) per year. So, the average shipment capacity was 2.34 m^3 per shipment.
- Conversions were made using the following factors. 1 m3 = 35.31 ft3. Drums were assumed to be 55 gal. (210 l) drums. It was assumed that loaded waste drums were 90% full.

"TRAGIS"

This worksheet contains the TRAGIS-generated route data used in the RADTRAN calculations. It is simply a convenient way of preparing a table to be inserted in the Work document describes the transportation analysis. No calculations are performed except for the stop times, which were determined by multiplying the TRAGIS-generated number of stops by an assumed 30 minute average stop time.

"Spent Fuel"

This worksheet contains the calculations of the radiological routine and accident impacts of spent fuel shipments. The data are grouped as follows:

- Columns A – G are the RADTRAN generated unit doses (dose per shipment). The values were taken directly from the RADTRAN output files and includes doses to the truck crews, public on-link (persons on the highway routes), public off-link (persons residing near the highway routes), and public stops (doses to persons at truck stops). A total public dose is calculated (on-link + off-link + stops) but not used or reported. Also provided are the radiological accident risks for shipments of spent fuel from each reactor site to Yucca Mountain.
- Columns H through N are per-shipment radiological routine dose values for each reactor site structured to be consistent with Table S-4 population groups. On-looker doses are the sum of the sum of the RADTRAN calculated doses to the persons exposed while they are on-link plus exposures at stops. Doses along routes are represented by off-link doses. Crew doses and doses to off-link populations are taken directly from RADTRAN 5 output files. This section of "Spent Fuel" also includes the concept of "allowable" doses based on Table S-4 conditions. These values are the per-shipment dose (grouped as above) from each reactor site divided by the corresponding value from Table S-4. The per-shipment doses are independent of reactor type because the radiation doses rates for all the shipments are assumed to be at the regulatory maximum level.
- Columns O through S are the radiological accident risk calculations for each reactor type and site. The top third of these columns presents the per-shipment risks in person-rem that are taken directly from RADTRAN output files. The middle third present the per-shipment risks in latent cancer fatalities (LCFs - product of person-rem per shipment and health effects conversion factor). A factor of 6E-4 LCFs per person-rem was used (FGR-13). The bottom third presents the total detriment (LCFs plus genetic effects) based on a conversion factor of 8.5E-4 incidences per person-rem. Below this are calculations leading to the total LCFs expected per year in the population exposed along the route from Clinton to Yucca Mountain. The total number of exposed persons within 800 m of the highway is a TRAGIS output. The annual cancer incident rate (194.4 cancer fatalities per 100,000 persons) was taken from U.S. Centers for Disease Control data (attached).

"0170"

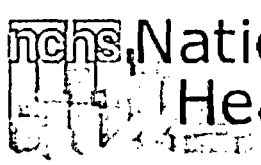
This worksheet contains the calculations that were used to develop comparisons of the results of this analysis with NUREG-1070 results. This information was added to Rev 3 of the Appendix (9/2004).

- Calculate person-rem/shipment: This calculation converts annual doses to crew, on-link, off-link, and stops from NUREG-0170 to doses per shipment. This is

done by dividing the annual doses (person-rem/yr) by the annual shipments (shipments/yr) from NUREG-0170.

- Parameters: Table that compares key NUREG-0170 input parameters to those used in this study.
- Adjustments: Calculations that adjust the doses calculated in this study to reflect updated RADTRAN 5 parameter values relative to NUREG-0170 parameters.

Cancer Mortality Rate – Copy of web page with CDC Data



Nation's Health

Cancer

(Data are for U.S. for year in parentheses)

Morbidity

- Percent of noninstitutionalized adults who have ever been diagnosed with cancer: 6.9 (2001)

Source: Summary Health Statistics for U.S. Adults, 2001

Health care use

Ambulatory care

- Number of visits to office-based physicians: 16 million (2001)

Source: National Ambulatory Medical Care Survey 2001 Summary

- Number of hospital outpatient department visits: 2.4 million (2001)

Source: National Hospital Ambulatory Medical Care Survey: 2001 Outpatient Department Summary

Hospital inpatient care

- Number of discharges: 1.2 million (2001)
- Average length of stay: 7.0 days (2001)

Source: 2001 National Hospital Discharge Survey

Home health care

- Number of current patients with cancer as primary diagnosis: 67,100 (2000)
- Percent of current patients with cancer as primary diagnosis: 5.0 (2000)

Source: National Home and Hospice Care Survey

Hospice care

- Number of current patients with cancer as primary diagnosis: 54,900 (2000)
- Percent of current patients with cancer as primary diagnosis:

52.0 (2000)
Source: National Home and Hospice Care Survey

Nursing home care

- Number of discharges with cancer as primary diagnosis: 146,700 (1999)
- Percent of discharges with cancer as primary diagnosis: 5.8 (1999)
- Average length of stay: 135.7 days (1999)

Source: **National Nursing Home Survey: 1999 Summary**

Mortality

- Number of deaths: 553,768 (2001)
- Deaths per 100,000 population: 194.4 (2001)
- Cause of death rank: 2 (2001)

Source: **Deaths: Final Data for 2001**

- Percent of hospital inpatient deaths from cancer: 12.1 (2001)

Source: **2001 National Hospital Discharge Survey**

More Data

- Frequencies and percents of adults who ever had cancer by age, sex, and race/ethnicity **Summary Health Statistics for U.S. Adults, 2001, tables 5, 6**
- Cancer incidence rates by sex, race, and Hispanic origin, 1990-98 **Health, United States, 2002, table 56**
- Rates of discharges and days of care in short stay hospitals by sex and age: 1990-2000 **Health, United States, 2002, table 93**
- Discharges and average length of stay in short stay hospitals by sex, and age: 1990-2000 **Health, United States, 2002, table 94**
- Death rates for cancer by sex, race, Hispanic origin, and age, 1950-2000 **Health, United States, 2002, table 39**

Related links

- **National Ambulatory Medical Care Survey**
- **National Health Interview Survey**
- **National Home and Hospice Care Survey**
- **National Hospital Ambulatory Medical Care Survey**
- **National Hospital Discharge Survey**
- **National Nursing Home Survey**
- **Mortality data**
- **National Center for Chronic Disease Prevention and Health Promotion**
- **National Cancer Institute**
- **American Cancer Society**

This page last reviewed

Radionuclide Inventory Data (Source: DOE 2003, *Early Site Permit Environmental Report Sections and Supporting Documentation*)
Source of Rem per Ci (inhalation) is FGR-13 database.

ABWR and ESBWR

Activation Products

Radionuclide	Ci/MTU	Rem/Ci (inhalation)
Ag-109m	7.76E-04	0.00E+00
Ar-37	5.48E-16	0.00E+00
Ar-39	3.42E-04	0.00E+00
C-14	7.70E-01	2.12E+04
Ca-41	1.18E-03	6.70E+02
Ca-45	8.65E-04	1.35E+04
Cd-109	7.76E-04	3.02E+04
Cd-115m	1.12E-13	2.83E+04
Cl-36	1.86E-02	1.40E+05
Co-58	7.49E-05	7.83E+03
Co-60	2.73E+03	1.14E+05
Cr-51	5.28E-16	1.37E+02
Eu-152	1.08E-03	3.46E+05
Eu-154	1.53E+02	4.09E+05
Eu-155	7.14E+01	4.63E+04
Fe-55	3.35E+03	2.89E+03
Fe-59	4.32E-10	1.49E+04
Gd-153	2.26E+01	8.87E+03
H-3	5.24E-04	9.70E+02
Hf-175	3.05E-07	5.28E+03
Hf-181	1.08E-10	2.20E+04
Ho-166m	2.39E-02	1.06E+06
In-113m	1.95E-02	7.77E+02
In-114	1.63E-09	0.00E+00
In-114m	1.70E-09	3.46E+04
Ir-192	8.59E-08	2.45E+04
K-42	1.63E-12	1.32E+03
Lu-177	9.04E-07	4.43E+03
Lu-177m	3.93E-06	5.98E+04
Mn-54	3.46E+01	1.21E+04
Mo-93	1.95E-02	8.60E+03
Nb-93m	1.98E-01	6.56E+03
Nb-94	1.76E-01	1.80E+05
Nb-95	4.55E-04	6.48E+03
Nb-95m	1.52E-06	3.26E+03
Ni-59	2.59E+00	1.64E+03
Ni-63	4.20E+02	7.26E+03
P-32	2.89E-08	1.44E+04
Re-188	9.56E-08	1.99E+03
Ru-103	8.38E-16	1.09E+04
S-35	1.84E-05	0.00E+00
Sb-124	2.93E-08	3.17E+04
Sb-125	9.16E+02	4.39E+05
Sc-46	7.04E-07	2.50E+04
Sn-113	1.95E-02	1.46E+04
Sn-119m	5.20E+01	1.23E+04
Sn-121m	1.12E+00	5.55E-04
Sn-123	2.40E-02	4.76E+04
Sr-89	8.94E-10	2.94E+04
Sr-90	6.68E-03	5.81E+05
Ta-182	1.74E-01	3.86E+04
Tb-160	1.49E-03	0.00E+00
Tc-99	4.80E-03	4.94E+04
Te-123m	2.45E-04	1.88E+04
Te-125m	2.24E+02	1.25E+04
Te-127	7.52E-07	5.16E+02
Te-127m	7.67E-07	3.62E+04
Tm-170	2.43E-07	3.44E+04
W-181	1.82E-04	1.01E+03
W-185	1.08E-05	1.43E+04
W-188	9.46E-08	5.74E+04
Y-90	6.68E-03	5.15E+03
Y-91	6.98E-08	3.30E+04
Zn-65	2.39E-03	8.32E+03

AP-1000

Fission Products

Radionuclide	Ci/MTU	Rem/Ci (inhalation)
H-3	4.17E+02	9.70E+02
Be-9	2.97E-06	0.00E+00
Be-10	1.20E-04	2.43E+04
Se-79	4.11E-01	4.20E+03
Kr-81	7.65E-07	0.00E+00
Kr-85	6.38E+03	0.00E+00
Rb-87	2.09E-05	1.84E+03
Sr-89	5.51E-06	2.94E+04
Sr-90	6.19E+04	5.81E+05
Y-90	6.19E+04	5.15E+03
Y-91	2.32E-04	3.30E+04
Zr-93	1.77E+00	9.28E+04
Nb-93m	5.24E-01	6.56E+03
Nb-94	1.47E-04	1.80E+05
Zr-95	2.31E-03	2.16E+04
Nb-95	5.12E-03	6.48E+03
Nb-95m	1.71E-05	3.26E+03
Tc-98	8.72E-06	3.61E+03
Tc-99	1.20E+01	4.94E+04
Rh-102	4.69E-01	6.48E+04
Ru-103	1.05E-08	1.09E+04
Ru-106	1.55E+04	2.44E+05
Rh-106	1.55E+04	0.00E+00
Pd-107	1.25E-01	2.17E+03
Ag-108	3.17E-06	0.00E+00
Ag-108m	3.57E-05	0.00E+00
Ag-109m	2.16E-04	0.00E+00
Cd-109	2.16E-04	3.02E+04
Ag-110	5.32E-01	0.00E+00
Ag-110m	4.00E+01	4.57E+04
Cd-113m	5.87E+01	4.06E+05
Sn-119m	1.25E+00	1.23E+04
Sn-121m	2.06E-01	5.55E-04
Sn-123	1.45E-01	4.76E+04
Te-123m	1.21E-03	1.88E+04
Sb-124	1.59E-06	3.17E+04
Sb-125	3.83E+03	4.39E+05
Te-125m	9.34E+02	1.25E+04
Sn-126	8.18E-01	5.72E+05
Sb-126	1.15E-01	1.20E+04
Sb-126m	8.18E-01	7.25E+01
Te-127	9.27E-02	5.16E+02
Te-127m	9.47E-02	3.62E+04
I-129	3.14E-02	1.33E+05
Cs-134	4.80E+04	7.55E+04
Cs-135	4.47E-01	3.16E+04
Cs-137	9.31E+04	1.45E+05
Ba-137m	8.81E+04	0.00E+00
Ce-142	2.73E-05	0.00E+00
Ce-144	8.87E+03	1.95E+05
Pr-144	8.87E+03	6.77E+01
Pr-144m	1.07E+02	0.00E+00
Pm-146	1.62E+00	1.64E+05
Sm-146	3.48E-07	9.40E+07
Pm-147	1.76E+04	2.58E+04
Sm-147	2.20E-06	8.54E+07
Eu-150	1.79E-05	4.66E+05
Sm-151	3.23E+02	3.40E+04
Eu-152	3.47E+00	3.46E+05
Gd-153	1.14E-01	7.84E+03
Eu-154	9.13E+03	4.09E+05
Eu-155	4.62E+03	4.63E+04
Tb-160	4.35E-05	0.00E+00
Ho-166m	8.56E-03	1.06E+06

MHR

Fission Products

Radionuclide	Ci/MTU	Rem/Ci (inhalation)
Ag-108	2.26E-08	0.00E+00
Ag-108m	2.54E-07	0.00E+00
Ag-109	7.90E-06	0.00E+00
Ag-110	5.89E-01	0.00E+00
Ag-110m	4.43E+01	4.57E+04
Ba-137m	2.78E+05	0.00E+00
Bi-210	1.02E-09	3.94E+03
Bi-211	2.11E-06	0.00E+00
Bi-212	1.47E-03	3.34E+04
C-14	2.53E-03	2.12E+04
C-14A	3.44E-03	2.12E+04
Cd-109	7.90E-06	3.02E+04
Cd-113m	3.02E+01	4.06E+05
Ce-139	1.38E-05	5.75E+03
Ce-142	4.74E-05	0.00E+00
Ce-144	5.82E+04	1.95E+05
Cs-134	5.98E+04	7.55E+04
Cs-135	1.08E+00	3.16E+04
Cs-137	2.93E+05	1.45E+05
Dy-159	2.25E-08	1.63E+03
Eu-152	2.31E+01	3.46E+05
Eu-154	8.72E+03	4.09E+05
Eu-155	2.37E+03	4.63E+04
Fr-223	3.03E-08	3.23E+03
Gd-153	1.41E-03	8.87E+03
H-3	9.95E+02	9.70E+02
H-3A	3.55E-02	9.70E+02
Ho-166m	8.80E-05	1.06E+06
I-129	8.82E-02	1.33E+05
Kr-81	6.51E-08	0.00E+00
Kr-85	2.50E+04	0.00E+00
La-137	1.53E-05	3.26E+04
Nb-93m	1.60E+00	6.56E+03
Nb-94	3.06E-04	1.80E+05
Nb-95	4.46E-02	6.48E+03
Nb-95m	2.03E-04	3.26E+03
Nd-144	1.84E-09	0.00E+00
P-32	7.69E-08	2.88E+03
Pb-210	1.02E-09	3.36E+06
Pb-211	2.11E-06	1.44E+04
Pb-212	1.47E-03	6.67E+04
Pd-107	2.15E-01	2.17E+03
Pm-146	5.68E-04	1.64E+05
Pm-147	1.87E+05	2.58E+04
Pm-148G	3.56E-10	1.42E+04
Pm-148M	6.74E-09	1.42E+04
Po-210	1.04E-09	2.25E+06
Po-211	5.91E-09	0.00E+00
Po-212	9.38E-04	0.00E+00
Po-214	2.11E-06	0.00E+00
Po-215	1.47E-03	0.00E+00
Pr-144	5.82E+04	6.77E+01
Pr-144m	7.57E+02	0.00E+00
Ra-223	2.15E-06	4.61E+05
Ra-224	1.47E-03	2.81E+05
Rb-87	6.82E-09	1.45E+03
Rh-103m	5.50E-08	1.01E+01
Rh-106	4.01E+04	0.00E+00
Ra-219	2.15E-06	0.00E+00
Ra-220	1.47E-03	0.00E+00
Ru-103	5.50E-08	1.77E+03
Ru-106	4.01E+04	2.94E+04
Sb-124	5.67E-08	3.17E+04
Sb-125	5.96E+03	4.39E+05

PBMR (notebook)

DO NOT USE

Fission Products

Radionuclide	Ci/MTU	Rem/Ci (inhalation)
H-3	1.10E+05	9.70E+02
Be-10	9.63E-04	2.43E+04
C-14	3.86E-02	2.12E+04
Se-79	2.20E+01	4.20E+03
Kr-81	9.90E-05	0.00E+00
Kr-85	2.13E+06	0.00E+00
Rb-87	7.31E-03	1.84E+03
Sr-89	1.39E-03	2.94E+04
Y-89m	1.29E-07	0.00E+00
Sr-90	2.37E+07	5.81E+05
Y-90	2.37E+07	5.15E+03
Y-91	5.66E-02	3.30E+04
Nb-91	1.69E-06	0.00E+00
Nb-92	4.03E-09	0.00E+00
Zr-93	4.05E+02	9.28E+04
Nb-93m	1.10E+02	6.56E+03
Nb-94	2.70E-02	1.80E+05
Zr-95	5.23E-01	2.16E+04
Nb-95	1.15E+00	6.48E+03
Nb-95m	6.16E-03	3.26E+03
Tc-98	2.46E-04	3.61E+03
Tc-99	4.33E+03	4.94E+04
Sb-124	6.72E-05	3.17E+04
Sb-125	5.50E+05	4.39E+05
Te-125m	1.34E+05	1.25E+04
Sn-126	1.56E+02	5.72E+05
Sb-126	2.19E+01	1.20E+04
Sb-126m	1.56E+02	7.25E+01
Te-127	1.90E+01	5.16E+02
Te-127m	1.94E+01	3.62E+04
I-129	1.01E+01	1.33E+05
Ba-133	4.81E-03	5.63E+03
Cs-134	8.84E+06	7.55E+04
Cs-135	1.29E+02	3.16E+04
Cs-137	3.10E+07	1.45E+05
Ba-137m	2.93E+07	0.00E+00
La-138	6.62E-08	5.77E+05
Ce-139	1.89E-03	5.75E+03
Ce-141	2.42E-09	3.47E+04
Ce-142	9.09E-03	0.00E+00
Ce-144	2.61E+06	1.95E+05
Rh-102	1.42E+01	6.48E+04
Ru-103	2.03E-06	1.09E+04
Rh-103m	2.02E-06	1.01E+01
Ru-106	3.67E+06	2.44E+05
Rh-106	3.67E+06	0.00E+00
Pd-107	3.20E+01	9.41E+01
Ag-108	1.37E-02	0.00E+00
Ag-108m	1.58E-01	0.00E+00
Cd-109	1.23E-03	3.02E+04
Ag-110	6.87E+01	0.00E+00
Ag-110m	5.05E+03	4.57E+04
Cd-113m	6.44E+03	4.06E+05
In-114	1.20E-08	0.00E+00
In-114m	1.25E-08	3.46E+04
Cd-115m	2.49E-08	2.83E+04
In-115	2.25E-09	1.44E+06
Sn-119m	6.17E+01	1.23E+04
Sn-121	4.62E+02	2.23E+02
Sn-121m	5.95E+02	5.55E+04
Sn-123	4.91E+00	4.76E+04
Te-123m	5.36E-03	1.88E+04
Pr-144	2.61E+06	6.77E+01
Pr-144m	3.65E+04	0.00E+00

PBMR (letter)

Fission Products

Radionuclide	Ci/MTU	Rem/Ci (inhalation)
H-3	1.36E+03	9.70E+02
Be-10	1.19E-05	2.43E+04
C-14	4.77E-04	2.12E+04
Se-79	2.71E-01	4.20E+03
Kr-81	1.22E-06	0.00E+00
Kr-85	2.63E+04	0.00E+00
Rb-87	9.02E-05	1.84E+03
Sr-89	1.71E-05	2.94E+04
Y-89m	1.59E-09	0.00E+00
Sr-90	2.92E+05	5.81E+05
Y-90	2.92E+05	5.15E+03
Y-91	6.99E-04	3.30E+04
Nb-91	2.09E-08	0.00E+00
Zr-93	5.00E+00	9.28E+04
Nb-93m	1.36E+00	6.56E+03
Nb-94	3.33E-04	1.80E+05
Zr-95	6.46E-03	2.16E+04
Nb-95	1.42E-02	6.48E+03
Nb-95m	7.60E-05	3.26E+03
Tc-98	3.03E-06	3.61E+03
Tc-99	5.34E+01	4.94E+04
Rh-102	1.76E-01	6.48E+04
Ru-103	2.50E-08	1.09E+04
Rh-103m	2.49E-08	1.01E+01
Ru-106	4.53E+04	2.44E+05
Rh-106	4.53E+04	0.00E+00
Pd-107	3.96E-01	9.41E+01
Ag-108	1.69E-04	0.00E+00
Ag-108m	1.94E-03	0.00E+00
Ag-109m	1.52E-05	3.02E+04
Cd-109	1.52E-05	0.00E+00
Ag-110	8.48E-01	0.00E+00
Ag-110m	6.23E+01	4.57E+04
Cd-113m	7.94E+01	4.06E+05
Sn-119m	7.62E-01	1.23E+04
Sn-121	5.70E+00	2.23E+02
Sn-121m	7.34E+00	5.55E+04
Sn-123	6.06E-02	4.76E+04
Te-123m	6.62E-05	1.88E+04
Sb-124	8.30E-07	3.17E+04
Sb-125	6.79E+03	4.39E+05
Te-125m	1.66E+03	1.25E+04
Sn-126	1.92E+00	5.72E+05
Sb-126	2.70E-01	1.20E+04
Sb-126m	1.92E+00	7.25E+01
Te-127	2.34E-01	5.16E+02
Te-127m	2.40E-01	3.62E+04
I-129	1.24E-01	1.33E+05
Ba-133	5.93E-05	5.63E+03
Cs-134	1.09E+05	7.55E+04
Cs-135	1.59E+00	3.16E+04
Cs-137	3.82E+05	1.45E+05
Ba-137m	3.61E+05	0.00E+00
Ce-139	2.33E-05	5.75E+03
Ce-142	1.12E-04	0.00E+00
Ce-144	3.22E+04	1.95E+05
Pr-144	3.22E+04	6.77E+01
Pr-144m	4.51E+02	0.00E+00
Nd-144	7.52E-09	0.00E+00
Pm-145	1.29E-03	3.12E+04
Sm-145	5.28E-05	1.08E+04
Pm-146	8.08E-01	1.64E+05
Sm-146	1.06E-07	9.40E+07
Pm-147	1.37E+05	2.58E+04

PBMR	AP-1000	ABWR	MHR
Radio-nuclide	Radio-nuclide	Radio-nuclide	Radio-nuclide
Pu-241	Pu-241	Pu-241	Pu-241
Pu-238	Pu-238	Pu-238	Pu-238
Cm-244	Cm-244	Cm-244	Am-241
Am-241	Am-241	Am-241	Pu-240
Pu-240	Pu-240	Pu-240	Pu-239
Sr-90	Pu-239	Pu-239	Cm-244
Pu-239	Sr-90	Sr-90	Sr-90
Cs-137	Cs-137	Cs-137	Cs-137
Am-243	Am-243	Am-243	U-236
U-236	Cm-243	U-236	Ce-144
Cm-243	U-236	Am-242m	Am-243
Ru-106	Am-242m	Cm-243	Pm-147
Cs-134	Ru-106	Eu-154	Am-242m
Am-242m	Eu-154	Ru-106	Cs-134
Ce-144	Cs-134	Cs-134	Eu-154
Pu-242	Ce-144	Ce-144	Sb-125
Eu-154	Sb-125	Cm-242	Pu-242
Pm-147	Pu-242	Pu-242	Cm-243
Sb-125	Cm-242	Pm-147	Y-90
Cm-242	Pm-147	Y-90	Ru-106
Y-90	Cm-245	Sb-125	Cm-242
Cm-245	Y-90	Co-60	
	Eu-155	Eu-155	
		Cm-245	
		Sb-125	
		Eu-154	

Co-60, Sb-125, and Eu-154 are activation products

ACR-700

Radionuclide	Ci/MTU	Rem/Ci (inhalation)
H-3		
Be-10		
C-14		
Se-79		
Kr-85		
Rb-87		
Sr-89		
Sr-90		
Y-90		
Y-91		
Zr-93		
Nb-93m		
Nb-94		
Zr-95		
Nb-95		
Nb-95m		
Tc-98		
Tc-99		
Rh-102		
Ru-106		
Rh-106		
Pd-107		
Ag-108		
Ag-108m		
Ag-109m		
Cd-1009		
Ag-110		
Ag-110m		
Cd-113m		
Sn-119m		
Sn-121		
Sn-123		
Te-123m		
Sb-124		
Sb-125		
Te-125m		
Sn-126		
Sb-126		
Sb-126m		
Te-127		
Te-127m		
I-129		
Ba-133		
Cs-134		
Cs-135		
Cs-137		
Ba-137m		
Ce-139		
Ce-142		
Ce-144		
Pr-144		
Pr-144m		
Pm-145		
Sm-145		
Pm-146		
Pm-147		
Pr-144m	Duplicate	
Pm-145	Duplicate	
Sm-145	Duplicate	
Pm-146	Duplicate	
Pm-147	Duplicate	
Sm-147		
Eu-150		
Sm-151		

Zr-93	6.86E-01	9.28E+04
Zr-95	2.05E-04	2.16E+04
	7.98E+03	
Fission Products		
Ag-108	3.44E-06	0.00E+00
Ag-109m	1.36E-04	0.00E+00
Ag-110	4.40E-01	0.00E+00
Ag-110m	3.34E+01	4.57E+04
Ba-137m	1.18E+05	0.00E+00
Cd-113m	6.13E+01	4.06E+05
Cd-115m	6.79E-10	2.83E+04
Ce-141	1.49E-11	3.47E+04
Ce-144	1.14E+04	1.95E+05
Cs-134	4.81E+04	7.55E+04
Cs-135	8.22E-01	3.16E+04
Cs-137	1.24E+05	1.45E+05
Eu-152	1.09E+01	3.46E+05
Eu-154	1.01E+04	4.09E+05
Eu-155	5.22E+03	4.63E+04
Gd-153	1.41E-01	8.87E+03
H-3	5.34E+02	9.70E+02
I-129	4.20E-02	1.33E+05
In-114	4.21E-11	0.00E+00
In-114m	4.39E-11	3.46E+04
In-115m	4.77E-14	2.31E+02
Kr-85	8.90E+03	0.00E+00
Nb-93m	7.54E-01	6.56E+03
Nb-95	6.78E-03	6.48E+03
Nb-95m	2.27E-05	3.26E+03
Pd-107	1.46E-01	2.17E+03
Pm-146	1.84E+00	1.64E+05
Pm-147	3.37E+04	2.58E+04
Pm-148	8.59E-11	8.03E+03
Pm-148m	1.52E-09	2.13E+04
Pr-144	1.14E+04	6.77E+01
Pr-144m	1.37E+02	0.00E+00
Rh-102	4.67E-01	6.48E+04
Rh-103m	1.09E-08	1.01E+01
Rh-106	1.64E+04	0.00E+00
Ru-103	1.21E-08	1.09E+04
Ru-106	1.64E+04	2.44E+05
Sb-124	1.17E-06	3.17E+04
Sb-125	4.45E+03	4.39E+04
Sb-126	1.43E-01	1.20E+04
Sb-126m	1.02E+00	7.25E+01
Sc-79	5.61E-01	2.50E+04
Sm-151	5.60E+02	3.40E+04
Sn-119m	1.24E+00	1.23E+04
Sn-121m	2.46E-01	5.55E+04
Sn-123	1.60E-01	4.76E+04
Sn-126	1.02E+00	5.72E+05
Sr-89	8.33E-06	2.94E+04
Sr-90	8.85E+04	5.81E+05
Tb-160	3.14E-05	3.06E+04
Tc-99	1.74E+01	4.94E+04
Te-123m	6.79E-04	1.88E+04
Te-125m	1.09E+03	1.53E+04
Te-127	1.02E-01	5.16E+02
Te-127m	1.04E-01	3.62E+04
Te-129	1.02E-12	1.45E+02
Te-129m	1.57E-12	2.93E+04
Y-90	8.85E+04	5.54E+03
Y-91	3.38E-04	3.30E+04
Zr-93	2.50E+00	9.28E+04
Zr-95	3.05E-03	2.16E+04
	5.88E+05	
Actinides and Daughters		
Am-241	1.34E+03	3.57E+08
Am-242	3.32E+01	7.29E+04
Am-242m	3.34E+01	3.41E+08
Am-243	3.24E+01	3.54E+08

Tm-170	7.69E-06	1.34E+04
Tm-171	6.76E-04	7.90E+03
	4.45E+05	
Actinides		
Tl-207	1.25E-07	0.00E+00
Tl-208	1.15E-02	0.00E+00
Tl-209	4.54E-09	0.00E+00
Pb-209	2.10E-07	0.00E+00
Pb-210	3.69E-09	3.36E+06
Pb-211	1.26E-07	1.44E+04
Pb-212	3.21E-02	6.67E+04
Pb-214	2.89E-09	1.08E+04
Bi-210	3.70E-09	3.94E+03
Bi-211	1.26E-07	0.00E+00
Bi-212	3.21E-02	1.23E+05
Bi-213	2.10E-07	3.87E+04
Bi-214	2.89E-09	2.67E+04
Po-210	3.70E-09	2.25E+06
Po-212	2.06E-02	0.00E+00
Po-213	2.06E-07	0.00E+00
Po-214	2.89E-09	0.00E+00
Po-215	1.26E-07	0.00E+00
Po-216	3.21E-02	0.00E+00
Po-218	2.89E-09	0.00E+00
At-217	2.10E-07	0.00E+00
Rn-219	1.26E-07	0.00E+00
Rn-220	3.21E-02	0.00E+00
Rn-222	2.89E-09	0.00E+00
Ra-224	3.21E-02	2.81E+05
Ac-225	2.10E-07	2.95E+06
Ac-227	1.26E-07	5.76E+08
Th-227	1.24E-07	2.48E+06
Th-228	3.21E-02	1.47E+08
Th-229	2.10E-07	8.85E+08
Th-230	3.05E-06	3.76E+08
Th-231	4.92E-03	1.24E+03
Th-234	1.62E-01	2.85E+04
Pa-231	9.21E-07	8.50E+08
Pa-233	4.79E-01	3.81E+03
Pa-234m	1.62E-01	0.00E+00
Pa-234	2.11E-04	6.04E+02
U-232	4.69E-02	1.37E+08
U-233	1.34E-05	2.15E+06
U-234	1.07E-01	3.48E+07
U-235	4.93E-03	3.13E+07
U-236	2.12E-01	3.23E+07
U-237	1.71E+00	6.96E+03
U-238	1.62E-01	2.97E+07
U-240	1.70E-06	2.15E+03
Np-235	4.61E-04	1.84E+08
Np-236	9.49E-06	3.34E+04
Np-237	4.79E-01	1.95E+03
Np-238	6.56E-02	1.29E+04
Np-239	3.34E+01	3.80E+03
Np-240m	1.70E-06	0.00E+00
Pu-236	3.90E-01	1.47E+08
Pu-238	6.07E+03	4.00E+08
Pu-239	2.55E+02	4.41E+08
Pu-240	5.43E+02	4.41E+08
Pu-241	6.96E+04	4.41E+08
Pu-242	1.82E+00	4.19E+08
Pu-243	2.77E-06	3.20E+02
Pu-244	1.71E-06	0.00E+00
Am-241	7.27E+02	3.57E+08
Am-242m	1.31E+01	3.41E+08
Am-242	1.31E+01	7.29E+04
Am-243	3.34E+01	3.54E+08
Am-245	2.29E-08	2.08E+02
Am-246	9.78E-13	1.23E-01
Cm-242	2.83E+01	2.19E+07
Cm-243	3.07E+01	2.57E+08
Cm-244	7.75E+03	2.11E+08

Sb-126	2.12E-01	1.20E+04
Sb-126m	1.52E+00	7.25E+01
Sb-126n	1.02E+00	7.25E+01
Se-79	1.10E+00	4.20E+03
Si-32	2.65E-09	1.18E+04
Sm-147	1.74E-05	8.54E+07
Sm-151	1.75E+03	3.40E+04
Sn-119m	1.31E+00	1.23E+04
Sn-121m	5.58E-01	5.55E+04
Sn-123	1.03E-01	4.76E+04
Sn-126	1.52E+00	5.72E+05
Sr-89	6.42E-05	2.94E+04
Sr-90	2.42E+05	5.81E+05
Tb-157	2.61E-05	1.10E+04
Tb-158	3.60E-04	3.88E+05
Tb-160	3.51E-07	1.55E+04
Tc-97	7.92E-10	1.62E+02
Tc-98	2.35E-07	3.61E+03
Tc-99	4.38E+01	4.94E+04
Te-123m	2.86E-07	1.88E+04
Te-125m	8.54E+02	1.25E+04
Te-127	4.10E-01	5.16E+02
Te-127m	4.18E-01	3.62E+04
Tl-207	2.10E-06	0.00E+00
Tl-208	5.27E-04	0.00E+00
Y-89m	9.63E-09	0.00E+00
Y-90	2.42E+05	5.15E+03
Y-91	2.51E-03	3.30E+04
Zr-93	6.10E+00	9.28E+04
Zr-95	2.02E-02	2.16E+04
	1.54E+06	
Actinides		
Ac-227	2.20E-06	5.76E+08
Am-241	2.21E+03	3.57E+08
Am-242	1.36E+01	7.29E+04
Am-242m	1.36E+01	3.41E+08
Am-243	1.39E+01	3.54E+08
Bk-249	2.04E-07	1.50E+06
Cf-249	3.17E-08	6.20E+08
Cf-250	7.20E-09	2.72E+08
Cm-242	4.08E+01	2.19E+07
Cm-243	5.45E+00	2.57E+08
Cm-244	7.64E+02	2.11E+08
Cm-245	4.36E-03	3.65E+08
Cm-246	8.34E-04	5.86E+07
Cm-247	1.71E-09	3.33E+08
Cm-248	2.86E-09	0.00E+00
Np-236	5.35E-05	3.34E+04
Np-237	7.11E-01	1.95E+03
Pa-231	2.28E-05	8.50E+08
Pu-236	3.57E-06	1.47E+08
Pu-238	3.17E+03	4.00E+08
Pu-239	6.07E+02	4.41E+08
Pu-240	1.07E+03	4.41E+08
Pu-241	2.25E+05	4.41E+08
Pu-242	4.21E+00	4.19E+08
Pu-244	1.49E-07	0.00E+00
Th-227	2.12E-06	2.48E+06
Th-228	1.47E-03	1.47E+08
Th-231	1.68E-01	1.24E+03
U-232	1.65E-03	1.37E+08
U-235	1.68E-01	3.13E+07
U-236	1.14E+00	3.23E+07
U-238	3.15E-01	2.97E+07
	2.33E+05	

Nd-144	6.09E-07	0.00E+00
Pm-145	1.04E-01	3.12E+04
Sm-145	4.28E-03	1.08E+04
Pm-146	6.54E+01	1.64E+05
Sm-146	8.60E-06	9.40E+07
Pm-147	1.11E+07	2.58E+04
Sm-147	1.50E-03	8.54E+07
Pm-148	1.08E-08	8.03E+03
Pm-148m	2.05E-07	2.13E+04
Sm-148	1.31E-08	0.00E+00
Sm-149	1.28E-10	0.00E+00
Sm-151	8.75E+04	3.40E+04
Eu-152	5.14E+02	3.46E+05
Gd-152	3.59E-10	7.04E+07
Gd-153	3.47E+01	8.87E+03
Eu-154	8.17E+05	4.09E+05
Eu-155	2.38E+05	4.63E+04
Tb-160	6.88E-03	1.55E+04
Ho-166m	2.52E-01	1.06E+06
Tm-170	2.37E-07	3.44E+04
Tm-171	1.23E-01	7.90E+03
	1.44E+08	
DO NOT USE		
Actinides		
DO NOT USE		
Tl-207	1.19E-04	0.00E+00
Tl-208	1.26E-01	0.00E+00
Tl-209	5.22E-08	0.00E+00
Pb-209	2.48E-06	0.00E+00
Pb-210	7.22E-08	3.36E+06
Pb-211	1.19E-04	1.44E+04
Pb-212	3.49E-01	7.03E+05
Pb-214	8.97E-07	1.08E+04
Bi-210	7.22E-08	3.94E+03
Bi-211	1.19E-04	0.00E+00
Bi-212	3.49E-01	1.23E+05
Bi-213	2.48E-06	3.87E+04
Bi-214	8.97E-07	2.67E+04
Po-210	7.22E-08	2.25E+06
Po-211	3.28E-07	0.00E+00
Po-212	2.24E-01	0.00E+00
Po-213	2.43E-06	0.00E+00
Po-214	8.97E-07	0.00E+00
Po-215	1.19E-04	0.00E+00
Po-216	3.49E-01	0.00E+00
Po-218	8.97E-07	0.00E+00
At-217	2.48E-06	0.00E+00
Rn-219	1.19E-04	0.00E+00
Rn-220	3.49E-01	0.00E+00
Rn-222	8.97E-07	0.00E+00
Fr-221	2.48E-06	0.00E+00
Fr-223	1.64E-06	3.32E+03
Ra-223	1.19E-04	4.61E+05
Ra-224	3.49E-01	1.24E+07
Ra-225	2.48E-06	4.75E+05
Ra-226	8.97E-07	1.33E+06
Ra-228	1.22E-08	3.36E+06
Ac-225	2.48E-06	2.95E+06
Ac-227	1.19E-04	5.76E+08
Ac-228	1.22E-08	4.41E+04
Th-227	1.17E-04	2.48E+06
Th-228	3.49E-01	1.47E+08
Th-229	2.48E-06	8.85E+08
Th-230	7.25E-04	3.76E+08
Th-231	2.27E+00	1.24E+03
Th-232	3.52E-08	4.07E+08
Th-234	2.21E+01	2.85E+04
Pa-231	6.90E-04	8.50E+08
Pa-233	8.03E+01	3.81E+03
Pa-234m	2.21E+01	0.00E+00
Pa-234	2.88E-02	6.04E+02
U-232	4.73E-01	1.37E+08
U-233	2.16E-03	2.15E+06

Sm-147	1.86E-05	8.54E+07
Pm-148m	2.53E-09	2.13E+04
Sm-151	1.08E+03	3.40E+04
Eu-152	6.34E+00	3.46E+05
Gd-153	4.29E-01	8.87E+03
Eu-154	1.01E+04	4.09E+05
Eu-155	2.93E+03	4.63E+04
Tb-160	8.49E-05	1.55E+04
Ho-166m	3.11E-03	1.06E+06
Tm-170	2.92E-09	3.44E+04
Tm-171	1.52E-03	7.90E+03
	1.78E+06	
Actinides		
Tl-207	1.47E-06	0.00E+00
Tl-208	1.56E-03	0.00E+00
Tl-209	6.44E-10	0.00E+00
Pb-209	3.07E-08	0.00E+00
Pb-210	8.91E-10	3.36E+06
Pb-211	1.47E-06	1.44E+04
Pb-212	4.31E-03	7.03E+05
Pb-214	1.11E-08	1.08E+04
Bi-210	8.91E-10	3.94E+03
Bi-211	1.47E-06	0.00E+00
Bi-212	4.31E-03	1.23E+05
Bi-213	3.07E-08	3.87E+04
Bi-214	1.11E-08	2.67E+04
Po-210	8.91E-10	2.25E+06
Po-211	4.04E-09	0.00E+00
Po-212	2.77E-03	0.00E+00
Po-213	3.00E-08	0.00E+00
Po-214	1.11E-08	0.00E+00
Po-215	1.47E-06	0.00E+00
Po-216	4.31E-03	0.00E+00
Po-218	1.11E-08	0.00E+00
At-217	3.07E-08	0.00E+00
Rn-219	1.47E-06	0.00E+00
Rn-220	4.31E-03	0.00E+00
Rn-222	1.11E-08	0.00E+00
Fr-221	3.07E-08	0.00E+00
Fr-223	2.02E-08	3.32E+03
Ra-223	1.47E-06	4.61E+05
Ra-224	4.31E-03	1.24E+07
Ra-225	3.07E-08	4.75E+05
Ra-226	1.11E-08	1.33E+06
Ra-228	1.51E-10	3.36E+06
Ac-225	3.07E-08	2.95E+06
Ac-227	1.47E-06	5.76E+08
Ac-228	1.51E-10	4.41E+04
Th-227	1.44E-06	2.48E+06
Th-228	4.31E-03	1.47E+08
Th-229	3.07E-08	8.85E+08
Th-230	8.94E-06	3.76E+08
Th-231	2.80E-02	1.24E+03
Th-232	4.34E-10	4.07E+08
Th-234	2.73E-01	2.85E+04
Pa-231	8.52E-06	8.50E+08
Pa-233	9.91E-01	3.81E+03
Pa-234m	2.73E-01	0.00E+00
Pa-234	3.56E-04	6.04E+02
U-232	5.83E-03	1.37E+08
U-233	2.67E-05	2.15E+06
U-234	2.51E-01	3.48E+07
U-235	2.08E-02	3.13E+07
U-236	1.17E+00	3.23E+07
U-237	4.66E+00	6.96E+03
U-238	2.73E-01	2.97E+07
Np-235	2.08E-04	1.84E+08
Np-236	3.10E-06	3.34E+04
Np-237	9.91E-01	1.95E+03
Np-238	1.03E-01	1.29E+04
Np-239	1.29E+02	3.80E+03

Eu-152
Gd-153
Eu-154
Eu-155
Tb-160
Ho-166m
Tm-171

Am-245	2.50E-09	2.08E+02
Bi-212	4.49E-02	1.23E+05
Bk-249	1.72E-04	1.50E+06
Cm-241	1.01E-17	1.38E+05
Cm-242	5.51E+01	2.19E+07
Cm-243	3.69E+01	2.57E+08
Cm-244	4.86E+03	2.11E+08
Cm-245	6.56E-01	3.65E+08
Cm-246	1.41E-01	5.86E+07
Np-235	5.01E-04	1.84E+08
Np-237	6.16E-01	1.95E+03
Np-238	1.67E-01	1.29E+04
Np-239	3.24E+01	3.80E+03
Np-240m	9.23E-07	0.00E+00
Pa-233	6.16E-01	1.43E+04
Pa-234m	3.13E-01	0.00E+00
Pb-212	4.49E-02	7.03E+05
Po-212	2.88E-02	0.00E+00
Po-216	4.49E-02	0.00E+00
Pu-236	3.56E-01	1.47E+08
Pu-237	4.37E-12	1.45E+03
Pu-238	6.14E+03	4.00E+08
Pu-239	3.87E+02	4.41E+08
Pu-240	6.15E+02	4.41E+08
Pu-241	1.22E+05	4.41E+08
Pu-242	2.24E+00	4.19E+08
Pu-243	5.85E-07	3.20E+02
Ra-224	4.49E-02	1.24E+07
Rn-220	4.49E-02	0.00E+00
Th-228	4.49E-02	1.47E+08
Th-231	2.20E-02	1.24E+03
Th-234	3.13E-01	2.85E+04
Tl-208	1.61E-02	0.00E+00
U-232	6.00E-02	1.37E+08
U-234	1.47E+00	3.48E+07
U-235	2.20E-02	3.13E+07
U-236	3.77E-01	3.23E+07
U-237	3.00E+00	6.96E+03
U-238	3.13E-01	2.97E+07
U-240	9.23E-07	2.15E+03
	1.36E+05	

Cm-245	1.21E+00	3.65E+08
Cm-246	4.81E-01	5.86E+07
Bk-249	1.58E-03	1.50E+06
Bk-250	4.77E-08	5.66E-01
Cf-249	2.30E-04	1.27E+02
Cf-250	1.03E-03	8.62E+01
Cf-251	1.03E-05	1.32E+02
Cf-252	9.28E-04	0.00E+00
	8.51E+04	

U-234	2.03E+01	3.48E+07
U-235	2.27E+00	3.13E+07
U-236	9.45E+01	3.02E+10
U-237	3.77E+02	6.96E+03
U-238	2.21E+01	2.97E+07
Np-235	1.68E-02	1.84E+08
Np-236	2.51E-04	3.34E+04
Np-237	8.03E+01	1.95E+03
Np-238	8.38E+00	1.29E+04
Np-239	1.04E+04	3.80E+03
Pu-236	2.93E+00	1.47E+08
Pu-238	9.99E+05	4.00E+08
Pu-239	2.42E+04	4.41E+08
Pu-240	7.27E+04	4.41E+08
Pu-241	1.58E+07	4.41E+08
Pu-242	9.90E+02	4.19E+08
Pu-243	1.76E-04	3.20E+02
Am-241	1.66E+05	3.57E+08
Am-242m	1.86E+03	3.41E+08
Am-243	1.04E+04	3.54E+08
Am-245	5.04E-07	2.08E+02
Cm-242	6.09E+03	2.19E+07
Cm-243	4.28E+03	2.57E+08
Cm-244	1.20E+06	2.11E+08
Cm-245	1.16E+02	3.65E+08
Cm-246	5.28E+01	5.86E+07
Cm-247	1.76E-04	1.50E+06
Cm-248	5.95E-04	0.00E+00
Bk-249	3.47E-02	1.50E+06
Bk-250	2.03E-07	5.66E-01
Cf-249	5.16E-03	2.30E-04
Cf-250	2.37E-02	1.03E-03
Cf-251	1.81E-04	1.03E-05
Cf-252	1.55E-02	9.28E-04
Es-254	2.03E-07	3.76E+07
	1.83E+07	

DO NOT USE

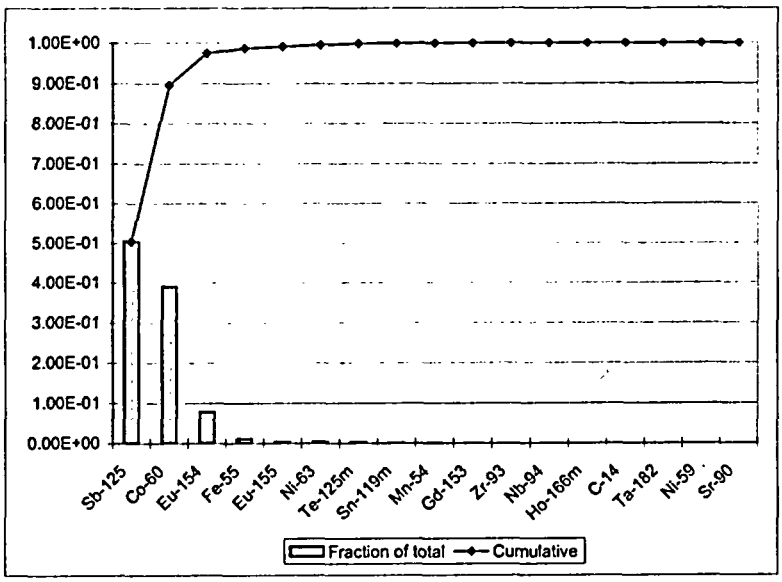
Pu-236	3.62E-02	1.47E+08
Pu-237	1.12E-12	9.81E+02
Pu-238	1.23E+04	4.00E+08
Pu-239	2.99E+02	4.41E+08
Pu-240	8.98E+02	4.41E+08
Pu-241	1.94E+05	4.41E+08
Pu-242	1.22E+01	4.19E+08
Pu-243	2.17E-06	3.20E+02
Am-241	2.04E+03	3.57E+08
Am-242m	2.30E+01	3.41E+08
Am-242	2.29E+01	4.16E+04
Am-243	1.29E+02	3.54E+08
Am-245	6.22E-09	2.08E+02
Cm-242	7.52E+01	2.19E+07
Cm-243	5.29E+01	2.57E+08
Cm-244	1.48E+04	2.11E+08
Cm-245	1.43E+00	3.65E+08
Cm-246	6.52E-01	5.86E+07
Cm-247	2.17E-06	1.50E+06
Cm-248	7.34E-06	0.00E+00
Bk-249	4.29E-04	1.50E+06
Bk-250	2.51E-09	5.66E-01
Cf-249	6.37E-05	2.30E-04
Cf-250	2.92E-04	1.03E-03
Cf-251	2.23E-06	1.03E-05
Cf-252	1.91E-04	9.28E-04
Es-254	2.51E-09	3.76E+07
	2.25E+05	

ABWR and ESBWR

Unit dose = Ci/MTU * Inhalation DCF
Fraction of Total = Unit Dose$_i$ * Σ_i (Unit Dose)$_i$

Activation Products

Radio-nuclide	Ci/MTU	Inhalation DCF,	Unit Dose	Fraction of total	Cumulative
Sb-125	9.16E+02	4.39E+05	4.02E+08	5.05E-01	5.0507E-01
Co-60	2.73E+03	1.14E+05	3.11E+08	3.91E-01	8.9596E-01
Eu-154	1.53E+02	4.09E+05	6.26E+07	7.86E-02	9.7456E-01
Fe-55	3.35E+03	2.89E+03	9.68E+06	1.22E-02	9.8672E-01
Eu-155	7.14E+01	4.63E+04	3.31E+06	4.15E-03	9.9087E-01
Ni-63	4.20E+02	7.26E+03	3.05E+06	3.83E-03	9.9470E-01
Te-125m	2.24E+02	1.25E+04	2.80E+06	3.52E-03	9.9822E-01
Sn-119m	5.20E+01	1.23E+04	6.40E+05	8.03E-04	9.9902E-01
Mn-54	3.46E+01	1.21E+04	4.19E+05	5.26E-04	9.9955E-01
Gd-153	2.26E+01	8.87E+03	2.00E+05	2.52E-04	9.9980E-01
Zr-93	6.86E-01	9.28E+04	6.37E+04	8.00E-05	9.9988E-01
Nb-94	1.76E-01	1.80E+05	3.17E+04	3.98E-05	9.9992E-01
Ho-166m	2.39E-02	1.06E+06	2.53E+04	3.18E-05	9.9995E-01
C-14	7.70E-01	2.12E+04	1.63E+04	2.05E-05	9.9997E-01
Ta-182	1.74E-01	3.86E+04	6.72E+03	8.44E-06	9.9998E-01
Ni-59	2.59E+00	1.64E+03	4.25E+03	5.34E-06	9.9999E-01
Sr-90	6.68E-03	5.81E+05	3.88E+03	4.87E-06	9.9999E-01
Cl-36	1.86E-02	1.40E+05	2.60E+03	3.27E-06	1.00E+00
Nb-93m	1.98E-01	6.56E+03	1.30E+03	1.63E-06	1.00E+00
Sn-123	2.40E-02	4.76E+04	1.14E+03	1.43E-06	1.00E+00
Eu-152	1.08E-03	3.46E+05	3.74E+02	4.69E-07	1.00E+00
Sn-113	1.95E-02	1.46E+04	2.85E+02	3.58E-07	1.00E+00
Tc-99	4.80E-03	4.94E+04	2.37E+02	2.98E-07	1.00E+00
Mo-93	1.95E-02	8.60E+03	1.68E+02	2.11E-07	1.00E+00
Y-90	6.68E-03	5.15E+03	3.44E+01	4.32E-08	1.00E+00
Cd-109	7.76E-04	3.02E+04	2.34E+01	2.94E-08	1.00E+00
Zn-65	2.39E-03	8.32E+03	1.99E+01	2.50E-08	1.00E+00
In-113m	1.95E-02	7.77E+02	1.52E+01	1.90E-08	1.00E+00
Ca-45	8.65E-04	1.35E+04	1.17E+01	1.47E-08	1.00E+00
Te-123m	2.45E-04	1.88E+04	4.61E+00	5.79E-09	1.00E+00
Zr-95	2.05E-04	2.16E+04	4.43E+00	5.56E-09	1.00E+00
Nb-95	4.55E-04	6.48E+03	2.95E+00	3.70E-09	1.00E+00
Ca-41	1.18E-03	6.70E+02	7.91E-01	9.93E-10	1.00E+00
Co-58	7.49E-05	7.83E+03	5.86E-01	7.37E-10	1.00E+00
H-3	5.24E-04	9.70E+02	5.08E-01	6.38E-10	1.00E+00
Lu-177m	3.93E-06	5.98E+04	2.35E-01	2.95E-10	1.00E+00
W-181	1.82E-04	1.01E+03	1.84E-01	2.31E-10	1.00E+00
W-185	1.08E-05	1.43E+04	1.54E-01	1.94E-10	1.00E+00
Te-127m	7.67E-07	3.62E+04	2.78E-02	3.49E-11	1.00E+00
Sc-46	7.04E-07	2.50E+04	1.76E-02	2.21E-11	1.00E+00
Tm-170	2.43E-07	3.44E+04	8.36E-03	1.05E-11	1.00E+00
W-188	9.46E-08	5.74E+04	5.43E-03	6.82E-12	1.00E+00
Nb-95m	1.52E-06	3.26E+03	4.96E-03	6.22E-12	1.00E+00
Lu-177	9.04E-07	4.43E+03	4.00E-03	5.03E-12	1.00E+00
Y-91	6.98E-08	3.30E+04	2.30E-03	2.89E-12	1.00E+00
Ir-192	8.59E-08	2.45E+04	2.10E-03	2.64E-12	1.00E+00
Hf-175	3.05E-07	5.28E+03	1.61E-03	2.02E-12	1.00E+00
Sb-124	2.93E-08	3.17E+04	9.29E-04	1.17E-12	1.00E+00
Sn-121m	1.12E+00	5.55E-04	6.22E-04	7.81E-13	1.00E+00
P-32	2.89E-08	1.44E+04	4.16E-04	5.23E-13	1.00E+00
Te-127	7.52E-07	5.16E+02	3.88E-04	4.87E-13	1.00E+00
Re-188	9.56E-08	1.99E+03	1.90E-04	2.39E-13	1.00E+00
In-114m	1.70E-09	3.46E+04	5.88E-05	7.39E-14	1.00E+00
Sr-89	8.94E-10	2.94E+04	2.63E-05	3.30E-14	1.00E+00
Fe-59	4.32E-10	1.49E+04	6.44E-06	8.08E-15	1.00E+00
Hf-181	1.08E-10	2.20E+04	2.38E-06	2.98E-15	1.00E+00
Cd-115m	1.12E-13	2.83E+04	3.17E-09	3.98E-18	1.00E+00
K-42	1.63E-12	1.32E+03	2.15E-09	2.70E-18	1.00E+00
Ru-103	8.38E-16	1.09E+04	9.13E-12	1.15E-20	1.00E+00
Cr-51	5.28E-16	1.37E+02	7.23E-14	9.09E-23	1.00E+00
Ag-109m	7.76E-04	0.00E+00	0.00E+00	0.00E+00	1.00E+00
Ar-37	5.48E-16	0.00E+00	0.00E+00	0.00E+00	1.00E+00
Ar-39	3.42E-04	0.00E+00	0.00E+00	0.00E+00	1.00E+00
In-114	1.63E-09	0.00E+00	0.00E+00	0.00E+00	1.00E+00
S-35	1.84E-05	0.00E+00	0.00E+00	0.00E+00	1.00E+00
Tb-160	1.49E-03	0.00E+00	0.00E+00	0.00E+00	1.00E+00
	7.98E+03		7.96E+08	1.00E+00	



Fission Products

Sr-90	8.85E+04	5.81E+05	5.14E+10	6.03E-01	6.0314E-01
Cs-137	1.24E+05	1.45E+05	1.80E+10	2.11E-01	8.1404E-01
Eu-154	1.01E+04	4.09E+05	4.13E+09	4.85E-02	8.6250E-01

Ru-106	1.64E+04	2.44E+05	4.00E+09	4.69E-02	9.0944E-01	
Cs-134	4.81E+04	7.55E+04	3.63E+09	4.26E-02	9.5204E-01	
Ce-144	1.14E+04	1.95E+05	2.22E+09	2.61E-02	9.7811E-01	
Pm-147	3.37E+04	2.58E+04	8.69E+08	1.02E-02	9.8831E-01	
Y-90	8.85E+04	5.54E+03	4.90E+08	5.75E-03	9.9406E-01	
Eu-155	5.22E+03	4.63E+04	2.42E+08	2.83E-03	9.9690E-01	
Sb-125	4.45E+03	4.39E+04	1.95E+08	2.29E-03	9.9919E-01	
Cd-113m	6.13E+01	4.06E+05	2.49E+07	2.92E-04	9.9948E-01	
Sm-151	5.60E+02	3.40E+04	1.90E+07	2.23E-04	9.9970E-01	
Te-125m	1.09E+03	1.53E+04	1.67E+07	1.96E-04	9.9990E-01	
Eu-152	1.09E+01	3.46E+05	3.77E+06	4.42E-05	9.9994E-01	
Ag-110m	3.34E+01	4.57E+04	1.53E+06	1.79E-05	9.9996E-01	
Tc-99	1.74E+01	4.94E+04	8.60E+05	1.01E-05	9.9997E-01	
Pr-144	1.14E+04	6.77E+01	7.72E+05	9.05E-06	9.9998E-01	
Sn-126	1.02E+00	5.72E+05	5.83E+05	6.84E-06	9.9999E-01	
H-3	5.34E+02	9.70E+02	5.18E+05	6.08E-06	9.9999E-01	
Pm-146	1.84E+00	1.64E+05	3.02E+05	3.54E-06	1.00E+00	
Zr-93	2.50E+00	9.28E+04	2.32E+05	2.72E-06	1.00E+00	
Rh-102	4.67E-01	6.48E+04	3.03E+04	3.55E-07	1.00E+00	
Cs-135	8.22E-01	3.16E+04	2.60E+04	3.05E-07	1.00E+00	
Sn-119m	1.24E+00	1.23E+04	1.53E+04	1.79E-07	1.00E+00	
Se-79	5.61E-01	2.50E+04	1.40E+04	1.65E-07	1.00E+00	
Sn-121m	2.46E-01	5.55E+04	1.37E+04	1.60E-07	1.00E+00	
Sn-123	1.60E-01	4.76E+04	7.62E+03	8.93E-08	1.00E+00	
I-129	4.20E-02	1.33E+05	5.59E+03	6.55E-08	1.00E+00	
Nb-93m	7.54E-01	6.56E+03	4.95E+03	5.80E-08	1.00E+00	
Te-127m	1.04E-01	3.62E+04	3.76E+03	4.42E-08	1.00E+00	
Sb-126	1.43E-01	1.20E+04	1.72E+03	2.01E-08	1.00E+00	
Gd-153	1.41E-01	8.87E+03	1.25E+03	1.47E-08	1.00E+00	
Pd-107	1.46E-01	2.17E+03	3.17E+02	3.72E-09	1.00E+00	
Sb-126m	1.02E+00	7.25E+01	7.40E+01	8.67E-10	1.00E+00	
Zr-95	3.05E-03	2.16E+04	6.59E+01	7.73E-10	1.00E+00	
Te-127	1.02E-01	5.16E+02	5.26E+01	6.17E-10	1.00E+00	
Nb-95	6.78E-03	6.48E+03	4.39E+01	5.15E-10	1.00E+00	
Te-123m	6.79E-04	1.88E+04	1.28E+01	1.50E-10	1.00E+00	
Y-91	3.38E-04	3.30E+04	1.12E+01	1.31E-10	1.00E+00	
Tb-160	3.14E-05	3.06E+04	9.61E-01	1.13E-11	1.00E+00	
Sr-89	8.33E-06	2.94E+04	2.45E-01	2.87E-12	1.00E+00	
Nb-95m	2.27E-05	3.26E+03	7.40E-02	8.68E-13	1.00E+00	
Sb-124	1.17E-06	3.17E+04	3.71E-02	4.35E-13	1.00E+00	
Ru-103	1.21E-08	1.09E+04	1.32E-04	1.55E-15	1.00E+00	
Pm-148m	1.52E-09	2.13E+04	3.24E-05	3.80E-16	1.00E+00	
Cd-115m	6.79E-10	2.83E+04	1.92E-05	2.25E-16	1.00E+00	
In-114m	4.39E-11	3.46E+04	1.52E-06	1.78E-17	1.00E+00	
Pm-148	8.59E-11	8.03E+03	6.90E-07	8.09E-18	1.00E+00	
Ce-141	1.49E-11	3.47E+04	5.17E-07	6.06E-18	1.00E+00	
Rh-103m	1.09E-08	1.01E+01	1.10E-07	1.29E-18	1.00E+00	
Te-129m	1.57E-12	2.93E+04	4.60E-08	5.40E-19	1.00E+00	
Te-129	1.02E-12	1.45E+02	1.48E-10	1.73E-21	1.00E+00	
In-115m	4.77E-14	2.31E+02	1.10E-11	1.29E-22	1.00E+00	
Ag-108	3.44E-06	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
Ag-109m	1.36E-04	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
Ag-110	4.40E-01	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
Ba-137m	1.18E+05	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
In-114	4.21E-11	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
Kr-85	8.90E+03	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
Pr-144m	1.37E+02	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
Rh-106	1.64E+04	0.00E+00	0.00E+00	0.00E+00	1.00E+00	
	5.88E+05		8.53E+10			
Actinides and Daughters						
Pu-241	1.22E+05	4.41E+08	5.38E+13	9.24E-01	9.2364E-01	A
Pu-238	6.14E+03	4.00E+08	2.46E+12	4.22E-02	9.6580E-01	A
Cm-244	4.86E+03	2.11E+08	1.03E+12	1.76E-02	9.8341E-01	A
Am-241	1.34E+03	3.57E+08	4.78E+11	8.21E-03	9.9162E-01	A
Pu-240	6.15E+02	4.41E+08	2.71E+11	4.66E-03	9.9628E-01	A
Pu-239	3.87E+02	4.41E+08	1.71E+11	2.93E-03	9.9921E-01	A
Am-243	3.24E+01	3.54E+08	1.15E+10	1.97E-04	9.9940E-01	A
U-236	3.77E-01	3.02E+10	1.14E+10	1.96E-04	9.9960E-01	A
Am-242m	3.34E+01	3.41E+08	1.14E+10	1.96E-04	9.9979E-01	A
Cm-243	3.69E+01	2.57E+08	9.48E+09	1.63E-04	9.9996E-01	A
Cm-242	5.51E+01	2.19E+07	1.21E+09	2.07E-05	9.9998E-01	A
Pu-242	2.24E+00	4.19E+08	9.39E+08	1.61E-05	9.9999E-01	A
Cm-245	6.56E-01	3.65E+08	2.39E+08	4.11E-06	1.0000E+00	A
Pu-236	3.56E-01	1.47E+08	5.23E+07	8.98E-07	1.0000E+00	A
U-234	1.47E+00	3.48E+07	5.12E+07	8.78E-07	1.00E+00	A
U-238	3.13E-01	2.97E+07	9.30E+06	1.60E-07	1.00E+00	A
Cm-246	1.41E-01	5.86E+07	8.26E+06	1.42E-07	1.00E+00	A
U-232	6.00E-02	1.37E+08	8.22E+06	1.41E-07	1.00E+00	A
Th-228	4.49E-02	1.47E+08	6.60E+06	1.13E-07	1.00E+00	A
Am-242	3.32E+01	7.29E+04	2.42E+06	4.15E-08	1.00E+00	A

U-235	2.20E-02	3.13E+07	6.89E+05	1.18E-08	1.00E+00	A
Ra-224	4.49E-02	1.24E+07	5.57E+05	9.56E-09	1.00E+00	A
Np-239	3.24E+01	3.80E+03	1.23E+05	2.11E-09	1.00E+00	A
Np-235	5.01E-04	1.84E+08	9.22E+04	1.58E-09	1.00E+00	A
Pb-212	4.49E-02	7.03E+05	3.16E+04	5.42E-10	1.00E+00	A
U-237	3.00E+00	6.96E+03	2.09E+04	3.58E-10	1.00E+00	A
Th-234	3.13E-01	2.85E+04	8.92E+03	1.53E-10	1.00E+00	A
Pa-233	6.16E-01	1.43E+04	8.81E+03	1.51E-10	1.00E+00	A
Bi-212	4.49E-02	1.23E+05	5.52E+03	9.48E-11	1.00E+00	A
Np-238	1.67E-01	1.29E+04	2.15E+03	3.70E-11	1.00E+00	A
Np-237	6.16E-01	1.95E+03	1.20E+03	2.06E-11	1.00E+00	A
Bk-249	1.72E-04	1.50E+06	2.58E+02	4.43E-12	1.00E+00	A
Th-231	2.20E-02	1.24E+03	2.73E+01	4.68E-13	1.00E+00	A
U-240	9.23E-07	2.15E+03	1.98E-03	3.41E-17	1.00E+00	A
Pu-243	5.85E-07	3.20E+02	1.87E-04	3.21E-18	1.00E+00	A
Am-245	2.50E-09	2.08E+02	5.20E-07	8.93E-21	1.00E+00	A
Pu-237	4.37E-12	1.45E+03	6.34E-09	1.09E-22	1.00E+00	A
Cm-241	1.01E-17	1.38E+05	1.39E-12	2.39E-26	1.00E+00	A
Np-240m	9.23E-07	0.00E+00	0.00E+00	0.00E+00	1.00E+00	A
Pa-234m	3.13E-01	0.00E+00	0.00E+00	0.00E+00	1.00E+00	A
Po-212	2.88E-02	0.00E+00	0.00E+00	0.00E+00	1.00E+00	A
Po-216	4.49E-02	0.00E+00	0.00E+00	0.00E+00	1.00E+00	A
Rn-220	4.49E-02	0.00E+00	0.00E+00	0.00E+00	1.00E+00	A
Tl-208	1.61E-02	0.00E+00	0.00E+00	0.00E+00	1.00E+00	A
	1.36E+05		5.82E+13			

AP-1000

Unit dose = Ci/MTU * Inhalation DCF
Fraction of Total = Unit $Dose_i$ * Σ_i (Unit $Dose)_i$

Radio-nuclide	Ci/MTU	Inhalation DCF, rem/Ci	Unit Dose	Fraction of total	Cumulative
Pu-241	6.96E+04	4.41E+08	3.07E+13	8.66E-01	86.556%
Pu-238	6.07E+03	4.00E+08	2.43E+12	6.85E-02	93.401%
Cm-244	7.75E+03	2.11E+08	1.64E+12	4.62E-02	98.018%
Am-241	7.27E+02	3.57E+08	2.60E+11	7.33E-03	98.750%
Pu-240	5.43E+02	4.41E+08	2.39E+11	6.75E-03	99.426%
Pu-239	2.55E+02	4.41E+08	1.12E+11	3.17E-03	99.743%
Sr-90	6.19E+04	5.81E+05	3.59E+10	1.01E-03	99.844%
Cs-137	9.31E+04	1.45E+05	1.35E+10	3.81E-04	99.882%
Am-243	3.34E+01	3.54E+08	1.18E+10	3.34E-04	99.916%
Cm-243	3.07E+01	2.57E+08	7.88E+09	2.22E-04	99.938%
Am-242m	1.31E+01	3.41E+08	4.47E+09	1.26E-04	99.951%
Ru-106	1.55E+04	2.44E+05	3.77E+09	1.06E-04	99.961%
Eu-154	9.13E+03	4.09E+05	3.73E+09	1.05E-04	99.972%
Cs-134	4.80E+04	7.55E+04	3.63E+09	1.02E-04	99.982%
Ce-144	8.87E+03	1.95E+05	1.73E+09	4.88E-05	99.987%
Sb-125	3.83E+03	4.39E+05	1.68E+09	4.74E-05	99.992%
Pu-242	1.82E+00	4.19E+08	7.60E+08	2.15E-05	99.994%
Cm-242	2.83E+01	2.19E+07	6.20E+08	1.75E-05	99.996%
Pm-147	1.76E+04	2.58E+04	4.55E+08	1.28E-05	99.997%
Cm-245	1.21E+00	3.65E+08	4.40E+08	1.24E-05	99.998%
Y-90	6.19E+04	5.15E+03	3.19E+08	8.99E-06	99.999%
Eu-155	4.62E+03	4.63E+04	2.14E+08	6.03E-06	100.000%
Pu-236	3.90E-01	1.47E+08	5.74E+07	1.62E-06	100.000%
Cm-246	4.81E-01	5.86E+07	2.82E+07	7.95E-07	100.000%
Cd-113m	5.87E+01	4.06E+05	2.38E+07	6.73E-07	100.000%
Te-125m	9.34E+02	1.25E+04	1.17E+07	3.29E-07	100.000%
Sm-151	3.23E+02	3.40E+04	1.10E+07	3.09E-07	100.000%
U-236	2.12E-01	3.23E+07	6.85E+06	1.93E-07	100.000%
U-232	4.69E-02	1.37E+08	6.43E+06		
U-238	1.62E-01	2.97E+07	4.82E+06		
Th-228	3.21E-02	1.47E+08	4.72E+06		
U-234	1.07E-01	3.48E+07	3.73E+06		
Ag-110m	4.00E+01	4.57E+04	1.83E+06		
Eu-152	3.47E+00	3.46E+05	1.20E+06		
Am-242	1.31E+01	7.29E+04	9.51E+05		
Pr-144	8.87E+03	6.77E+01	6.01E+05		
Tc-99	1.20E+01	4.94E+04	5.94E+05		
Sn-126	8.18E-01	5.72E+05	4.68E+05		
H-3	4.17E+02	9.70E+02	4.04E+05		
Pm-146	1.62E+00	1.64E+05	2.65E+05		
Zr-93	1.77E+00	9.28E+04	1.64E+05		
U-235	4.93E-03	3.13E+07	1.54E+05		

Np-239	3.34E+01	3.80E+03	1.27E+05
Np-235	4.61E-04	1.84E+08	8.49E+04
Rh-102	4.69E-01	6.48E+04	3.04E+04
Sn-119m	1.25E+00	1.23E+04	1.54E+04
Cs-135	4.47E-01	3.16E+04	1.41E+04
U-237	1.71E+00	6.96E+03	1.19E+04
Ho-166m	8.56E-03	1.06E+06	9.07E+03
Ra-224	3.21E-02	2.81E+05	9.03E+03
Sn-123	1.45E-01	4.76E+04	6.91E+03
Th-234	1.62E-01	2.85E+04	4.63E+03
I-129	3.14E-02	1.33E+05	4.17E+03
Bi-212	3.21E-02	1.23E+05	3.95E+03
Nb-93m	5.24E-01	6.56E+03	3.43E+03
Te-127m	9.47E-02	3.62E+04	3.43E+03
Bk-249	1.58E-03	1.50E+06	2.37E+03
Pb-212	3.21E-02	6.67E+04	2.14E+03
Pa-233	4.79E-01	3.81E+03	1.83E+03
Se-79	4.11E-01	4.20E+03	1.73E+03
Sb-126	1.15E-01	1.20E+04	1.37E+03
Th-230	3.05E-06	3.76E+08	1.15E+03
Np-237	4.79E-01	1.95E+03	9.35E+02
Gd-153	1.14E-01	7.84E+03	8.92E+02
Np-238	6.56E-02	1.29E+04	8.46E+02
Pa-231	9.21E-07	8.50E+08	7.83E+02
Pd-107	1.25E-01	2.17E+03	2.72E+02
Sm-147	2.20E-06	8.54E+07	1.88E+02
Th-229	2.10E-07	8.85E+08	1.86E+02
Ac-227	1.26E-07	5.76E+08	7.24E+01
Sb-126m	8.18E-01	7.25E+01	5.93E+01
Zr-95	2.31E-03	2.16E+04	4.98E+01
Te-127	9.27E-02	5.16E+02	4.78E+01
Nb-95	5.12E-03	6.48E+03	3.32E+01
Sm-146	3.48E-07	9.40E+07	3.27E+01
U-233	1.34E-05	2.15E+06	2.88E+01
Nb-94	1.47E-04	1.80E+05	2.64E+01
Te-123m	1.21E-03	1.88E+04	2.28E+01
Eu-150	1.79E-05	4.66E+05	8.33E+00
Y-91	2.32E-04	3.30E+04	7.66E+00
Cd-109	2.16E-04	3.02E+04	6.52E+00
Th-231	4.92E-03	1.24E+03	6.10E+00
Tm-171	6.76E-04	7.90E+03	5.34E+00
Be-10	1.20E-04	2.43E+04	2.90E+00
Ac-225	2.10E-07	2.95E+06	6.20E-01
Np-236	9.49E-06	3.34E+04	3.17E-01
Th-227	1.24E-07	2.48E+06	3.08E-01
Sr-89	5.51E-06	2.94E+04	1.62E-01
Pa-234	2.11E-04	6.04E+02	1.28E-01
Tm-170	7.69E-06	1.34E+04	1.03E-01
Cf-250	1.03E-03	8.62E+01	8.86E-02
Nb-95m	1.71E-05	3.26E+03	5.57E-02
Sb-124	1.59E-06	3.17E+04	5.04E-02

Rb-87	2.09E-05	1.84E+03	3.84E-02
Tc-98	8.72E-06	3.61E+03	3.15E-02
Cf-249	2.30E-04	1.27E+02	2.92E-02
Pb-210	3.69E-09	3.36E+06	1.24E-02
Po-210	3.70E-09	2.25E+06	8.32E-03
Bi-213	2.10E-07	3.87E+04	8.13E-03
U-240	1.70E-06	2.15E+03	3.66E-03
Pb-211	1.26E-07	1.44E+04	1.81E-03
Cf-251	1.03E-05	1.32E+02	1.35E-03
Pu-243	2.77E-06	3.20E+02	8.87E-04
Ru-103	1.05E-08	1.09E+04	1.15E-04
Sn-121m	2.06E-01	5.55E-04	1.14E-04
Bi-214	2.89E-09	2.67E+04	7.72E-05
Pb-214	2.89E-09	1.08E+04	3.12E-05
Bi-210	3.70E-09	3.94E+03	1.46E-05
Am-245	2.29E-08	2.08E+02	4.76E-06
Bk-250	4.77E-08	5.66E-01	2.70E-08
Am-246	9.78E-13	1.23E-01	1.20E-13
Be-9	2.97E-06	0.00E+00	0.00E+00
Kr-81	7.65E-07	0.00E+00	0.00E+00
Kr-85	6.38E+03	0.00E+00	0.00E+00
Rh-106	1.55E+04	0.00E+00	0.00E+00
Ag-108	3.17E-06	0.00E+00	0.00E+00
Ag-108m	3.57E-05	0.00E+00	0.00E+00
Ag-109m	2.16E-04	0.00E+00	0.00E+00
Ag-110	5.32E-01	0.00E+00	0.00E+00
Ba-137m	8.81E+04	0.00E+00	0.00E+00
Ce-142	2.73E-05	0.00E+00	0.00E+00
Pr-144m	1.07E+02	0.00E+00	0.00E+00
Tb-160	4.35E-05	0.00E+00	0.00E+00
Tl-207	1.25E-07	0.00E+00	0.00E+00
Tl-208	1.15E-02	0.00E+00	0.00E+00
Tl-209	4.54E-09	0.00E+00	0.00E+00
Pb-209	2.10E-07	0.00E+00	0.00E+00
Bi-211	1.26E-07	0.00E+00	0.00E+00
Po-212	2.06E-02	0.00E+00	0.00E+00
Po-213	2.06E-07	0.00E+00	0.00E+00
Po-214	2.89E-09	0.00E+00	0.00E+00
Po-215	1.26E-07	0.00E+00	0.00E+00
Po-216	3.21E-02	0.00E+00	0.00E+00
Po-218	2.89E-09	0.00E+00	0.00E+00
At-217	2.10E-07	0.00E+00	0.00E+00
Rn-219	1.26E-07	0.00E+00	0.00E+00
Rn-220	3.21E-02	0.00E+00	0.00E+00
Rn-222	2.89E-09	0.00E+00	0.00E+00
Pa-234m	1.62E-01	0.00E+00	0.00E+00
Np-240m	1.70E-06	0.00E+00	0.00E+00
Pu-244	1.71E-06	0.00E+00	0.00E+00
Cf-252	9.28E-04	0.00E+00	0.00E+00
Actinides			3.54E+13

ABWR and ESBWR

Unit dose = Ci/MTU * Inhalation DCF
Fraction of Total = Unit Dose$_i$ * Σ_i (Unit Dose)$_i$

Radio-nuclide	Ci/MTU	Inhalation DCF, rem/Ci	Unit Dose	Fraction of total	Cumulative
Pu-241	1.22E+05	4.41E+08	5.38E+13	9.22E-01	92.246%
Pu-238	6.14E+03	4.00E+08	2.46E+12	4.21E-02	96.457%
Cm-244	4.86E+03	2.11E+08	1.03E+12	1.76E-02	98.215%
Am-241	1.34E+03	3.57E+08	4.78E+11	8.20E-03	99.035%
Pu-240	6.15E+02	4.41E+08	2.71E+11	4.65E-03	99.500%
Pu-239	3.87E+02	4.41E+08	1.71E+11	2.93E-03	99.793%
Sr-90	8.85E+04	5.81E+05	5.14E+10	8.82E-04	99.881%
Cs-137	1.24E+05	1.45E+05	1.80E+10	3.08E-04	99.912%
Am-243	3.24E+01	3.54E+08	1.15E+10	1.97E-04	99.931%
Am-242m	3.34E+01	3.41E+08	1.14E+10	1.95E-04	99.951%
Cm-243	3.69E+01	2.57E+08	9.48E+09	1.63E-04	99.967%
Eu-154	1.01E+04	4.09E+05	4.13E+09	7.08E-05	99.974%
Ru-106	1.64E+04	2.44E+05	4.00E+09	6.86E-05	99.981%
Cs-134	4.81E+04	7.55E+04	3.63E+09	6.23E-05	99.987%
Ce-144	1.14E+04	1.95E+05	2.22E+09	3.81E-05	99.991%
Cm-242	5.51E+01	2.19E+07	1.21E+09	2.07E-05	99.993%
Pu-242	2.24E+00	4.19E+08	9.39E+08	1.61E-05	99.995%
Pm-147	3.37E+04	2.58E+04	8.69E+08	1.49E-05	99.996%
Y-90	8.85E+04	5.54E+03	4.90E+08	8.41E-06	99.997%
Sb-125	9.16E+02	4.39E+05	4.02E+08	6.89E-06	99.998%
Co-60	2.73E+03	1.14E+05	3.11E+08	5.34E-06	99.998%
Eu-155	5.22E+03	4.63E+04	2.42E+08	4.14E-06	99.999%
Cm-245	6.56E-01	3.65E+08	2.39E+08	4.11E-06	99.999%
Sb-125	4.45E+03	4.39E+04	1.95E+08	3.35E-06	99.999%
Eu-154	1.53E+02	4.09E+05	6.26E+07	1.07E-06	100.000%
Pu-236	3.56E-01	1.47E+08	5.23E+07	8.97E-07	100.000%
U-234	1.47E+00	3.48E+07	5.12E+07	8.77E-07	100.000%
Cd-113m	6.13E+01	4.06E+05	2.49E+07	4.27E-07	100.000%
Sm-151	5.60E+02	3.40E+04	1.90E+07		
Te-125m	1.09E+03	1.53E+04	1.67E+07		
U-236	3.77E-01	3.23E+07	1.22E+07		
Fe-55	3.35E+03	2.89E+03	9.68E+06		
U-238	3.13E-01	2.97E+07	9.30E+06		
Cm-246	1.41E-01	5.86E+07	8.26E+06		
U-232	6.00E-02	1.37E+08	8.22E+06		
Th-228	4.49E-02	1.47E+08	6.60E+06		
Eu-152	1.09E+01	3.46E+05	3.77E+06		
Eu-155	7.14E+01	4.63E+04	3.31E+06		
Ni-63	4.20E+02	7.26E+03	3.05E+06		
Te-125m	2.24E+02	1.25E+04	2.80E+06		
Am-242	3.32E+01	7.29E+04	2.42E+06		

Ag-110m	3.34E+01	4.57E+04	1.53E+06
Tc-99	1.74E+01	4.94E+04	8.60E+05
Pr-144	1.14E+04	6.77E+01	7.72E+05
U-235	2.20E-02	3.13E+07	6.89E+05
Sn-119m	5.20E+01	1.23E+04	6.40E+05
Sn-126	1.02E+00	5.72E+05	5.83E+05
Ra-224	4.49E-02	1.24E+07	5.57E+05
H-3	5.34E+02	9.70E+02	5.18E+05
Mn-54	3.46E+01	1.21E+04	4.19E+05
Pm-146	1.84E+00	1.64E+05	3.02E+05
Zr-93	2.50E+00	9.28E+04	2.32E+05
Gd-153	2.26E+01	8.87E+03	2.00E+05
Np-239	3.24E+01	3.80E+03	1.23E+05
Np-235	5.01E-04	1.84E+08	9.22E+04
Zr-93	6.86E-01	9.28E+04	6.37E+04
Nb-94	1.76E-01	1.80E+05	3.17E+04
Pb-212	4.49E-02	7.03E+05	3.16E+04
Rh-102	4.67E-01	6.48E+04	3.03E+04
Cs-135	8.22E-01	3.16E+04	2.60E+04
Ho-166m	2.39E-02	1.06E+06	2.53E+04
U-237	3.00E+00	6.96E+03	2.09E+04
C-14	7.70E-01	2.12E+04	1.63E+04
Sn-119m	1.24E+00	1.23E+04	1.53E+04
Se-79	5.61E-01	2.50E+04	1.40E+04
Sn-121m	2.46E-01	5.55E+04	1.37E+04
Th-234	3.13E-01	2.85E+04	8.92E+03
Pa-233	6.16E-01	1.43E+04	8.81E+03
Sn-123	1.60E-01	4.76E+04	7.62E+03
Ta-182	1.74E-01	3.86E+04	6.72E+03
I-129	4.20E-02	1.33E+05	5.59E+03
Bi-212	4.49E-02	1.23E+05	5.52E+03
Nb-93m	7.54E-01	6.56E+03	4.95E+03
Ni-59	2.59E+00	1.64E+03	4.25E+03
Sr-90	6.68E-03	5.81E+05	3.88E+03
Te-127m	1.04E-01	3.62E+04	3.76E+03
Cl-36	1.86E-02	1.40E+05	2.60E+03
Np-238	1.67E-01	1.29E+04	2.15E+03
Sb-126	1.43E-01	1.20E+04	1.72E+03
Nb-93m	1.98E-01	6.56E+03	1.30E+03
Gd-153	1.41E-01	8.87E+03	1.25E+03
Np-237	6.16E-01	1.95E+03	1.20E+03
Sn-123	2.40E-02	4.76E+04	1.14E+03
Eu-152	1.08E-03	3.46E+05	3.74E+02
Pd-107	1.46E-01	2.17E+03	3.17E+02
Sn-113	1.95E-02	1.46E+04	2.85E+02
Bk-249	1.72E-04	1.50E+06	2.58E+02
Tc-99	4.80E-03	4.94E+04	2.37E+02
Mo-93	1.95E-02	8.60E+03	1.68E+02
Sb-126m	1.02E+00	7.25E+01	7.40E+01
Zr-95	3.05E-03	2.16E+04	6.59E+01
Te-127	1.02E-01	5.16E+02	5.26E+01

Nb-95	6.78E-03	6.48E+03	4.39E+01
Y-90	6.68E-03	5.15E+03	3.44E+01
Th-231	2.20E-02	1.24E+03	2.73E+01
Cd-109	7.76E-04	3.02E+04	2.34E+01
Zn-65	2.39E-03	8.32E+03	1.99E+01
In-113m	1.95E-02	7.77E+02	1.52E+01
Te-123m	6.79E-04	1.88E+04	1.28E+01
Ca-45	8.65E-04	1.35E+04	1.17E+01
Y-91	3.38E-04	3.30E+04	1.12E+01
Te-123m	2.45E-04	1.88E+04	4.61E+00
Zr-95	2.05E-04	2.16E+04	4.43E+00
Nb-95	4.55E-04	6.48E+03	2.95E+00
Tb-160	3.14E-05	3.06E+04	9.61E-01
Ca-41	1.18E-03	6.70E+02	7.91E-01
Co-58	7.49E-05	7.83E+03	5.86E-01
H-3	5.24E-04	9.70E+02	5.08E-01
Sr-89	8.33E-06	2.94E+04	2.45E-01
Lu-177m	3.93E-06	5.98E+04	2.35E-01
W-181	1.82E-04	1.01E+03	1.84E-01
W-185	1.08E-05	1.43E+04	1.54E-01
Nb-95m	2.27E-05	3.26E+03	7.40E-02
Sb-124	1.17E-06	3.17E+04	3.71E-02
Te-127m	7.67E-07	3.62E+04	2.78E-02
Sc-46	7.04E-07	2.50E+04	1.76E-02
Tm-170	2.43E-07	3.44E+04	8.36E-03
W-188	9.46E-08	5.74E+04	5.43E-03
Nb-95m	1.52E-06	3.26E+03	4.96E-03
Lu-177	9.04E-07	4.43E+03	4.00E-03
Y-91	6.98E-08	3.30E+04	2.30E-03
Ir-192	8.59E-08	2.45E+04	2.10E-03
U-240	9.23E-07	2.15E+03	1.98E-03
Hf-175	3.05E-07	5.28E+03	1.61E-03
Sb-124	2.93E-08	3.17E+04	9.29E-04
Sn-121m	1.12E+00	5.55E-04	6.22E-04
P-32	2.89E-08	1.44E+04	4.16E-04
Te-127	7.52E-07	5.16E+02	3.88E-04
Re-188	9.56E-08	1.99E+03	1.90E-04
Pu-243	5.85E-07	3.20E+02	1.87E-04
Ru-103	1.21E-08	1.09E+04	1.32E-04
In-114m	1.70E-09	3.46E+04	5.88E-05
Pm-148m	1.52E-09	2.13E+04	3.24E-05
Sr-89	8.94E-10	2.94E+04	2.63E-05
Cd-115m	6.79E-10	2.83E+04	1.92E-05
Fe-59	4.32E-10	1.49E+04	6.44E-06
Hf-181	1.08E-10	2.20E+04	2.38E-06
In-114m	4.39E-11	3.46E+04	1.52E-06
Pm-148	8.59E-11	8.03E+03	6.90E-07
Am-245	2.50E-09	2.08E+02	5.20E-07
Ce-141	1.49E-11	3.47E+04	5.17E-07
Rh-103m	1.09E-08	1.01E+01	1.10E-07
Te-129m	1.57E-12	2.93E+04	4.60E-08

Pu-237	4.37E-12	1.45E+03	6.34E-09
Cd-115m	1.12E-13	2.83E+04	3.17E-09
K-42	1.63E-12	1.32E+03	2.15E-09
Te-129	1.02E-12	1.45E+02	1.48E-10
In-115m	4.77E-14	2.31E+02	1.10E-11
Ru-103	8.38E-16	1.09E+04	9.13E-12
Cm-241	1.01E-17	1.38E+05	1.39E-12
Cr-51	5.28E-16	1.37E+02	7.23E-14
Ag-109m	7.76E-04	0.00E+00	0.00E+00
Ar-37	5.48E-16	0.00E+00	0.00E+00
Ar-39	3.42E-04	0.00E+00	0.00E+00
In-114	1.63E-09	0.00E+00	0.00E+00
S-35	1.84E-05	0.00E+00	0.00E+00
Tb-160	1.49E-03	0.00E+00	0.00E+00
Ag-108	3.44E-06	0.00E+00	0.00E+00
Ag-109m	1.36E-04	0.00E+00	0.00E+00
Ag-110	4.40E-01	0.00E+00	0.00E+00
Ba-137m	1.18E+05	0.00E+00	0.00E+00
In-114	4.21E-11	0.00E+00	0.00E+00
Kr-85	8.90E+03	0.00E+00	0.00E+00
Pr-144m	1.37E+02	0.00E+00	0.00E+00
Rh-106	1.64E+04	0.00E+00	0.00E+00
Np-240m	9.23E-07	0.00E+00	0.00E+00
Pa-234m	3.13E-01	0.00E+00	0.00E+00
Po-212	2.88E-02	0.00E+00	0.00E+00
Po-216	4.49E-02	0.00E+00	0.00E+00
Rn-220	4.49E-02	0.00E+00	0.00E+00
Tl-208	1.61E-02	0.00E+00	0.00E+00
			5.83E+13

PBMR LETTER

Unit dose = Ci/MTU * Inhalation DCF
Fraction of Total = Unit Dose$_i$ * Σ_i (Unit Dose)$_i$

Radio-nuclide	Ci/MTU	Inhalation DCF, rem/Ci	Unit Dose	Fraction of total	Cumulative		
Pu-241	1.94E+05	4.41E+08	8.56E+13	8.99E-01	89.877%	2.020833	9.63E+04
Pu-238	1.23E+04	4.00E+08	4.92E+12	5.17E-02	95.045%	2.019704	6.11E+03
Cm-244	1.48E+04	2.11E+08	3.12E+12	3.28E-02	98.326%	2.0191	7.35E+03
Am-241	2.04E+03	3.57E+08	7.28E+11	7.65E-03	99.091%		1.01E+03
Pu-240	8.98E+02	4.41E+08	3.96E+11	4.16E-03	99.507%		4.46E+02
Sr-90	2.92E+05	5.81E+05	1.70E+11	1.78E-03	99.685%	2.013793	1.45E+05
Pu-239	2.99E+02	4.41E+08	1.32E+11	1.39E-03	99.824%		1.48E+02
Cs-137	3.82E+05	1.45E+05	5.54E+10	5.82E-04	99.882%		1.90E+05
Am-243	1.29E+02	3.54E+08	4.57E+10	4.80E-04	99.930%		6.41E+01
Cm-243	5.29E+01	2.57E+08	1.36E+10	1.43E-04	99.944%		2.63E+01
Ru-106	4.53E+04	2.44E+05	1.11E+10	1.16E-04	99.956%		2.25E+04
Cs-134	1.09E+05	7.55E+04	8.23E+09	8.65E-05	99.964%		5.41E+04
Am-242m	2.30E+01	3.41E+08	7.84E+09	8.24E-05	99.973%		1.14E+01
Ce-144	3.22E+04	1.95E+05	6.28E+09	6.60E-05	99.979%		1.60E+04
Pu-242	1.22E+01	4.19E+08	5.11E+09	5.37E-05	99.985%		6.06E+00
Eu-154	1.01E+04	4.09E+05	4.13E+09	4.34E-05	99.989%		5.02E+03
Pm-147	1.37E+05	2.58E+04	3.53E+09	3.71E-05	99.993%		6.80E+04
Sb-125	6.79E+03	4.39E+05	2.98E+09	3.13E-05	99.996%		3.37E+03
Cm-242	7.52E+01	2.19E+07	1.65E+09	1.73E-05	99.998%		3.73E+01
Y-90	2.92E+05	5.15E+03	1.50E+09	1.58E-05	99.999%		1.45E+05
Cm-245	1.43E+00	3.65E+08	5.22E+08	5.48E-06	100.000%		7.10E-01
Eu-155	2.93E+03	4.63E+04	1.36E+08	1.43E-06	100.000%		1.45E+03
Cm-246	6.52E-01	5.86E+07	3.82E+07	4.01E-07	100.000%		3.24E-01
U-236	1.17E+00	3.23E+07	3.78E+07	3.97E-07	100.000%		5.81E-01
Sm-151	1.08E+03	3.40E+04	3.67E+07	3.86E-07	100.000%		5.36E+02
Cd-113m	7.94E+01	4.06E+05	3.22E+07	3.39E-07	100.000%		3.94E+01
Te-125m	1.66E+03	1.25E+04	2.08E+07	2.18E-07			
U-234	2.51E-01	3.48E+07	8.73E+06	9.18E-08			
U-238	2.73E-01	2.97E+07	8.11E+06	8.52E-08			
Pu-236	3.62E-02	1.47E+08	5.32E+06	5.59E-08			
Ag-110m	6.23E+01	4.57E+04	2.85E+06	2.99E-08			
Tc-99	5.34E+01	4.94E+04	2.64E+06	2.77E-08			
Eu-152	6.34E+00	3.46E+05	2.19E+06	2.30E-08			
Pr-144	3.22E+04	6.77E+01	2.18E+06	2.29E-08			
H-3	1.36E+03	9.70E+02	1.32E+06	1.39E-08			
Sn-126	1.92E+00	5.72E+05	1.10E+06	1.15E-08			
Am-242	2.29E+01	4.16E+04	9.53E+05	1.00E-08			
U-232	5.83E-03	1.37E+08	7.99E+05	8.39E-09			
U-235	2.08E-02	3.13E+07	6.51E+05	6.84E-09			
Th-228	4.31E-03	1.47E+08	6.34E+05	6.66E-09			
Np-239	1.29E+02	3.80E+03	4.90E+05	5.15E-09			
Zr-93	5.00E+00	9.28E+04	4.64E+05	4.87E-09			

Sn-121m	7.34E+00	5.55E+04	4.07E+05	4.28E-09
Pm-146	8.08E-01	1.64E+05	1.33E+05	1.39E-09
Ra-224	4.31E-03	1.24E+07	5.34E+04	5.61E-10
Cs-135	1.59E+00	3.16E+04	5.02E+04	5.28E-10
Np-235	2.08E-04	1.84E+08	3.83E+04	4.02E-10
U-237	4.66E+00	6.96E+03	3.24E+04	3.41E-10
I-129	1.24E-01	1.33E+05	1.65E+04	1.73E-10
Rh-102	1.76E-01	6.48E+04	1.14E+04	1.20E-10
Sn-119m	7.62E-01	1.23E+04	9.37E+03	9.85E-11
Nb-93m	1.36E+00	6.56E+03	8.92E+03	9.37E-11
Te-127m	2.40E-01	3.62E+04	8.69E+03	9.13E-11
Th-234	2.73E-01	2.85E+04	7.78E+03	8.17E-11
Pa-231	8.52E-06	8.50E+08	7.24E+03	7.61E-11
Gd-153	4.29E-01	8.87E+03	3.81E+03	4.00E-11
Pa-233	9.91E-01	3.81E+03	3.78E+03	3.97E-11
Th-230	8.94E-06	3.76E+08	3.36E+03	3.53E-11
Ho-166m	3.11E-03	1.06E+06	3.30E+03	3.46E-11
Sb-126	2.70E-01	1.20E+04	3.24E+03	3.40E-11
Pb-212	4.31E-03	7.03E+05	3.03E+03	3.18E-11
Sn-123	6.06E-02	4.76E+04	2.88E+03	3.03E-11
Np-237	9.91E-01	1.95E+03	1.93E+03	2.03E-11
Sm-147	1.86E-05	8.54E+07	1.59E+03	1.67E-11
Np-238	1.03E-01	1.29E+04	1.33E+03	1.40E-11
Sn-121	5.70E+00	2.23E+02	1.27E+03	1.34E-11
Se-79	2.71E-01	4.20E+03	1.14E+03	1.20E-11
Ac-227	1.47E-06	5.76E+08	8.47E+02	8.90E-12
Bk-249	4.29E-04	1.50E+06	6.44E+02	6.76E-12
Bi-212	4.31E-03	1.23E+05	5.30E+02	5.57E-12
Zr-95	6.46E-03	2.16E+04	1.40E+02	1.47E-12
Sb-126m	1.92E+00	7.25E+01	1.39E+02	1.46E-12
Te-127	2.34E-01	5.16E+02	1.21E+02	1.27E-12
Nb-95	1.42E-02	6.48E+03	9.20E+01	9.67E-13
Nb-94	3.33E-04	1.80E+05	5.99E+01	6.30E-13
U-233	2.67E-05	2.15E+06	5.74E+01	6.03E-13
Pm-145	1.29E-03	3.12E+04	4.02E+01	4.23E-13
Pd-107	3.96E-01	9.41E+01	3.73E+01	3.91E-13
Th-231	2.80E-02	1.24E+03	3.47E+01	3.65E-13
Th-229	3.07E-08	8.85E+08	2.72E+01	2.85E-13
Y-91	6.99E-04	3.30E+04	2.31E+01	2.42E-13
Tm-171	1.52E-03	7.90E+03	1.20E+01	1.26E-13
C-14	4.77E-04	2.12E+04	1.01E+01	1.06E-13
Sm-146	1.06E-07	9.40E+07	9.96E+00	1.05E-13
Th-227	1.44E-06	2.48E+06	3.57E+00	3.75E-14
Cm-247	2.17E-06	1.50E+06	3.26E+00	3.42E-14
Tb-160	8.49E-05	1.55E+04	1.32E+00	1.38E-14
Te-123m	6.62E-05	1.88E+04	1.24E+00	1.31E-14
Ra-223	1.47E-06	4.61E+05	6.78E-01	7.12E-15
Sm-145	5.28E-05	1.08E+04	5.70E-01	5.99E-15
Sr-89	1.71E-05	2.94E+04	5.03E-01	5.28E-15
Ag-109m	1.52E-05	3.02E+04	4.59E-01	4.82E-15
Ba-133	5.93E-05	5.63E+03	3.34E-01	3.51E-15

Be-10	1.19E-05	2.43E+04	2.89E-01	3.04E-15
Nb-95m	7.60E-05	3.26E+03	2.48E-01	2.60E-15
Pa-234	3.56E-04	6.04E+02	2.15E-01	2.26E-15
Th-232	4.34E-10	4.07E+08	1.77E-01	1.86E-15
Rb-87	9.02E-05	1.84E+03	1.66E-01	1.74E-15
Ce-139	2.33E-05	5.75E+03	1.34E-01	1.41E-15
Np-236	3.10E-06	3.34E+04	1.04E-01	1.09E-15
Es-254	2.51E-09	3.76E+07	9.44E-02	9.91E-16
Ac-225	3.07E-08	2.95E+06	9.06E-02	9.51E-16
Sb-124	8.30E-07	3.17E+04	2.63E-02	2.76E-16
Pb-211	1.47E-06	1.44E+04	2.12E-02	2.22E-16
Ra-226	1.11E-08	1.33E+06	1.48E-02	1.55E-16
Ra-225	3.07E-08	4.75E+05	1.46E-02	1.53E-16
Tc-98	3.03E-06	3.61E+03	1.09E-02	1.15E-16
Pb-210	8.91E-10	3.36E+06	2.99E-03	3.15E-17
Po-210	8.91E-10	2.25E+06	2.00E-03	2.11E-17
Bi-213	3.07E-08	3.87E+04	1.19E-03	1.25E-17
Pu-243	2.17E-06	3.20E+02	6.94E-04	7.29E-18
Ra-228	1.51E-10	3.36E+06	5.07E-04	5.33E-18
Bi-214	1.11E-08	2.67E+04	2.96E-04	3.11E-18
Ru-103	2.50E-08	1.09E+04	2.73E-04	2.86E-18
Pb-214	1.11E-08	1.08E+04	1.20E-04	1.26E-18
Tm-170	2.92E-09	3.44E+04	1.00E-04	1.06E-18
Fr-223	2.02E-08	3.32E+03	6.71E-05	7.05E-19
Pm-148m	2.53E-09	2.13E+04	5.39E-05	5.66E-19
Ac-228	1.51E-10	4.41E+04	6.66E-06	7.00E-20
Bi-210	8.91E-10	3.94E+03	3.51E-06	3.69E-20
Am-245	6.22E-09	2.08E+02	1.29E-06	1.36E-20
Cf-250	2.92E-04	1.03E-03	3.00E-07	3.15E-21
Rh-103m	2.49E-08	1.01E+01	2.51E-07	2.64E-21
Cf-252	1.91E-04	9.28E-04	1.77E-07	1.86E-21
Cf-249	6.37E-05	2.30E-04	1.46E-08	1.54E-22
Bk-250	2.51E-09	5.66E-01	1.42E-09	1.49E-23
Pu-237	1.12E-12	9.81E+02	1.10E-09	1.15E-23
Cf-251	2.23E-06	1.03E-05	2.29E-11	2.40E-25
Kr-81	1.22E-06	0.00E+00	0.00E+00	0.00E+00
Kr-85	2.63E+04	0.00E+00	0.00E+00	0.00E+00
Y-89m	1.59E-09	0.00E+00	0.00E+00	0.00E+00
Nb-91	2.09E-08	0.00E+00	0.00E+00	0.00E+00
Rh-106	4.53E+04	0.00E+00	0.00E+00	0.00E+00
Ag-108	1.69E-04	0.00E+00	0.00E+00	0.00E+00
Ag-108m	1.94E-03	0.00E+00	0.00E+00	0.00E+00
Cd-109	1.52E-05	0.00E+00	0.00E+00	0.00E+00
Ag-110	8.48E-01	0.00E+00	0.00E+00	0.00E+00
Ba-137m	3.61E+05	0.00E+00	0.00E+00	0.00E+00
Ce-142	1.12E-04	0.00E+00	0.00E+00	0.00E+00
Pr-144m	4.51E+02	0.00E+00	0.00E+00	0.00E+00
Nd-144	7.52E-09	0.00E+00	0.00E+00	0.00E+00
Tl-207	1.47E-06	0.00E+00	0.00E+00	0.00E+00
Tl-208	1.56E-03	0.00E+00	0.00E+00	0.00E+00
Tl-209	6.44E-10	0.00E+00	0.00E+00	0.00E+00

Pb-209	3.07E-08	0.00E+00	0.00E+00	0.00E+00
Bi-211	1.47E-06	0.00E+00	0.00E+00	0.00E+00
Po-211	4.04E-09	0.00E+00	0.00E+00	0.00E+00
Po-212	2.77E-03	0.00E+00	0.00E+00	0.00E+00
Po-213	3.00E-08	0.00E+00	0.00E+00	0.00E+00
Po-214	1.11E-08	0.00E+00	0.00E+00	0.00E+00
Po-215	1.47E-06	0.00E+00	0.00E+00	0.00E+00
Po-216	4.31E-03	0.00E+00	0.00E+00	0.00E+00
Po-218	1.11E-08	0.00E+00	0.00E+00	0.00E+00
At-217	3.07E-08	0.00E+00	0.00E+00	0.00E+00
Rn-219	1.47E-06	0.00E+00	0.00E+00	0.00E+00
Rn-220	4.31E-03	0.00E+00	0.00E+00	0.00E+00
Rn-222	1.11E-08	0.00E+00	0.00E+00	0.00E+00
Fr-221	3.07E-08	0.00E+00	0.00E+00	0.00E+00
Pa-234m	2.73E-01	0.00E+00	0.00E+00	0.00E+00
Cm-248	7.34E-06	0.00E+00	0.00E+00	0.00E+00
	4.33E+05		9.52E+13	

MHR

Unit dose = Ci/MTU * Inhalation DCF
Fraction of Total = Unit Dose$_i$ * Σ_i (Unit Dose)$_i$

Radio-nuclide	Ci/MTU	Inhalation DCF, rem/Ci	Unit Dose	Fraction of total	Cumulative
Pu-241	2.25E+05	4.41E+08	9.92E+13	9.69E-01	96.891%
Pu-238	3.17E+03	4.00E+08	1.27E+12	1.24E-02	98.129%
Am-241	2.21E+03	3.57E+08	7.89E+11	7.70E-03	98.899%
Pu-240	1.07E+03	4.41E+08	4.72E+11	4.61E-03	99.360%
Pu-239	6.07E+02	4.41E+08	2.68E+11	2.61E-03	99.622%
Cm-244	7.64E+02	2.11E+08	1.61E+11	1.57E-03	99.779%
Sr-90	2.42E+05	5.81E+05	1.41E+11	1.37E-03	99.916%
Cs-137	2.93E+05	1.45E+05	4.25E+10	4.15E-04	99.958%
Ce-144	5.82E+04	1.95E+05	1.13E+10	1.11E-04	99.969%
Am-243	1.39E+01	3.54E+08	4.92E+09	4.80E-05	99.974%
Pm-147	1.87E+05	2.58E+04	4.82E+09	4.71E-05	99.978%
Am-242m	1.36E+01	3.41E+08	4.64E+09	4.53E-05	99.983%
Cs-134	5.98E+04	7.55E+04	4.51E+09	4.41E-05	99.987%
Eu-154	8.72E+03	4.09E+05	3.57E+09	3.48E-05	99.991%
Sb-125	5.96E+03	4.39E+05	2.62E+09	2.55E-05	99.993%
Pu-242	4.21E+00	4.19E+08	1.76E+09	1.72E-05	99.995%
Cm-243	5.45E+00	2.57E+08	1.40E+09	1.37E-05	99.997%
Y-90	2.42E+05	5.15E+03	1.25E+09	1.22E-05	99.998%
Ru-106	4.01E+04	2.94E+04	1.18E+09	1.15E-05	99.999%
Cm-242	4.08E+01	2.19E+07	8.94E+08	8.73E-06	100.000%
Eu-155	2.37E+03	4.63E+04	1.10E+08	1.07E-06	100.000%
Sm-151	1.75E+03	3.40E+04	5.95E+07	5.81E-07	100.000%
U-236	1.14E+00	3.23E+07	3.68E+07	3.60E-07	100.000%
Cd-113m	3.02E+01	4.06E+05	1.23E+07	1.20E-07	100.000%
Te-125m	8.54E+02	1.25E+04	1.07E+07	1.04E-07	100.000%
U-238	3.15E-01	2.97E+07	9.36E+06		
Eu-152	2.31E+01	3.46E+05	7.99E+06		
U-235	1.68E-01	3.13E+07	5.26E+06		
Pr-144	5.82E+04	6.77E+01	3.94E+06		
Tc-99	4.38E+01	4.94E+04	2.16E+06		
Ag-110m	4.43E+01	4.57E+04	2.02E+06		
Cm-245	4.36E-03	3.65E+08	1.59E+06		
Am-242	1.36E+01	7.29E+04	9.91E+05		
H-3	9.95E+02	9.70E+02	9.65E+05		
Sn-126	1.52E+00	5.72E+05	8.69E+05		
Zr-93	6.10E+00	9.28E+04	5.66E+05		
U-232	1.65E-03	1.37E+08	2.26E+05		
Th-228	1.47E-03	1.47E+08	2.16E+05		
Cm-246	8.34E-04	5.86E+07	4.89E+04		
Cs-135	1.08E+00	3.16E+04	3.41E+04		
Sn-121m	5.58E-01	5.55E+04	3.10E+04		
Pa-231	2.28E-05	8.50E+08	1.94E+04		

Sn-119m	1.31E+00	1.23E+04	1.61E+04
Te-127m	4.18E-01	3.62E+04	1.51E+04
I-129	8.82E-02	1.33E+05	1.17E+04
Nb-93m	1.60E+00	6.56E+03	1.05E+04
Sn-123	1.03E-01	4.76E+04	4.90E+03
Se-79	1.10E+00	4.20E+03	4.62E+03
Sb-126	2.12E-01	1.20E+04	2.54E+03
Sm-147	1.74E-05	8.54E+07	1.49E+03
Np-237	7.11E-01	1.95E+03	1.39E+03
Ac-227	2.20E-06	5.76E+08	1.27E+03
Pu-236	3.57E-06	1.47E+08	5.25E+02
Pd-107	2.15E-01	2.17E+03	4.67E+02
Zr-95	2.02E-02	2.16E+04	4.36E+02
Ra-224	1.47E-03	2.81E+05	4.13E+02
Nb-95	4.46E-02	6.48E+03	2.89E+02
Te-127	4.10E-01	5.16E+02	2.12E+02
Th-231	1.68E-01	1.24E+03	2.08E+02
Tb-158	3.60E-04	3.88E+05	1.40E+02
Sb-126m	1.52E+00	7.25E+01	1.10E+02
Pb-212	1.47E-03	6.67E+04	9.80E+01
Ho-166m	8.80E-05	1.06E+06	9.33E+01
Pm-146	5.68E-04	1.64E+05	9.32E+01
Y-91	2.51E-03	3.30E+04	8.28E+01
Sb-126n	1.02E+00	7.25E+01	7.40E+01
C-14A	3.44E-03	2.12E+04	7.29E+01
Nb-94	3.06E-04	1.80E+05	5.51E+01
C-14	2.53E-03	2.12E+04	5.36E+01
Bi-212	1.47E-03	3.34E+04	4.91E+01
H-3A	3.55E-02	9.70E+02	3.44E+01
Cf-249	3.17E-08	6.20E+08	1.97E+01
Gd-153	1.41E-03	8.87E+03	1.25E+01
Th-227	2.12E-06	2.48E+06	5.26E+00
Cf-250	7.20E-09	2.72E+08	1.96E+00
Sr-89	6.42E-05	2.94E+04	1.89E+00
Np-236	5.35E-05	3.34E+04	1.79E+00
Ra-223	2.15E-06	4.61E+05	9.91E-01
Nb-95m	2.03E-04	3.26E+03	6.62E-01
Cm-247	1.71E-09	3.33E+08	5.69E-01
La-137	1.53E-05	3.26E+04	4.99E-01
Bk-249	2.04E-07	1.50E+06	3.06E-01
Tb-157	2.61E-05	1.10E+04	2.87E-01
Cd-109	7.90E-06	3.02E+04	2.39E-01
Ce-139	1.38E-05	5.75E+03	7.94E-02
Pb-211	2.11E-06	1.44E+04	3.04E-02
Tb-160	3.51E-07	1.55E+04	5.44E-03
Te-123m	2.86E-07	1.88E+04	5.38E-03
Pb-210	1.02E-09	3.36E+06	3.43E-03
Po-210	1.04E-09	2.25E+06	2.34E-03
Sb-124	5.67E-08	3.17E+04	1.80E-03
Tc-98	2.35E-07	3.61E+03	8.48E-04
P-32	7.69E-08	2.88E+03	2.21E-04

Fr-223	3.03E-08	3.23E+03	9.79E-05
Ru-103	5.50E-08	1.77E+03	9.74E-05
Pm-148M	6.74E-09	1.42E+04	9.57E-05
Dy-159	2.25E-08	1.63E+03	3.67E-05
Si-32	2.65E-09	1.18E+04	3.13E-05
Rb-87	6.82E-09	1.45E+03	9.89E-06
Pm-148G	3.56E-10	1.42E+04	5.06E-06
Bi-210	1.02E-09	3.94E+03	4.02E-06
Rh-103m	5.50E-08	1.01E+01	5.56E-07
Tc-97	7.92E-10	1.62E+02	1.28E-07
Ag-108	2.26E-08	0.00E+00	0.00E+00
Ag-108m	2.54E-07	0.00E+00	0.00E+00
Ag-109	7.90E-06	0.00E+00	0.00E+00
Ag-110	5.89E-01	0.00E+00	0.00E+00
Ba-137m	2.78E+05	0.00E+00	0.00E+00
Bi-211	2.11E-06	0.00E+00	0.00E+00
Ce-142	4.74E-05	0.00E+00	0.00E+00
Kr-81	6.51E-08	0.00E+00	0.00E+00
Kr-85	2.50E+04	0.00E+00	0.00E+00
Nd-144	1.84E-09	0.00E+00	0.00E+00
Po-211	5.91E-09	0.00E+00	0.00E+00
Po-212	9.38E-04	0.00E+00	0.00E+00
Po-214	2.11E-06	0.00E+00	0.00E+00
Po-215	1.47E-03	0.00E+00	0.00E+00
Pr-144m	7.57E+02	0.00E+00	0.00E+00
Rh-106	4.01E+04	0.00E+00	0.00E+00
Rn-219	2.15E-06	0.00E+00	0.00E+00
Rn-220	1.47E-03	0.00E+00	0.00E+00
Tl-207	2.10E-06	0.00E+00	0.00E+00
Tl-208	5.27E-04	0.00E+00	0.00E+00
Y-89m	9.63E-09	0.00E+00	0.00E+00
Cm-248	2.86E-09	0.00E+00	0.00E+00
Pu-244	1.49E-07	0.00E+00	0.00E+00
	3.44E+05		1.02E+14

ABWR and E		AP-1000		GT-MHR		PBMR	
Radionuclide	Inventory, Ci/	Radionucli	Inventory,	Radionucli	Inventory,	Radionucli	Inventory, Ci/MTU
Am-241	1.34E+03	Am-241	7.27E+02	Am-241	2.21E+03	Am-241	2.04E+03
Am-242m	3.34E+01	Am-242m	1.31E+01	Am-242m	1.36E+01	Am-242m	2.30E+01
Am-243	3.24E+01	Am-243	3.34E+01	Am-243	1.39E+01	Am-243	1.29E+02
Ce-144	1.14E+04	Ce-144	8.87E+03	Ce-144	5.82E+04	Ce-144	3.22E+04
Cm-242	5.51E+01	Cm-242	2.83E+01	Cm-242	4.08E+01	Cm-242	7.52E+01
Cm-243	3.69E+01	Cm-243	3.07E+01	Cm-243	5.45E+00	Cm-243	5.29E+01
Cm-244	4.86E+03	Cm-244	7.75E+03	Cm-244	7.64E+02	Cm-244	1.48E+04
Cm-245	6.56E-01	Cm-245	1.21E+00	Cm-245	4.46E-03	Cm-245	1.43E+00
Co-60	2.73E+03	Co-60	0.00E+00	Co-60	0.00E+00	Co-60	0.00E+00
Cs-134	4.81E+04	Cs-134	4.80E+04	Cs-134	5.98E+04	Cs-134	1.09E+05
Cs-137	1.24E+05	Cs-137	9.31E+04	Cs-137	2.93E+05	Cs-137	3.82E+05
Eu-154	1.03E+04	Eu-154	9.13E+03	Eu-154	8.72E+03	Eu-154	1.01E+04
Eu-155	5.22E+03	Eu-155	4.62E+03	Eu-155	2.37E+03	Eu-155	2.93E+03
Pm-147	3.37E+04	Pm-147	1.76E+04	Pm-147	1.87E+05	Pm-147	1.37E+05
Pu-238	6.14E+03	Pu-238	6.07E+03	Pu-238	3.17E+03	Pu-238	1.23E+04
Pu-239	3.87E+02	Pu-239	2.55E+02	Pu-239	6.07E+02	Pu-239	2.99E+02
Pu-240	6.15E+02	Pu-240	5.43E+02	Pu-240	1.07E+03	Pu-240	8.98E+02
Pu-241	1.22E+05	Pu-241	6.96E+04	Pu-241	2.25E+05	Pu-241	1.94E+05
Pu-242	2.24E+00	Pu-242	1.82E+00	Pu-242	4.21E+00	Pu-242	1.22E+01
Ru-106	1.64E+04	Ru-106	1.55E+04	Ru-106	4.01E+04	Ru-106	4.53E+04
Sb-125	5.37E+03	Sb-125	3.83E+03	Sb-125	5.96E+03	Sb-125	6.79E+03
Sr-90	8.85E+04	Sr-90	6.19E+04	Sr-90	2.42E+05	Sr-90	2.92E+05
Y-90	8.85E+04	Y-90	6.19E+04	Y-90	2.42E+05	Y-90	2.92E+05

Activation Product (CRUD)

DOSE FACTORS

	TABHLF	PHTENG	CLDOSF	GRDOSF	RPCVAL EDE-50	RPCVAL Gonad	RPCVAL Lung	RPCVAL Marrow	Nuclide name for ingestion	Not needed in DEFINE A1	Not needed in DEFINE A2
Cm243	1.06E+04	2.80E-01	1.96E-02	3.78E-05	2.57E+08	2.61E+08	1.67E+07	4.31E+08	None		
Cm245	3.10E+06	1.75E-01	1.30E-02	2.57E-05	3.65E+08	3.10E+08	2.87E+07	5.56E+08	None	2.43E+02	2.43E-02
Am242m	5.15E+04	4.92E-02	9.22E-05	7.23E-07	3.41E+08	3.02E+08	2.72E+07	5.15E+08	None		

	Cm245				Cm243			Am-242m		
Half-life	8500 yr	3.10E+06	days	Chart of Nuclides	29.1 yr	1.06E+04	days	141 yr	5.15E+04	days
PHTENG		1.75E-01	MeV	Chart of Nuclides		0.28	MeV	0.0492	0.0492	MeV
CLDOSF	4.09E+05 rem-m3/Ci-yr	1.30E-02	rem-m3/Ci-sec	FGR 13 database	6.20E+05 rem-m3/Ci-yr	0.019646614	rem-m3/Ci-sec	2910 rem-m3/Ci-yr	9.22E-05	rem-m3/Ci-sec
GRDOSF	9.40E+03 rem-m2/Ci-yr	2.57E-05	rem-m2/uCi-d	FGR 13 database	1.38E+04 rem-m2/Ci-yr	3.77823E-05	rem-m2/uCi-d	264 rem-m2/Ci-yr	7.23E-07	rem-m2/uCi-d
RPCVAL-1		3.65E+08	rem/Ci	FGR 13 database		2.57E+08	rem/Ci		3.41E+08	rem/Ci
RPCVAL-2		3.10E+08	rem/Ci	FGR 13 database		2.61E+08	rem/Ci		3.02E+08	rem/Ci
RPCVAL-3		2.87E+07	rem/Ci	FGR 13 database		1.67E+07	rem/Ci		2.72E+07	rem/Ci
RPCVAL-4		5.56E+08	rem/Ci	FGR 13 database		4.31E+08	rem/Ci		5.15E+08	rem/Ci
A1	9 TBq	2.43E+02	Ci	IAEA SS TS-R-1						
A2	9.00E-04 TBq	2.43E-02								

Ground dose factor							
	3.02E-18	3700000	60	60	24	9.65434E-07	
	7.22E-19					2.30809E-07	
Cm-245	8.70E-17					2.78122E-05	FGR-12

		2 TBq	9	9.00E-04
		1.00E+12	1.00E+12	1.00E+12
		2.00E+12 Bq	9.00E+12	9.00E+08
		3.70E+10 Bq/Ci	3.70E+10	3.70E+10
	54.1 Ci	5.41E+01 Ci	2.43E+02	2.43E-02

SEVERITY FRACTIONS
Source: NUREG/CR-6672, Table 7.31
For Steel-DU-Steel Truck Casks
All population zones

1.53E-08	5.88E-05	1.81E-06	7.49E-08	4.65E-07
3.31E-09	0	1.13E-08	8.03E-11	0.00E+00
1.44E-10	1.02E-12	0	7.49E-11	0.00E+00
0.00E+00	0	5.86E-06	1.00E+00	

RELEASE FRACTIONS (RFRAC)
Source: NUREG/CR-6672, Table 7.31
Gas (AERSOL and RESP = 1.0)

0.8	0.14	0.18	0.84	0.43
0.49	0.85	0.82	0.89	0.91
0.82	0.89	0.91	0.84	0.85
0.91	0.91	0.84	0	

Cs (AERSOL and RESP = 1.0)

2.4E-08	4.1E-09	5.4E-09	3.6E-05	1.3E-08
1.5E-08	2.7E-05	2.4E-08	2.7E-08	5.9E-06
2.4E-08	2.7E-08	5.9E-06	9.6E-05	5.5E-05
5.9E-06	5.9E-06	1.7E-05	0.0E+00	

Ru (AERSOL and RESP = 1.0)

6.0E-07	1.0E-07	1.3E-07	3.8E-06	3.2E-07
3.7E-07	2.1E-06	6.1E-07	6.7E-07	6.8E-07
6.1E-07	6.7E-07	6.8E-07	8.4E-05	5.0E-05
6.4E-06	6.4E-06	6.7E-08	0.0E+00	

Particulate (AERSOL and RESP = 1.0)

6.0E-07	1.0E-07	1.3E-07	3.8E-06	3.2E-07
3.7E-07	2.1E-06	6.1E-07	6.7E-07	6.8E-07
6.1E-07	6.7E-07	6.8E-07	1.8E-05	9.0E-06
6.8E-07	6.8E-07	6.7E-08	0.0E+00	

Crud (AERSOL and RESP = 1.0)

2.0E-03	1.4E-03	1.8E-03	3.2E-03	1.8E-03
2.1E-03	3.1E-03	2.0E-02	2.2E-03	2.5E-03
2.0E-03	2.2E-03	2.5E-03	6.4E-03	5.9E-03
3.3E-03	3.3E-03	2.5E-03	0.0E+00	

Release Fractions

Severity Category	Severity Fraction	Gas	Cs	Ru	Particulates	Crud
1	1.53E-08	0.8	2.4E-08	6.0E-07	6.0E-07	2.0E-03
2	5.88E-05	0.14	4.1E-09	1.0E-07	1.0E-07	1.4E-03
3	1.81E-06	0.18	5.4E-09	1.3E-07	1.3E-07	1.8E-03
4	7.49E-08	0.84	3.6E-05	3.8E-06	3.8E-06	3.2E-03
5	4.65E-07	0.43	1.3E-08	3.2E-07	3.2E-07	1.8E-03
6	3.31E-09	0.49	1.5E-08	3.7E-07	3.7E-07	2.1E-03
7	0	0.85	2.7E-05	2.1E-06	2.1E-06	3.1E-03
8	1.13E-08	0.82	2.4E-08	6.1E-07	6.1E-07	2.0E-02
9	8.03E-11	0.89	2.7E-08	6.7E-07	6.7E-07	2.2E-03
10	0	0.91	5.9E-06	6.8E-07	6.8E-07	2.5E-03
11	1.44E-10	0.82	2.4E-08	6.1E-07	6.1E-07	2.0E-03
12	1.02E-12	0.89	2.7E-08	6.7E-07	6.7E-07	2.2E-03
13	0	0.91	5.9E-06	6.8E-07	6.8E-07	2.5E-03
14	7.49E-11	0.84	9.6E-05	8.4E-05	1.8E-05	6.4E-03
15	0	0.85	5.5E-05	5.0E-05	9.0E-06	5.9E-03
16	0	0.91	5.9E-06	6.4E-06	6.8E-07	3.3E-03
17	0	0.91	5.9E-06	6.4E-06	6.8E-07	3.3E-03
18	5.86E-06	0.84	1.7E-05	6.7E-08	6.7E-08	2.5E-03
19	0.99993	0	0	0	0	0

ESP Calculation Worksheet

Changes Revise to normalize to 880 Mwe

1. Calculate Initial shipments of fresh fuel and annual refueling shipments

WASH-1238 used for comparison			CALCULATED	
Page 23				
	BWR	PWR		
Core power, MWt			Capacity fac	Net Mwe
Electric generation, MWe	1100	1100	0.8	880
Initial core load, MTU	150	100	ESP Rpt	
Shipments	18	18		
Refueling, MTU/yr	30	30		
Shipments/yr	6	6		
Total over 40 yrs	252	252		

Assume 39 years of annual reloads

	Number of Shipments per Site						Normalized		
	Initial Core	Annual Re	Total	Unit capaci	Capacity fa	Net Mwe	Initial Core	Reload	Total (40 yr)
WASH-1238	18	6.0	252	1,100	0.8	880	18	6	252
ABWR/ESBWR	30	6.1	267	1,500	0.95	1425	19	4	165
AP-1000	14	3.8	161	1,150	0.95	1092.5	12	4	130
ACR-700	15	7.7	314	731	0.9	657.9	21	11	420
IRIS	34	4.3	201	1,005	0.96	964.8	32	4	184
GT-MHR	51	20.0	831	1,140	0.88	1003.2	45	18	729
PBMR	44	20.0	824	1,320	0.95	1254	31	15	579

ABWR	4300 MWt		ESBWR	4000 MWt	
	1500 MWe			ABWR Ca	Net Mwe
Initial core load, MTU	156.96		156.96	0.95	1425
Initial core load, assemblies	872		1020		
MTU/assembly	0.18	b16/b17	0.1538824		
Reload, MTU/yr	32.76		32.76	212.8899	
Truck shipment capacity	30	assemblies/s	28	Range given in ESP questionaire	
Truck shipment capacity	5.4	MTU/shipm	5.04		

Initial shipments	29.066667	to	31.142857
Annual shipments	6.0666667	to	6.5
Total over 40 yrs	265.66667	to	291.14286

AP-1000	3400 MWt		Capacity fac	Net Mwe
	1150 MWe		0.95	1092.5
Initial core load, MTU	84.5			
Reload, MTU/yr	24.4			
MTU/assembly	0.5383			
Assemblies/truck	12	(2/container, 6 containers/truck)		
MTU/shipment	6.4596			

Initial shipments	13.081305
Annual reload shipments	3.7773237
Total over 40 yrs	160.39693

ACR-700	1982	MWt	3964	2 units per site
	731	MWe	1462	2 units per site
Initial core load, MTU	61.3		Capacity fac	Net Mwe
Initial core load, bundles	3406		0.9	657.9
Reload, MTU/yr	33.1	18	kgU per bundle (DOE 2003)	
Reload, bundles/yr	1839			
Bundles/truck (HIGH)	240	60 bundles/basket, 4 baskets/truck		

Fresh Fuel Shipment Radiological Impact Calculation

	Normalized Average Annual Shipments, per 1,100 Mwe plant @ 80%	Unit Dose, person-rem/shipment Worker	Pub - on+s	Pub - offlink	Source: RADTRAN 5 output. person-Sv	Public	
		0.00171	6.65E-03	0.000161			
		person-rem					
			Public			Public	
		Workers	On-link plu	Off-link	Workers	On-link plus	Off-link
WASH-1238	6.3	1.1E-02	4.2E-02	1.0E-03	1.1E-04	4.2E-04	1.0E-05
ABWR/ESBWR	4.1	7.1E-03	2.7E-02	6.6E-04	7.1E-05	2.7E-04	6.6E-06
AP-1000	3.3	5.6E-03	2.2E-02	5.2E-04	5.6E-05	2.2E-04	5.2E-06
ACR-700	10.5	1.8E-02	7.0E-02	1.7E-03	1.8E-04	7.0E-04	1.7E-05
IRIS	4.6	7.9E-03	3.1E-02	7.4E-04	7.9E-05	3.1E-04	7.4E-06
GT-MHR	18.2	3.1E-02	1.2E-01	2.9E-03	3.1E-04	1.2E-03	2.9E-05
PBMR	14.5	2.5E-02	9.6E-02	2.3E-03	2.5E-04	9.6E-04	2.3E-05

Accident Rates		% Reduction
WASH-1238		
Large Motor Car	2.46E-06	8.70E-01
HAzMat	1.69E-06	8.10E-01
Saricks		
Total Rate	3.21E-07	

Bundles/truck (LOW) 180 60 bundles/basket, 4 baskets/truck

Initial Shipments	14.189815	to	18.919753	per unit
Annual shipments	7.662037	to	10.216049	per unit
Total over 40 yrs	313.00926	to	427.56173	per unit

IRIS				
	1002	MWt	Capacity fac Net Mwe	
	335	MWe	0.96	321.6
	1005	Mwe per 3 unit site		964.8

Initial core loading, MTU	48.67	0.5469 MTU/assembly	
Reload, MTU/yr	6.26	88.992503 assemblies initial core load confirme	11.44633388 assemblies per yr
Initial load, assemblies	89		
Annual reload	11.428571	40 assemblies per 3.5 yrs	
Assemblies/truck	8		

Initial Shipments	11.125	per unit	33.375
Annual Shipments	1.4285714	per unit	4.2857143
Total over 40 yrs	66.839286	per unit	200.51786

GT MHR				
	600	MWt	Capacity fac Net Mwe	
	285	MWe	0.88	250.8
	1140	Mwe per site (4 units)		

Initial core load, MTU	5.65		
Reload, MTU/yr	1.711	4	6.844
Initial load, assemblies	1020	elements per unit	
Reload, assemblies/yr	520	elements/yr per unit	
Assemblies/shipment	80		
Refueling frequency	1.32	yr	

0.44313725	MTU/shipment
3.86110619	Shipments/yr per unit
15.3951603	Shipments/yr per 1000 MWe

Use this number. It accounts for less than annual refueling.

Initial shipments	12.75	4	51	shipments/4 unit site
Annual Shipments	4.9242424	4	20	shipments/yr per 4 unit site
Total over 40 yrs	204.79545	4	819.18182	shipments/4 unit site

PBMR				
	400	MWt	Capacity fac Net Mwe	
	165	MWe	0.95	156.75
	1320	Mwe per site (8 units)		

Initial core, spheres	260000	per module
Reload, spheres	120000	
Spheres/shipment	48000	2 containers at 24,000 per container

Initial shipments	5.4166667	8	44	shipments/8unit site
Annual Shipments	2.5	8	20	shipments/yr per 8 unit site
Total over 40 yrs	105.41667	8	843.33333	

	6.32	MTU/1000 Mwe
	8.3424	MTU/yr per 8 unit site
	5.8543158	MTU/yr, normalized

	Initial Core, per unit			
	# of fuel elements	U per elem	MTU	Total
Standard	720	5.7334	4.128048	5.649978
Non-Standard	300	5.0731	1.52193	
	Reload, per unit			
Standard	360	5.7334	2.064024	2.824989
Non-Standard	150	5.0731	0.760965	

	From DOE 2003	Volume, m3	Electric gen	Capacity f	m3/1000 M	Shipments/1000 MWe	
WASH-1238	3800 ft3/yr	107.61824	1000	1	107.6182	46	
ABWR	100 m3/yr	100	1500	1	66.66667	29	
ESBWR	100 m3/yr	100	1500	1	66.66667	29	
AP-1000	1964 ft3/yr	55.621637	1150	1	48.36664	21	
ACR-700	47.5 m3/yr	47.5	731	1	64.97948	28	
IRIS	870 ft3/yr per unit	24.638912	335	1	73.54899	32	
GT-MHR	98 m3/yr (4 unit plant)	98	1140	1	85.96491	5	90% in 1000 ft3 shipments
PBMR	100 drums/yr per modul	151.2	1320	1	114.5455	6	and 10% in 200 ft3 shipments

46 shipments/yr

2.34 m3/shipment

Alternate shipment capacities given in DOE (2003)

1000 ft3 = 28.32059 m3/shipment

200 ft3 = 5.664118 m3/shipment

	From DOE 2003	Volume, m3	Shipments/y	Electric ge	Capacity f	Net Mwe	m3/1,100 I	Shipments/1000 MWe	
WASH-1238	3800 ft3/yr	108	46	1100	0.8	880	107.6	46	
ABWR	100 m3/yr	100	43	1500	0.95	1425	61.8	27	
ESBWR	100 m3/yr	100	43	1500	0.95	1425	61.8	27	
AP-1000	1964 ft3/yr	56	24	1150	0.95	1092.5	44.8	20	
ACR-700	47.5 m3/yr	47.5	20	731	0.9	657.9	63.5	28	
IRIS	870 ft3/yr per unit	74	32	1005	0.96	964.8	67.4	29	
GT-MHR	98 m3/yr (4 unit site)	98	42	1140	0.88	1003.2	86.0	37	5
PBMR	100 drums/yr per modul	168	72	1320	0.95	1254	117.9	51	6

46 shipments/yr

2.34 m3/shipment

Alternate shipment capacities given in DOE (2003)

1000 ft3 = 28.32059 m3/shipment

200 ft3 = 5.664118 m3/shipment

0.21 m3/drum (55-gal)

Advance Reactor Site	Total	One-way Shipping Distance, km			Population Density, persons/km2			Stop time per trip, hr	hr/km	No. of Stops
		Rural	Suburban	Urban	Rural	Suburban	Urban			
Primary Site										
North Anna	4409.5	3498	812.4	99.1	11.3	319	2310.6	5	0.001134	10
Clinton	3076.3	2626.3	398.3	51.7	9.4	306.1	2372.2	3.5	0.001138	7
Grand Gulf	3718.3	3030.4	581.3	106.6	9.2	339.4	2429.4	4	0.001076	8
Backup Site										
Savannah River Site (SRS)	4263	3260	881	122	11	331.5	2311.2	5	0.001173	10
Portsmouth Gaseous Diffusion Plant (PGDP)	3902.2	3166.9	647.2	88.1	10.7	316.4	2339.7	4.5	0.001153	9
Fitzpatrick	4212.2	3228.6	875.4	108.2	11.4	312.4	2348.7	5	0.001187	10
Pilgrim	4682.3	3469.3	1091.7	121.3	11.8	312.3	2377.2	5.5	0.001175	11
Zion	3138.9	2629.6	441.3	68	9.5	323.8	2360.3	3.5	0.001115	7
Quad Cities	2853.1	2451	352.6	49.5	9.1	310.2	2391.3	3	0.001051	6
Braidwood	3034.5	2604.4	378.7	51.4	9.4	308.9	2377.2	3.5	0.001153	7
Surry	4555.4	3590.7	863.9	100.8	11.4	317.6	2301.6	5	0.001098	10
	TRAGIS Data							Assumes 30 min per stop		See TRAGIS output files for the number of stops.

Quad Cities	Travel fractior	0.85906558	0.1235849	0.0173495
	6.37756			
	2910.068365			
	1773.213176			
	2910.068365			

Distance	1600 km	
Band width	1.6 km (800 m on either side of road)	
Area	2560 km2	

Rural	0.9	6	13824
Suburban	0.05	719	92032
Urban	0.05	3861	494208
			600064

Spent Fuel RADTRAN 5 output — Calculated value

Person-rem/Shipment per MTU/shipment

	Worker Crew	Public Off-link	On-link	Stops	Total	Accident
ABWR						
Braidwood	5.05E-02	3.36E-03	1.83E-02	1.70E-01	1.92E-01	1.11E-05
Clinton	5.12E-02	3.48E-03	1.86E-02	1.70E-01	1.92E-01	5.11E-05
Fitzpatrick	7.01E-02	7.31E-03	2.69E-02	2.43E-01	2.77E-01	1.86E-05
Grand Gulf	6.19E-02	5.35E-03	2.35E-02	1.94E-01	2.23E-01	2.05E-05
North Anna	7.34E-02	7.05E-03	2.77E-02	2.43E-01	2.78E-01	2.33E-05
Pilgrim	7.79E-02	8.98E-03	3.02E-02	2.67E-01	3.06E-01	4.01E-05
Portsmouth	6.49E-02	5.65E-03	2.43E-02	2.19E-01	2.49E-01	2.55E-05
Quad Cities	4.75E-02	3.13E-03	1.72E-02	1.46E-01	1.66E-01	1.03E-05
Savannah River	7.09E-02	7.73E-03	2.75E-02	2.43E-01	2.78E-01	2.63E-05
Surry	7.58E-02	7.43E-03	2.86E-02	2.43E-01	2.79E-01	2.39E-05
Zion	5.22E-02	3.99E-03	1.93E-02	1.70E-01	1.93E-01	1.50E-05
AP-1000						
Braidwood	5.05E-02	3.36E-03	1.83E-02	1.70E-01	1.92E-01	9.98E-07
Clinton	5.12E-02	3.48E-03	1.86E-02	1.70E-01	1.92E-01	1.01E-06
Fitzpatrick	7.01E-02	7.21E-03	2.69E-02	2.43E-01	2.77E-01	1.70E-06
Grand Gulf	6.19E-02	5.35E-03	2.35E-02	1.94E-01	2.23E-01	1.86E-06
North Anna	7.34E-02	7.15E-03	2.77E-02	1.43E-01	1.78E-01	2.13E-06
Pilgrim	7.79E-02	8.98E-03	3.02E-02	2.67E-01	3.06E-01	3.67E-06
Portsmouth	6.49E-02	5.65E-03	2.43E-02	2.19E-01	2.49E-01	2.05E-06
Quad Cities	4.75E-02	3.13E-03	1.72E-02	1.46E-01	1.66E-01	9.39E-07
Savannah River	7.09E-02	7.73E-03	2.75E-02	2.43E-01	2.78E-01	2.40E-06
Surry	7.58E-02	7.43E-03	2.86E-02	2.43E-01	2.79E-01	2.19E-06
Zion	5.22E-02	3.99E-03	1.93E-02	1.70E-01	1.93E-01	1.37E-06
GT MHR						
Braidwood	5.05E-02	3.36E-03	1.83E-02	1.70E-01	1.92E-01	1.49E-06
Clinton	5.12E-02	3.48E-03	1.86E-02	1.70E-01	1.92E-01	1.51E-06
Fitzpatrick	7.01E-02	7.21E-03	2.69E-02	2.43E-01	2.77E-01	2.54E-06
Grand Gulf	6.19E-02	5.35E-03	2.35E-02	1.94E-01	2.23E-01	2.79E-06
North Anna	7.34E-02	7.15E-03	2.77E-02	1.43E-01	1.78E-01	3.18E-06
Pilgrim	7.79E-02	8.98E-03	3.02E-02	2.67E-01	3.06E-01	5.84E-06
Portsmouth	6.49E-02	5.65E-03	2.43E-02	2.19E-01	2.49E-01	3.07E-06
Quad Cities	4.75E-02	3.13E-03	1.72E-02	1.46E-01	1.66E-01	1.40E-06
Savannah River	7.09E-02	7.73E-03	2.75E-02	2.43E-01	2.78E-01	3.59E-06
Surry	7.58E-02	7.43E-03	2.86E-02	2.43E-01	2.79E-01	3.27E-06
Zion	5.22E-02	3.99E-03	1.93E-02	1.70E-01	1.93E-01	2.05E-06
PBMR						
Braidwood	5.05E-02	3.36E-03	1.83E-02	1.70E-01	1.92E-01	2.53E-06
Clinton	5.12E-02	3.48E-03	1.86E-02	1.70E-01	1.92E-01	2.56E-06
Fitzpatrick	7.01E-02	7.21E-03	2.69E-02	2.43E-01	2.77E-01	4.30E-06
Grand Gulf	6.19E-02	5.35E-03	2.35E-02	1.94E-01	2.23E-01	4.72E-06
North Anna	7.34E-02	7.15E-03	2.77E-02	1.43E-01	1.78E-01	5.39E-06
Pilgrim	7.79E-02	8.98E-03	3.02E-02	2.67E-01	3.06E-01	9.30E-06
Portsmouth	6.49E-02	5.65E-03	2.43E-02	2.19E-01	2.49E-01	5.20E-06
Quad Cities	4.75E-02	3.13E-03	1.72E-02	1.46E-01	1.66E-01	1.40E-06
Savannah River	7.09E-02	7.73E-03	2.75E-02	2.43E-01	2.78E-01	6.09E-06
Surry	7.58E-02	7.43E-03	2.86E-02	2.43E-01	2.79E-01	5.55E-06
Zion	5.22E-02	3.99E-03	1.93E-02	1.70E-01	1.93E-01	3.48E-06

= Taken from RADTRAN5 Output Files'

= Calculated Value

= Taken from Published Reference

Radiological Routine Exposures

Table S-4	Workers	Onlookers	Along Route			
	4	3	3			
	~~Population Dose, person-rem/shipment~~			~~Allowed Shipments~~		
	~~Crew~~	~~Onlookers~~	~~Along Route~~	~~Crew~~	~~Onlookers~~	~~Along Route~~
~~Braidwood~~	~~5.05E-02~~	~~1.88E-01~~	~~3.36E-03~~	~~20~~	~~16~~	~~893~~
~~Clinton~~	~~5.12E-02~~	~~1.89E-01~~	~~3.48E-03~~	~~78~~	~~16~~	~~862~~
~~Fitzpatrick~~	~~7.01E-02~~	~~2.70E-01~~	~~7.31E-03~~	~~67~~	~~11~~	~~410~~
~~Grand Gulf~~	~~6.19E-02~~	~~2.18E-01~~	~~5.35E-03~~	~~65~~	~~14~~	~~864~~
~~North Anna~~	~~7.34E-02~~	~~2.71E-01~~	~~7.05E-03~~	~~54~~	~~11~~	~~426~~
~~Pilgrim~~	~~7.79E-02~~	~~3.07E-01~~	~~8.98E-03~~	~~51~~	~~10~~	~~334~~
~~Portsmouth~~	~~6.49E-02~~	~~2.43E-01~~	~~5.65E-03~~	~~62~~	~~12~~	~~631~~
~~Quad Cities~~	~~4.75E-02~~	~~1.63E-01~~	~~3.13E-03~~	~~84~~	~~18~~	~~958~~
~~Savannah River~~	~~7.09E-02~~	~~2.71E-01~~	~~7.73E-03~~	~~56~~	~~11~~	~~388~~
~~Surry~~	~~7.58E-02~~	~~2.72E-01~~	~~7.43E-03~~	~~53~~	~~11~~	~~404~~
~~Zion~~	~~5.22E-02~~	~~1.89E-01~~	~~3.99E-03~~	~~77~~	~~16~~	~~752~~

~~THESE ARE OLD RESULTS - DO NOT USE~~

Radiological Routine exposures

	1.4	1.3	1.3	Adjustment factors - see Ratios bel

	Population Dose, person-rem/shipment		
	Crew	Onlookers	Along Route
Braidwood	7.1E-02	2.4E-01	4.4E-03
Clinton	7.2E-02	2.5E-01	4.5E-03
Fitzpatrick	9.8E-02	3.5E-01	9.5E-03
Grand Gulf	8.7E-02	2.8E-01	7.0E-03
North Anna	1.0E-01	3.5E-01	9.2E-03
Pilgrim	1.1E-01	3.9E-01	1.2E-02
Portsmouth	9.1E-02	3.2E-01	7.3E-03
Quad Cities	6.7E-02	2.1E-01	4.1E-03
Savannah River	9.9E-02	3.5E-01	1.0E-02
Surry	1.1E-01	3.5E-01	9.7E-03
Zion	7.3E-02	2.5E-01	5.2E-03

Revised results; adjusted vehicle dose rate to reg maximum

REVISED RADTRAN RESULTS			
Clinton	7.17E-02	0.2452	0.00453
Surry	1.06E-01	0.3532	0.00966
RATIO - OLD TO REVISED			
Clinton	1.40E+00	1.30E+00	1.30E+00
Surry	1.40E+00	1.30E+00	1.30E+00

During internal reviews, it was noted that the vehicle dose rate was set to an incorrect value that would understate results. New RADTRAN runs were performed for Clinton and Surry to calculate ratios that would reflect the impact of increasing the dose rate to the regulatory maximum.

Radiological Accident Risks

Taken from FGR-13

6.00E-04 LCFs/person-rem

8.50E-04 Total detriment /person-rem

Site	ABWR/ESBWR	AP-1000	GT-MHR	PBMR
Population Dose, person-rem/MTU				
Braidwood	1.1E-05	1.0E-06	1.5E-06	2.5E-06
Clinton	5.1E-05	1.0E-06	1.5E-06	2.6E-06
Fitzpatrick	1.9E-05	1.7E-06	2.5E-06	4.3E-06
Grand Gulf	2.1E-05	1.9E-06	2.8E-06	4.7E-06
North Anna	2.3E-05	2.1E-06	3.2E-06	5.4E-06
Pilgrim	4.0E-05	3.7E-06	5.8E-06	9.3E-06
Portsmouth	2.6E-05	2.1E-06	3.1E-06	5.2E-06
Quad Cities	1.0E-05	9.4E-07	1.4E-06	1.4E-06
Savannah Rive	2.6E-05	2.4E-06	3.6E-06	6.1E-06
Surry	2.4E-05	2.2E-06	3.3E-06	5.6E-06
Zion	1.5E-05	1.4E-06	2.1E-06	3.5E-06
Latent Cancer Fatalities per MTU				
Braidwood	6.7E-09	6.0E-10	8.9E-10	1.5E-09
Clinton	3.1E-08	6.1E-10	9.1E-10	1.5E-09
Fitzpatrick	1.1E-08	1.0E-09	1.5E-09	2.6E-09
Grand Gulf	1.2E-08	1.1E-09	1.7E-09	2.8E-09
North Anna	1.4E-08	1.3E-09	1.9E-09	3.2E-09
Pilgrim	2.4E-08	2.2E-09	3.5E-09	5.6E-09
Portsmouth	1.5E-08	1.2E-09	1.8E-09	3.1E-09
Quad Cities	6.2E-09	5.6E-10	8.4E-10	8.4E-10
Savannah Rive	1.6E-08	1.4E-09	2.2E-09	3.7E-09
Surry	1.4E-08	1.3E-09	2.0E-09	3.3E-09
Zion	9.0E-09	8.2E-10	1.2E-09	2.1E-09
Total Detrimental Health Effects per MTU				
Braidwood	9.4E-09	8.5E-10	1.3E-09	2.2E-09
Clinton	4.3E-08	8.6E-10	1.3E-09	2.2E-09
Fitzpatrick	1.6E-08	1.4E-09	2.2E-09	3.7E-09
Grand Gulf	1.7E-08	1.6E-09	2.4E-09	4.0E-09
North Anna	2.0E-08	1.8E-09	2.7E-09	4.6E-09
Pilgrim	3.4E-08	3.1E-09	5.0E-09	7.9E-09
Portsmouth	2.2E-08	1.7E-09	2.6E-09	4.4E-09
Quad Cities	8.8E-09	8.0E-10	1.2E-09	1.2E-09
Savannah Rive	2.2E-08	2.0E-09	3.1E-09	5.2E-09
Surry	2.0E-08	1.9E-09	2.8E-09	4.7E-09
Zion	1.3E-08	1.2E-09	1.7E-09	3.0E-09

US Cancer Fatalities	
194.4	cancers/100000
358705	Exposed persons (Clinton to Yucca)
697	Cancers in exposed population

Advanced Reactor Type	ABWR/ES	AP-1000	GT-MHR	PBMR
MTU/yr	32.8	24.4	6.8	8.3
Population Dose, person-rem/yr				
Braidwood	4.E-04	2.E-05	1.E-05	2.E-05
Clinton	2.E-03	2.E-05	1.E-05	2.E-05
Fitzpatrick	6.E-04	4.E-05	2.E-05	4.E-05
Grand Gulf	7.E-04	5.E-05	2.E-05	4.E-05
North Anna	8.E-04	5.E-05	2.E-05	4.E-05
Pilgrim	1.E-03	9.E-05	4.E-05	8.E-05
Portsmouth	8.E-04	5.E-05	2.E-05	4.E-05
Quad Cities	3.E-04	2.E-05	1.E-05	1.E-05
Savannah R	9.E-04	6.E-05	2.E-05	5.E-05
Surry	8.E-04	5.E-05	2.E-05	5.E-05
Zion	5.E-04	3.E-05	1.E-05	3.E-05
Latent Cancer Fatalities per Year				
Braidwood	2.E-07	1.E-08	6.E-09	1.E-08
Clinton	1.E-06	1.E-08	6.E-09	1.E-08
Fitzpatrick	4.E-07	2.E-08	1.E-08	2.E-08
Grand Gulf	4.E-07	3.E-08	1.E-08	2.E-08
North Anna	5.E-07	3.E-08	1.E-08	3.E-08
Pilgrim	8.E-07	5.E-08	2.E-08	5.E-08
Portsmouth	5.E-07	3.E-08	1.E-08	3.E-08
Quad Cities	2.E-07	1.E-08	6.E-09	7.E-09
Savannah R	5.E-07	4.E-08	1.E-08	3.E-08
Surry	5.E-07	3.E-08	1.E-08	3.E-08
Zion	3.E-07	2.E-08	8.E-09	2.E-08
Total Detrimental Health Effects per Year				
Braidwood	3.E-07	2.E-08	9.E-09	2.E-08
Clinton	1.E-06	2.E-08	9.E-09	2.E-08
Fitzpatrick	5.E-07	4.E-08	1.E-08	3.E-08
Grand Gulf	6.E-07	4.E-08	2.E-08	3.E-08
North Anna	6.E-07	4.E-08	2.E-08	4.E-08
Pilgrim	1.E-06	8.E-08	3.E-08	7.E-08
Portsmouth	7.E-07	4.E-08	2.E-08	4.E-08
Quad Cities	3.E-07	2.E-08	8.E-09	1.E-08
Savannah R	7.E-07	5.E-08	2.E-08	4.E-08
Surry	7.E-07	5.E-08	2.E-08	4.E-08
Zion	4.E-07	3.E-08	1.E-08	2.E-08

Normalized

	ABWR/ES	AP-1000	GT-MHR	PBMR
MTU/yr	20.25544	19.65400458	5.964912281	5.824561404
880	1425	1092.5	1003.2	1254
Factor	0.617544	0.805491991	0.877192982	0.701754386
Population Dose, person-rem/yr				
Braidwood	2.2E-04	2.0E-05	8.9E-06	1.5E-05
Clinton	1.0E-03	2.0E-05	9.0E-06	1.5E-05
Fitzpatrick	3.8E-04	3.3E-05	1.5E-05	2.5E-05
Grand Gul	4.2E-04	3.7E-05	1.7E-05	2.7E-05
North Anr	4.7E-04	4.2E-05	1.9E-05	3.1E-05
Pilgrim	8.1E-04	7.2E-05	3.5E-05	5.4E-05
Portsmout	5.2E-04	4.0E-05	1.8E-05	3.0E-05
Quad Citi	2.1E-04	1.8E-05	8.4E-06	8.2E-06
Savannah	5.3E-04	4.7E-05	2.1E-05	3.5E-05
Surry	4.8E-04	4.3E-05	2.0E-05	3.2E-05
Zion	3.0E-04	2.7E-05	1.2E-05	2.0E-05
Latent Cancer Fatalities per Year				
Braidwood	1.3E-07	1.2E-08	5.3E-09	8.8E-09
Clinton	6.2E-07	1.2E-08	5.4E-09	8.9E-09
Fitzpatrick	2.3E-07	2.0E-08	9.1E-09	1.5E-08
Grand Gul	2.5E-07	2.2E-08	1.0E-08	1.6E-08
North Anr	2.8E-07	2.5E-08	1.1E-08	1.9E-08
Pilgrim	4.9E-07	4.3E-08	2.1E-08	3.3E-08
Portsmout	3.1E-07	2.4E-08	1.1E-08	1.8E-08
Quad Citi	1.3E-07	1.1E-08	5.0E-09	4.9E-09
Savannah	3.2E-07	2.8E-08	1.3E-08	2.1E-08
Surry	2.9E-07	2.6E-08	1.2E-08	1.9E-08
Zion	1.8E-07	1.6E-08	7.3E-09	1.2E-08
Total Detrimental Health Effects per Year				
Braidwood	1.9E-07	1.7E-08	7.6E-09	1.3E-08
Clinton	8.8E-07	1.7E-08	7.7E-09	1.3E-08
Fitzpatrick	3.2E-07	2.8E-08	1.3E-08	2.1E-08
Grand Gul	3.5E-07	3.1E-08	1.4E-08	2.3E-08
North Anr	4.0E-07	3.6E-08	1.6E-08	2.7E-08
Pilgrim	6.9E-07	6.1E-08	3.0E-08	4.6E-08
Portsmout	4.4E-07	3.4E-08	1.6E-08	2.6E-08
Quad Citi	1.8E-07	1.6E-08	7.1E-09	6.9E-09
Savannah	4.5E-07	4.0E-08	1.8E-08	3.0E-08
Surry	4.1E-07	3.7E-08	1.7E-08	2.7E-08
Zion	2.6E-07	2.3E-08	1.0E-08	1.7E-08

Spent Fuel Shipments per year

	MTU/yr	MTU/cask	Shipments/yr			
Reference LWR	30	0.5	60			
ABWR	32.76	0.5	66			
AP-1000	24.4	0.5	49			
ACR-700	33.1	0.5	67			
IRIS	18.78	0.5	38			
GT MHR	19		38	6.844		
PBMR	8		16	6.32	MTU/1000	8.3424

Population Dose

	Reference LWR			ABWR/ESBWR			AP-1000		
No Shipments p	60			66			49		
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood	4.2E+00	1.5E+01	2.6E-01	4.7E+00	1.6E+01	2.9E-01	3.5E+00	1.2E+01	2.1E-01
Clinton	4.3E+00	1.5E+01	2.7E-01	4.7E+00	1.6E+01	3.0E-01	3.5E+00	1.2E+01	2.2E-01
Fitzpatrick	5.9E+00	2.1E+01	5.7E-01	6.5E+00	2.3E+01	6.3E-01	4.8E+00	1.7E+01	4.7E-01
Grand Gulf	5.2E+00	1.7E+01	4.2E-01	5.7E+00	1.9E+01	4.6E-01	4.2E+00	1.4E+01	3.4E-01
North Anna	6.2E+00	2.1E+01	5.5E-01	6.8E+00	2.3E+01	6.0E-01	5.0E+00	1.7E+01	4.5E-01
Pilgrim	6.5E+00	2.3E+01	7.0E-01	7.2E+00	2.5E+01	7.7E-01	5.3E+00	1.9E+01	5.7E-01
Portsmouth	5.5E+00	1.9E+01	4.4E-01	6.0E+00	2.1E+01	4.8E-01	4.5E+00	1.5E+01	3.6E-01
Quad Cities	4.0E+00	1.3E+01	2.4E-01	4.4E+00	1.4E+01	2.7E-01	3.3E+00	1.0E+01	2.0E-01
Savannah River	6.0E+00	2.1E+01	6.0E-01	6.6E+00	2.3E+01	6.6E-01	4.9E+00	1.7E+01	4.9E-01
Surry	6.4E+00	2.1E+01	5.8E-01	7.0E+00	2.3E+01	6.4E-01	5.2E+00	1.7E+01	4.7E-01
Zion	4.4E+00	1.5E+01	3.1E-01	4.8E+00	1.6E+01	3.4E-01	3.6E+00	1.2E+01	2.5E-01

	ACR-700			IRIS			GT MHR			PBMR		
No Shipments p	67			38			38			16		
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood	4.7E+00	1.6E+01	2.9E-01	2.7E+00	9.3E+00	1.7E-01	2.7E+00	9.3E+00	1.7E-01	1.1E+00	3.9E+00	7.0E-02
Clinton	4.8E+00	1.6E+01	3.0E-01	2.7E+00	9.3E+00	1.7E-01	2.7E+00	9.3E+00	1.7E-01	1.1E+00	3.9E+00	7.2E-02
Fitzpatrick	6.6E+00	2.4E+01	6.4E-01	3.7E+00	1.3E+01	3.6E-01	3.7E+00	1.3E+01	3.6E-01	1.6E+00	5.6E+00	1.5E-01
Grand Gulf	5.8E+00	1.9E+01	4.7E-01	3.3E+00	1.1E+01	2.6E-01	3.3E+00	1.1E+01	2.6E-01	1.4E+00	4.5E+00	1.1E-01
North Anna	6.9E+00	2.4E+01	6.1E-01	3.9E+00	1.3E+01	3.5E-01	3.9E+00	1.3E+01	3.5E-01	1.6E+00	5.6E+00	1.5E-01
Pilgrim	7.3E+00	2.6E+01	7.8E-01	4.1E+00	1.5E+01	4.4E-01	4.1E+00	1.5E+01	4.4E-01	1.7E+00	6.2E+00	1.9E-01
Portsmouth	6.1E+00	2.1E+01	4.9E-01	3.5E+00	1.2E+01	2.8E-01	3.5E+00	1.2E+01	2.8E-01	1.5E+00	5.1E+00	1.2E-01
Quad Cities	4.5E+00	1.4E+01	2.7E-01	2.5E+00	8.1E+00	1.5E-01	2.5E+00	8.1E+00	1.5E-01	1.1E+00	3.4E+00	6.5E-02
Savannah River	6.7E+00	2.4E+01	6.7E-01	3.8E+00	1.3E+01	3.8E-01	3.8E+00	1.3E+01	3.8E-01	1.6E+00	5.6E+00	1.6E-01
Surry	7.1E+00	2.4E+01	6.5E-01	4.0E+00	1.3E+01	3.7E-01	4.0E+00	1.3E+01	3.7E-01	1.7E+00	5.6E+00	1.5E-01
Zion	4.9E+00	1.6E+01	3.5E-01	2.8E+00	9.4E+00	2.0E-01	2.8E+00	9.4E+00	2.0E-01	1.2E+00	3.9E+00	8.3E-02

Braidwood	YES	YES	YES	YES		YES	YES	YES		YES		YES	YES
Clinton	YES	YES	YES	YES		YES	YES	YES		YES		YES	YES
Fitzpatrick	YES	YES	YES	YES	YES	YES	YES	YES		YES		YES	YES
Grand Gulf	YES	YES	YES	YES	YES	YES	YES	YES		YES		YES	YES
North Anna	YES	YES	YES	YES	YES	YES	YES	YES		YES		YES	YES
Pilgrim	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Portsmouth	YES	YES	YES	YES	YES	YES	YES	YES		YES		YES	YES
Quad Cities		YES	YES	YES		YES	YES	YES		YES		YES	YES
Savannah River	YES	YES	YES	YES	YES	YES	YES	YES		YES		YES	YES
Surry	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Zion	YES	YES	YES	YES		YES	YES	YES		YES		YES	YES

LCFs Conversion Factor is in cell P3

	Reference LWR			ABWR ESBWR			AP-1000			ACR-700			IRIS			GT MHR			PBMR		
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Rou	Crew	Onlookers	Along Route	Crew	Onlookers	Along Rou	Crew	Onlookers	Along Route
Braidwood	2.5E-03	8.8E-03	1.6E-04	2.8E-03	9.7E-03	1.7E-04	2.1E-03	7.2E-03	1.3E-04	2.8E-03	9.8E-03	1.8E-04	1.6E-03	5.6E-03	1.0E-04	1.6E-03	5.6E-03	1.0E-04	6.8E-04	2.3E-03	4.2E-05
Clinton	2.6E-03	8.8E-03	1.6E-04	2.8E-03	9.7E-03	1.8E-04	2.1E-03	7.2E-03	1.3E-04	2.9E-03	9.9E-03	1.8E-04	1.6E-03	5.6E-03	1.0E-04	1.6E-03	5.6E-03	1.0E-04	6.9E-04	2.4E-03	4.3E-05
Fitzpatrick	3.5E-03	1.3E-02	3.4E-04	3.9E-03	1.4E-02	3.8E-04	2.9E-03	1.0E-02	2.8E-04	3.9E-03	1.4E-02	3.8E-04	2.2E-03	8.0E-03	2.2E-04	2.2E-03	8.0E-03	2.2E-04	9.4E-04	3.4E-03	9.1E-05
Grand Gulf	3.1E-03	1.0E-02	2.5E-04	3.4E-03	1.1E-02	2.8E-04	2.5E-03	8.3E-03	2.0E-04	3.5E-03	1.1E-02	2.8E-04	2.0E-03	6.4E-03	1.6E-04	2.0E-03	6.4E-03	1.6E-04	8.3E-04	2.7E-03	6.7E-05
North Anna	3.7E-03	1.3E-02	3.3E-04	4.1E-03	1.4E-02	3.6E-04	3.0E-03	1.0E-02	2.7E-04	4.1E-03	1.4E-02	3.7E-04	2.3E-03	8.0E-03	2.1E-04	2.3E-03	8.0E-03	2.1E-04	9.9E-04	3.4E-03	8.8E-05
Pilgrim	3.9E-03	1.4E-02	4.2E-04	4.3E-03	1.5E-02	4.6E-04	3.2E-03	1.1E-02	3.4E-04	4.4E-03	1.6E-02	4.7E-04	2.5E-03	8.8E-03	2.7E-04	2.5E-03	8.8E-03	2.7E-04	1.0E-03	3.7E-03	1.1E-04
Portsmouth	3.3E-03	1.1E-02	2.6E-04	3.6E-03	1.3E-02	2.9E-04	2.7E-03	9.3E-03	2.2E-04	3.7E-03	1.3E-02	3.0E-04	2.1E-03	7.2E-03	1.7E-04	2.1E-03	7.2E-03	1.7E-04	8.7E-04	3.0E-03	7.1E-05
Quad Cities	2.4E-03	7.6E-03	1.5E-04	2.6E-03	8.4E-03	1.6E-04	2.0E-03	6.2E-03	1.2E-04	2.7E-03	8.5E-03	1.6E-04	1.5E-03	4.8E-03	9.3E-05	1.5E-03	4.8E-03	9.3E-05	6.4E-04	2.0E-03	3.9E-05
Savannah River	3.6E-03	1.3E-02	3.6E-04	3.9E-03	1.4E-02	4.0E-04	2.9E-03	1.0E-02	3.0E-04	4.0E-03	1.4E-02	4.0E-04	2.3E-03	8.0E-03	2.3E-04	2.3E-03	8.0E-03	2.3E-04	9.5E-04	3.4E-03	9.6E-05
Surry	3.8E-03	1.3E-02	3.5E-04	4.2E-03	1.4E-02	3.8E-04	3.1E-03	1.0E-02	2.8E-04	4.3E-03	1.4E-02	3.9E-04	2.4E-03	8.1E-03	2.2E-04	2.4E-03	8.1E-03	2.2E-04	1.0E-03	3.4E-03	9.3E-05
Zion	2.6E-03	8.9E-03	1.9E-04	2.9E-03	9.7E-03	2.1E-04	2.1E-03	7.2E-03	1.5E-04	2.9E-03	9.9E-03	2.1E-04	1.7E-03	5.6E-03	1.2E-04	1.7E-03	5.6E-03	1.2E-04	7.0E-04	2.4E-03	5.0E-05

Total Detriment Conversion factor is in cell P4

	Reference LWR			ABWR ESBWR			AP-1000			ACR-700			IRIS			GT MHR			PBMR		
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Rou	Crew	Onlookers	Along Route	Crew	Onlookers	Along Rou	Crew	Onlookers	Along Route
Braidwood	3.6E-03	1.2E-02	2.2E-04	4.0E-03	1.4E-02	2.5E-04	2.9E-03	1.0E-02	1.8E-04	4.0E-03	1.4E-02	2.5E-04	2.3E-03	7.9E-03	1.4E-04	2.3E-03	7.9E-03	1.4E-04	9.6E-04	3.3E-03	5.9E-05
Clinton	3.7E-03	1.3E-02	2.3E-04	4.0E-03	1.4E-02	2.5E-04	3.0E-03	1.0E-02	1.9E-04	4.1E-03	1.4E-02	2.6E-04	2.3E-03	7.9E-03	1.5E-04	2.3E-03	7.9E-03	1.5E-04	9.7E-04	3.3E-03	6.2E-05
Fitzpatrick	5.0E-03	1.8E-02	4.8E-04	5.5E-03	2.0E-02	5.3E-04	4.1E-03	1.5E-02	4.0E-04	5.6E-03	2.0E-02	5.4E-04	3.2E-03	1.1E-02	3.1E-04	3.2E-03	1.1E-02	3.1E-04	1.3E-03	4.8E-03	1.3E-04
Grand Gulf	4.4E-03	1.4E-02	3.5E-04	4.9E-03	1.6E-02	3.9E-04	3.6E-03	1.2E-02	2.9E-04	4.9E-03	1.6E-02	4.0E-04	2.8E-03	9.1E-03	2.2E-04	2.8E-03	9.1E-03	2.2E-04	1.2E-03	3.8E-03	9.5E-05
North Anna	5.2E-03	1.8E-02	4.7E-04	5.8E-03	2.0E-02	5.1E-04	4.3E-03	1.5E-02	3.8E-04	5.9E-03	2.0E-02	5.2E-04	3.3E-03	1.1E-02	3.0E-04	3.3E-03	1.1E-02	3.0E-04	1.4E-03	4.8E-03	1.2E-04
Pilgrim	5.6E-03	2.0E-02	6.0E-04	6.1E-03	2.2E-02	6.5E-04	4.5E-03	1.6E-02	4.9E-04	6.2E-03	2.2E-02	6.6E-04	3.5E-03	1.2E-02	3.8E-04	3.5E-03	1.2E-02	3.8E-04	1.5E-03	5.3E-03	1.6E-04
Portsmouth	4.6E-03	1.6E-02	3.7E-04	5.1E-03	1.8E-02	4.1E-04	3.8E-03	1.3E-02	3.1E-04	5.2E-03	1.8E-02	4.2E-04	2.9E-03	1.0E-02	2.4E-04	2.9E-03	1.0E-02	2.4E-04	1.2E-03	4.3E-03	1.0E-04
Quad Cities	3.4E-03	1.1E-02	2.1E-04	3.7E-03	1.2E-02	2.3E-04	2.8E-03	8.8E-03	1.7E-04	3.8E-03	1.2E-02	2.3E-04	2.1E-03	6.9E-03	1.3E-04	2.1E-03	6.9E-03	1.3E-04	9.0E-04	2.9E-03	5.5E-05
Savannah River	5.1E-03	1.8E-02	5.1E-04	5.6E-03	2.0E-02	5.6E-04	4.1E-03	1.5E-02	4.2E-04	5.7E-03	2.0E-02	5.7E-04	3.2E-03	1.1E-02	3.2E-04	3.2E-03	1.1E-02	3.2E-04	1.3E-03	4.8E-03	1.4E-04
Surry	5.4E-03	1.8E-02	4.9E-04	6.0E-03	2.0E-02	5.4E-04	4.4E-03	1.5E-02	4.0E-04	6.0E-03	2.0E-02	5.5E-04	3.4E-03	1.1E-02	3.1E-04	3.4E-03	1.1E-02	3.1E-04	1.4E-03	4.8E-03	1.3E-04
Zion	3.7E-03	1.3E-02	2.6E-04	4.1E-03	1.4E-02	2.9E-04	3.0E-03	1.0E-02	2.2E-04	4.2E-03	1.4E-02	3.0E-04	2.4E-03	7.9E-03	1.7E-04	2.4E-03	7.9E-03	1.7E-04	9.9E-04	3.3E-03	7.1E-05

NORMALIZED

		Factor	Shipments
Reference LWR	880 / 880	1	60
ABWR ESBWR	1425	0.617544	40.757895
AP-1000	1092.5	0.805491991	39.469108
ACR-700	657.9	1.337589	89.61848
IRIS	964.8	0.912106	34.66003317
GT MHR	1003.2	0.877192982	33.33333
PBMR	1254	0.701754	11.22807018

	Reference LWR			ABWR ESBWR			AP-1000			ACR-700			IRIS			GT MHR			PBMR		
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Rou	Crew	Onlookers	Along Route	Crew	Onlookers	Along Rou	Crew	Onlookers	Along Route
Person-rem/year																					
Braidwood	4.2E+00	1.5E+01	2.6E-01	2.9E+00	1.0E+01	1.8E-01	2.8E+00	9.7E+00	1.7E-01	6.3E+00	2.2E+01	3.9E-01	2.5E+00	8.5E+00	1.5E-01	2.4E+00	8.2E+00	1.5E-01	7.9E-01	2.7E+00	4.9E-02
Clinton	4.3E+00	1.5E+01	2.7E-01	2.9E+00	1.0E+01	1.8E-01	2.8E+00	9.7E+00	1.8E-01	6.4E+00	2.2E+01	4.1E-01	2.5E+00	8.5E+00	1.6E-01	2.4E+00	8.2E+00	1.5E-01	8.0E-01	2.8E+00	5.1E-02
Fitzpatrick	5.9E+00	2.1E+01	5.7E-01	4.0E+00	1.4E+01	3.9E-01	3.9E+00	1.4E+01	3.8E-01	8.8E+00	3.1E+01	8.5E-01	3.4E+00	1.2E+01	3.3E-01	3.3E+00	1.2E+01	3.2E-01	1.1E+00	3.9E+00	1.1E-01
Grand Gulf	5.2E+00	1.7E+01	4.2E-01	3.5E+00	1.2E+01	2.8E-01	3.4E+00	1.1E+01	2.7E-01	7.8E+00	2.5E+01	6.2E-01	3.0E+00	9.8E+00	2.4E-01	2.9E+00	9.4E+00	2.3E-01	9.7E-01	3.2E+00	7.8E-02
North Anna	6.2E+00	2.1E+01	5.5E-01	4.2E+00	1.4E+01	3.7E-01	4.1E+00	1.4E+01	3.6E-01	9.2E+00	3.2E+01	8.2E-01	3.6E+00	1.2E+01	3.2E-01	3.4E+00	1.2E+01	3.1E-01	1.2E+00	4.0E+00	1.0E-01
Pilgrim	6.5E+00	2.3E+01	7.0E-01	4.4E+00	1.6E+01	4.8E-01	4.3E+00	1.5E+01	4.6E-01	9.8E+00	3.5E+01	1.0E+00	3.8E+00	1.3E+01	4.0E-01	3.6E+00	1.3E+01	3.9E-01	1.2E+00	4.3E+00	1.3E-01
Portsmouth	5.5E+00	1.9E+01	4.4E-01	3.7E+00	1.3E+01	3.0E-01	3.6E+00	1.2E+01	2.9E-01	8.1E+00	2.8E+01	6.6E-01	3.1E+00	1.1E+01	2.5E-01	3.0E+00	1.1E+01	2.4E-01	1.0E+00	3.6E+00	8.2E-02
Quad Cities	4.0E+00	1.3E+01	2.4E-01	2.7E+00	8.6E+00	1.7E-01	2.6E+00	8.4E+00	1.6E-01	6.0E+00	1.9E+01	3.6E-01	2.3E+00	7.4E+00	1.4E-01	2.2E+00	7.1E+00	1.4E-01	7.5E-01	2.4E+00	4.6E-02
Savannah River	6.0E+00	2.1E+01	6.0E-01	4.0E+00	1.4E+01	4.1E-01	3.9E+00	1.4E+01	4.0E-01	8.9E+00	3.2E+01	9.0E-01	3.4E+00	1.2E+01	3.5E-01	3.3E+00	1.2E+01	3.3E-01	1.1E+00	3.9E+00	1.1E-01
Surry	6.4E+00	2.1E+01	5.8E-01	4.3E+00	1.4E+01	3.9E-01	4.2E+00	1.4E+01	3.8E-01	9.5E+00	3.2E+01	8.7E-01	3.7E+00	1.2E+01	3.3E-01	3.5E+00	1.2E+01	3.2E-01	1.2E+00	4.0E+00	1.1E-01
Zion	4.4E+00	1.5E+01	3.1E-01	3.0E+00	1.0E+01	2.1E-01	2.9E+00	9.7E+00	2.0E-01	6.5E+00	2.2E+01	4.6E-01	2.5E+00	8.5E+00	1.8E-01	2.4E+00	8.2E+00	1.7E-01	8.2E-01	2.8E+00	5.8E-02
Latent Cancer Fatalities per Year																					
Braidwood	2.5E-03	8.8E-03	1.6E-04	1.7E-03	6.0E-03	1.1E-04	1.7E-03	5.8E-03	1.0E-04	3.8E-03	1.3E-02	2.3E-04	1.5E-03	5.1E-03	9.1E-05	1.4E-03	4.9E-03	8.7E-05	4.8E-04	1.6E-03	2.9E-05
Clinton	2.6E-03	8.8E-03	1.6E-04	1.8E-03	6.0E-03	1.1E-04	1.7E-03	5.8E-03	1.1E-04	3.9E-03	1.3E-02	2.4E-04	1.5E-03	5.1E-03	9.4E-05	1.4E-03	4.9E-03	9.0E-05	4.8E-04	1.7E-03	3.0E-05
Fitzpatrick	3.5E-03	1.3E-02	3.4E-04	2.4E-03	8.6E-03	2.3E-04	2.3E-03	8.3E-03	2.3E-04	5.3E-03	1.9E-02	5.1E-04	2.0E-03	7.3E-03	2.0E-04	2.0E-03	7.0E-03	1.9E-04	6.6E-04	2.4E-03	6.4E-05
Grand Gulf	3.1E-03	1.0E-02	2.5E-04	2.1E-03	6.9E-03	1.7E-04	2.1E-03	6.7E-03	1.6E-04	4.7E-03	1.5E-02	3.7E-04	1.8E-03	5.9E-03	1.4E-04	1.7E-03	5.7E-03	1.4E-04	5.8E-04	1.9E-03	4.7E-05
North Anna	3.7E-03	1.3E-02	3.3E-04	2.5E-03	8.6E-03	2.2E-04	2.4E-03	8.3E-03	2.2E-04	5.5E-03	1.9E-02	4.9E-04	2.1E-03	7.3E-03	1.9E-04	2.1E-03	7.0E-03	1.8E-04	6.9E-04	2.4E-03	6.2E-05
Pilgrim	3.9E-03	1.4E-02	4.2E-04	2.7E-03	9.4E-03	2.9E-04	2.6E-03	9.1E-03	2.8E-04	5.9E-03	2.1E-02	6.3E-04	2.3E-03	8.0E-03	2.4E-04	2.2E-03	7.7E-03	2.3E-04	7.3E-04	2.6E-03	7.9E-05
Portsmouth	3.3E-03	1.1E-02	2.6E-04	2.2E-03	7.7E-03	1.8E-04	2.2E-03	7.5E-03	1.7E-04	4.9E-03	1.7E-02	3.9E-04	1.9E-03	6.6E-03	1.5E-04	1.8E-03	6.3E-03	1.5E-04	6.1E-04	2.1E-03	4.9E-05
Quad Cities	2.4E-03	7.6E-03	1.5E-04	1.6E-03	5.2E-03	1.0E-04	1.6E-03	5.0E-03	9.6E-05	3.6E-03	1.1E-02	2.2E-04	1.4E-03	4.4E-03	8.5E-05	1.3E-03	4.2E-03	8.1E-05	4.5E-04	1.4E-03	2.7E-05
Savannah River	3.6E-03	1.3E-02	3.6E-04	2.4E-03	8.6E-03	2.5E-04	2.4E-03	8.3E-03	2.4E-04	5.3E-03	1.9E-02	5.4E-04	2.1E-03	7.3E-03	2.1E-04	2.0E-03	7.0E-03	2.0E-04	6.7E-04	2.4E-03	6.8E-05
Surry	3.8E-03	1.3E-02	3.5E-04	2.6E-03	8.6E-03	2.4E-04	2.5E-03	8.4E-03	2.3E-04	5.7E-03	1.9E-02	5.2E-04	2.2E-03	7.3E-03	2.0E-04	2.1E-03	7.1E-03	1.9E-04	7.1E-04	2.4E-03	6.5E-05
Zion	2.6E-03	8.9E-03	1.9E-04	1.8E-03	6.0E-03	1.3E-04	1.7E-03	5.8E-03	1.2E-04	3.9E-03	1.3E-02	2.8E-04	1.5E-03	5.1E-03	1.1E-04	1.5E-03	4.9E-03	1.0E-04	4.9E-04	1.7E-03	3.5E-05
Total Detrimental Health Effects per Year																					
Braidwood	3.6E-03	1.2E-02	2.2E-04	2.4E-03	8.5E-03	1.5E-04	2.4E-03	8.2E-03	1.5E-04	5.4E-03	1.9E-02	3.3E-04	2.1E-03	7.2E-03	1.3E-04	2.0E-03	6.9E-03	1.2E-04	6.7E-04	2.3E-03	4.2E-05
Clinton	3.7E-03	1.3E-02	2.3E-04	2.5E-03	8.5E-03	1.6E-04	2.4E-03	8.2E-03	1.5E-04	5.5E-03	1.9E-02	3.4E-04	2.1E-03	7.2E-03	1.3E-04	2.0E-03	6.9E-03	1.3E-04	6.8E-04	2.3E-03	4.3E-05
Fitzpatrick	5.0E-03	1.8E-02	4.8E-04	3.4E-03	1.2E-02	3.3E-04	3.3E-03	1.2E-02	3.2E-04	7.5E-03	2.7E-02	7.2E-04	2.9E-03	1.0E-02	2.8E-04	2.8E-03	9.9E-03	2.7E-04	9.4E-04	3.3E-03	9.1E-05
Grand Gulf	4.4E-03	1.4E-02	3.5E-04	3.0E-03	9.8E-03	2.4E-04	2.9E-03	9.5E-03	2.3E-04	6.6E-03	2.2E-02	5.3E-04	2.6E-03	8.3E-03	2.0E-04	2.5E-03	8.0E-03	2.0E-04	8.3E-04	2.7E-03	6.6E-05
North Anna	5.2E-03	1.8E-02	4.7E-04	3.6E-03	1.2E-02	3.2E-04	3.4E-03	1.2E-02	3.1E-04	7.8E-03	2.7E-02	7.0E-04	3.0E-03	1.0E-02	2.7E-04	2.9E-03	1.0E-02	2.6E-04	9.8E-04	3.4E-03	8.7E-05
Pilgrim	5.6E-03	2.0E-02	6.0E-04	3.8E-03	1.3E-02	4.0E-04	3.7E-03	1.3E-02	3.9E-04	8.3E-03	2.9E-02	8.9E-04	3.2E-03	1.1E-02	3.4E-04	3.1E-03	1.1E-02	3.3E-04	1.0E-03	3.7E-03	1.1E-04
Portsmouth	4.6E-03	1.6E-02	3.7E-04	3.1E-03	1.1E-02	2.5E-04	3.0E-03	1.1E-02	2.5E-04	6.9E-03	2.4E-02	5.6E-04	2.7E-03	9.3E-03	2.2E-04	2.6E-03	9.0E-03	2.1E-04	8.7E-04	3.0E-03	7.0E-05
Quad Cities	3.4E-03	1.1E-02	2.1E-04	2.3E-03	7.4E-03	1.4E-04	2.2E-03	7.1E-03	1.4E-04	5.1E-03	1.6E-02	3.1E-04	2.0E-03	6.3E-03	1.2E-04	1.9E-03	6.0E-03	1.2E-04	6.3E-04	2.0E-03	3.9E-05
Savannah River	5.1E-03	1.8E-02	5.1E-04	3.4E-03	1.2E-02	3.5E-04	3.3E-03	1.2E-02	3.4E-04	7.6E-03	2.7E-02	7.7E-04	2.9E-03	1.0E-02	3.0E-04	2.8E-03	1.0E-02	2.8E-04	9.5E-04	3.4E-03	9.6E-05
Surry	5.4E-03	1.8E-02	4.9E-04	3.7E-03	1.2E-02	3.3E-04	3.6E-03	1.2E-02	3.2E-04	8.1E-03	2.7E-02	7.4E-04	3.1E-03	1.0E-02	2.8E-04	3.0E-03	1.0E-02	2.7E-04	1.0E-03	3.4E-03	9.2E-05
Zion	3.7E-03	1.3E-02	2.6E-04	2.5E-03	8.5E-03	1.8E-04	2.5E-03	8.3E-03	1.7E-04	5.6E-03	1.9E-02	4.0E-04	2.2E-03	7.3E-03	1.5E-04	2.1E-03	7.0E-03	1.5E-04	7.0E-04	2.3E-03	5.0E-05
	8																				
Braidwood	4.2E+00	1.5E+01	2.6E-01	2.9E+00	1.0E+01	1.8E-01	2.8E+00	9.7E+00	1.7E-01	6.3E+00	2.2E+01	3.9E-01	2.5E+00	8.5E+00	1.5E-01	2.4E+00	8.2E+00	1.5E-01	7.9E-01	2.7E+00	4.9E-02
Clinton	4.3E+00	1.5E+01	2.7E-01	2.9E+00	1.0E+01	1.8E-01	2.8E+00	9.7E+00	1.8E-01	6.4E+00	2.2E+01	4.1E-01	2.5E+00	8.5E+00	1.6E-01	2.4E+00	8.2E+00	1.5E-01	8.0E-01	2.8E+00	5.1E-02
Fitzpatrick	5.9E+00	2.1E+01	5.7E-01	4.0E+00	1.4E+01	3.9E-01	3.9E+00	1.4E+01	3.8E-01	8.8E+00	3.1E+01	8.5E-01	3.4E+00	1.2E+01	3.3E-01	3.3E+00	1.2E+01	3.2E-01	1.1E+00	3.9E+00	1.1E-01

Grand Gulf	5.2E+00	1.7E+01	4.2E-01	3.5E+00	1.2E+01	2.8E-01	3.4E+00	1.1E+01	2.7E-01	7.8E+00	2.5E+01	6.2E-01	3.0E+00	9.8E+00	2.4E-01	2.9E+00	9.4E+00	2.3E-01	9.7E-01	3.2E+00	7.8E-02
North Anna	6.2E+00	2.1E+01	5.5E-01	4.2E+00	1.4E+01	3.7E-01	4.1E+00	1.4E+01	3.6E-01	9.2E+00	3.2E+01	8.2E-01	3.6E+00	1.2E+01	3.2E-01	3.4E+00	1.2E+01	3.1E-01	1.2E+00	4.0E+00	1.0E-01
Pilgrim	6.5E+00	2.3E+01	7.0E-01	4.4E+00	1.6E+01	4.8E-01	4.3E+00	1.5E+01	4.6E-01	9.8E+00	3.5E+01	1.0E+00	3.8E+00	1.3E+01	4.0E-01	3.6E+00	1.3E+01	3.9E-01	1.2E+00	4.3E+00	1.3E-01
Portsmouth	5.5E+00	1.9E+01	4.4E-01	3.7E+00	1.3E+01	3.0E-01	3.6E+00	1.2E+01	2.9E-01	8.1E+00	2.8E+01	6.6E-01	3.1E+00	1.1E+01	2.5E-01	3.0E+00	1.1E+01	2.4E-01	1.0E+00	3.6E+00	8.2E-02
Quad Cities	4.0E+00	1.3E+01	2.4E-01	2.7E+00	8.6E+00	1.7E-01	2.6E+00	8.4E+00	1.6E-01	6.0E+00	1.9E+01	3.6E-01	2.3E+00	7.4E+00	1.4E-01	2.2E+00	7.1E+00	1.4E-01	7.5E-01	2.4E+00	4.6E-02
Savannah River	6.0E+00	2.1E+01	6.0E-01	4.0E+00	1.4E+01	4.1E-01	3.9E+00	1.4E+01	4.0E-01	8.9E+00	3.2E+01	9.0E-01	3.4E+00	1.2E+01	3.5E-01	3.3E+00	1.2E+01	3.3E-01	1.1E+00	3.9E+00	1.1E-01
Surry	6.4E+00	2.1E+01	5.8E-01	4.3E+00	1.4E+01	3.9E-01	4.2E+00	1.4E+01	3.8E-01	9.5E+00	3.2E+01	8.7E-01	3.7E+00	1.2E+01	3.3E-01	3.5E+00	1.2E+01	3.2E-01	1.2E+00	4.0E+00	1.1E-01
Zion	4.4E+00	1.5E+01	3.1E-01	3.0E+00	1.0E+01	2.1E-01	2.9E+00	9.7E+00	2.0E-01	6.5E+00	2.2E+01	4.6E-01	2.5E+00	8.5E+00	1.8E-01	2.4E+00	8.2E+00	1.7E-01	8.2E-01	2.8E+00	5.8E-02
Braidwood	5.3E-01	1.8E+00	3.3E-02	3.6E-01	1.2E+00	2.2E-02	3.5E-01	1.2E+00	2.2E-02	7.9E-01	2.7E+00	4.9E-02	3.1E-01	1.1E+00	1.9E-02	2.9E-01	1.0E+00	1.8E-02	9.9E-02	3.4E-01	6.1E-03
Clinton	5.4E-01	1.8E+00	3.4E-02	3.7E-01	1.2E+00	2.3E-02	3.5E-01	1.2E+00	2.2E-02	8.0E-01	2.7E+00	5.1E-02	3.1E-01	1.1E+00	2.0E-02	3.0E-01	1.0E+00	1.9E-02	1.0E-01	3.4E-01	6.3E-03
Fitzpatrick	7.4E-01	2.6E+00	7.1E-02	5.0E-01	1.8E+00	4.8E-02	4.8E-01	1.7E+00	4.7E-02	1.1E+00	3.9E+00	1.1E-01	4.3E-01	1.5E+00	4.1E-02	4.1E-01	1.5E+00	4.0E-02	1.4E-01	4.9E-01	1.3E-02
Grand Gulf	6.5E-01	2.1E+00	5.2E-02	4.4E-01	1.4E+00	3.5E-02	4.3E-01	1.4E+00	3.4E-02	9.7E-01	3.2E+00	7.8E-02	3.8E-01	1.2E+00	3.0E-02	3.6E-01	1.2E+00	2.9E-02	1.2E-01	4.0E-01	9.8E-03
North Anna	7.7E-01	2.6E+00	6.9E-02	5.2E-01	1.8E+00	4.7E-02	5.1E-01	1.7E+00	4.5E-02	1.2E+00	3.9E+00	1.0E-01	4.5E-01	1.5E+00	4.0E-02	4.3E-01	1.5E+00	3.8E-02	1.4E-01	4.9E-01	1.3E-02
Pilgrim	8.2E-01	2.9E+00	8.8E-02	5.6E-01	2.0E+00	5.9E-02	5.4E-01	1.9E+00	5.8E-02	1.2E+00	4.3E+00	1.3E-01	4.7E-01	1.7E+00	5.1E-02	4.5E-01	1.6E+00	4.9E-02	1.5E-01	5.4E-01	1.6E-02
Portsmouth	6.8E-01	2.4E+00	5.5E-02	4.6E-01	1.6E+00	3.7E-02	4.5E-01	1.6E+00	3.6E-02	1.0E+00	3.5E+00	8.2E-02	3.9E-01	1.4E+00	3.2E-02	3.8E-01	1.3E+00	3.1E-02	1.3E-01	4.4E-01	1.0E-02
Quad Cities	5.0E-01	1.6E+00	3.1E-02	3.4E-01	1.1E+00	2.1E-02	3.3E-01	1.0E+00	2.0E-02	7.4E-01	2.4E+00	4.6E-02	2.9E-01	9.2E-01	1.8E-02	2.8E-01	8.8E-01	1.7E-02	9.3E-02	3.0E-01	5.7E-03
Savannah River	7.4E-01	2.6E+00	7.5E-02	5.1E-01	1.8E+00	5.1E-02	4.9E-01	1.7E+00	5.0E-02	1.1E+00	3.9E+00	1.1E-01	4.3E-01	1.5E+00	4.4E-02	4.1E-01	1.5E+00	4.2E-02	1.4E-01	4.9E-01	1.4E-02
Surry	8.0E-01	2.6E+00	7.2E-02	5.4E-01	1.8E+00	4.9E-02	5.2E-01	1.7E+00	4.8E-02	1.2E+00	4.0E+00	1.1E-01	4.6E-01	1.5E+00	4.2E-02	4.4E-01	1.5E+00	4.0E-02	1.5E-01	5.0E-01	1.4E-02
Zion	5.5E-01	1.8E+00	3.9E-02	3.7E-01	1.3E+00	2.6E-02	3.6E-01	1.2E+00	2.6E-02	8.2E-01	2.8E+00	5.8E-02	3.2E-01	1.1E+00	2.2E-02	3.0E-01	1.0E+00	2.2E-02	1.0E-01	3.5E-01	7.3E-03

Braidwood
Clinton
Fitzpatrick
Grand Gulf
North Anna
Pilgrim
Portsmouth
Quad Cities
Savannah River
Surry
Zion

YES

Comparison to NUREG-0170

Calculate person-rem/shipment

	1975 pop dose	No shipments	Person-rem/shipment	
Crew	31.3	254	0.123228346	
Off-link	3.8	254	0.01496063	
On-link	1.88	254	0.007401575	
Stops	4.82	254	0.018976378	
			0.164566929	41.8 person-rem per yr (254 shipments/yr)
	0170, Tbl 4-16	0170, Tbl 1-1		(Matches NUREG/CR-6672, Table E-1)

	1985 pop dose	No shipments	Person-rem/shipment	
Crew	188	1530	0.122875817	
Off-link	22.9	1530	0.01496732	
On-link	11.3	1530	0.007385621	
Stops	29	1530	0.018954248	
			0.164183007	251.2 person-rem per yr (1530 shipments/yr)
	0170, Tbl 4-18	0170, Tbl 1-1		

Parameters

Incident-Free Exposure Parameter	NUREG-0170	Quad Cities		
Shipping Distance, km	2,530	2,853		
Travel Fraction				
Urban	0.05	0.86		
Suburban	0.05	0.12		
Rural	0.9	0.02		
Population Density along Highway, per km2				
Urban	3,861	2391.3		
Suburban	719	310.2		
Rural	6	9.1	10	
Speed, km/hr			3.11E-04	km2 (1 to 10 m)
Urban	24	88	3.22E+04	
Suburban	40	88		
Rural	88	88		
Traffic Count, vehicles/hr				
Urban	2,800	2,400		

Suburban	780	760		
Rural	470	530		
Shipment Dose Rate, mrem/hr at 2m	10	10		
Crew Dose Rate, mrem/hr	2	Calculated (7.4 m from package)		
Stop time, hr per trip				
Urban	2	3 hrs per trip (30		
Suburban	5	minutes per 4 hrs		
Rural	1	driving time)		
Population Density at Stops (per km2)				
Urban	3,861	Distribution: 1 to 10 m		
Suburban	719	- 30,000; 10 to 800 m -		
Rural	6	340 (see Figure X.1)		
Person-rem/Shipment				
Crew	1.2E-01	4.8E-02		
Off-link	1.5E-02	3.1E-03		
On-link	7.4E-03	1.7E-02		
Stops	1.9E-02	1.7E-02	1.5E-01	Corrections
Total	1.6E-01	8.5E-02	1.9E+00	
Handlers + Storage	2.1E-01	Not Calculated		
Grand Total	3.7E-01	8.5E-02		

STOP Model Adjustments		
6.9	people at stops (DOE 2002)	
10		
0.69	Factor	
20	min/stop (DOE 2002)	
30		
0.666667	Factor	
0.5	Number of stops	
0.5	Fuel age	
0.115	TOTAL	
0.333333		

		Adjustment	Adjusted Dose
Crew	4.8E-02	1	0.0475
Off-link	3.1E-03	1	0.00313
On-link	1.7E-02	1	0.0172
Stop - People at Stops	0.145	0.114999999	0.016675
Stops - Residents Near Truck Stops	0.000626	1	0.000626
Total Stops	0.145626		0.017301

2391	2391	
3	850	
0.001254705	2.812941176	
	3	stops
	1.5	stop time, hr, at 30 min/stop