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LADTAP XL© VERSION 2017: A SPREADSHEET FOR ESTIMATING DOSE RESULTING FROM AQUEOUS RELEASES

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EXECUTIVE SUMMARY

LADTAP XL© is an EXCEL© spreadsheet used to estimate dose to offsite individuals and populations resulting from routine and accidental releases of radioactive materials to the Savannah River. LADTAP XL© contains two worksheets: LADTAP and IRRIDOSE. The LADTAP worksheet estimates dose for environmental pathways including external exposure resulting from recreational activities on the Savannah River and internal exposure resulting from ingestion of water, fish, and invertebrates originating from the Savannah River. IRRIDOSE estimates offsite dose to individuals and populations from irrigation of foodstuffs with contaminated water from the Savannah River. In 2004, a complete description of the LADTAP XL© code and an associated user's manual was documented in *LADTAP XL©: A Spreadsheet for Estimating Dose Resulting from Aqueous Release* (WSRC-TR-2004-00059) and revised input parameters, dose coefficients, and radionuclide decay constants were incorporated into LADTAP XL© Version 2013 (SRNL-STI-2011-00238). LADTAP XL© Version 2017 is a slight modification to Version 2013 with minor changes made for more user-friendly parameter inputs and organization, updates in the time conversion factors used within the dose calculations, and fixed an issue with the expected time build-up parameter referenced within the population shoreline dose calculations. This manual has been produced to update the code description, verification of the models, and provide an updated user's manual. LADTAP XL© Version 2017 has been verified by Minter (2017) and is ready for use at the Savannah River Site (SRS).

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LIST OF ABBREVIATIONS

BJC	Beaufort-Jasper Chelsea Water Treatment Plant
BJP	Beaufort-Jasper Purrysburg Water Treatment Plant
BJWSA	Beaufort-Jasper Water and Sewer Authority
MEI	Maximally Exposed Individual
PW	Port Wentworth
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
USNRC	U. S. Nuclear Regulatory Committee

1.0 Introduction

LADTAP XL© is an EXCEL© spreadsheet used at the Savannah River Site (SRS) to estimate dose to offsite individuals and populations resulting from routine and accidental releases of radioactive materials to the Savannah River. LADTAP XL© contains two worksheets: LADTAP and IRRIDOSE. The LADTAP worksheet estimates dose for environmental pathways including external exposure resulting from recreational activities on the Savannah River and internal exposure resulting from ingestion of water, fish, and invertebrates originating from the Savannah River. IRRIDOSE estimates offsite dose to individuals and populations from irrigation of foodstuffs with contaminated water from the Savannah River.

In compliance with U.S. Department of Energy (DOE) Order 458.1 (2011a), dose can be calculated to the maximally exposed individual (MEI) or to a representative person. Since 2012, SRS has used the representative person concept for DOE public dose limit compliance. SRS calculates the representative person dose using site-specific reference person parameters that fall in the 95th percentile of national and regional data.

The reference person is weighted based on gender and age and this weighting is based on the six age groups documented in International Commission on Radiation Protection Publication 89 (ICRP 2002): Infant (0 years), 1 year, 5 years, 10 years, 15 years, and Adult. The reference person accounts for the fact that younger people are, in general, more sensitive to radioactivity than older people. SRS also developed usage parameters at the 50th percentile to use in calculating dose to a "typical" person for determining population doses.

2.0 Version Updates

LADTAP XL© was previously verified prior to adding the IRRIDOSE methods (Hamby 1991). IRRIDOSE was developed as an independent worksheet in 1993 (Hamby 1993) with methods taken from LADTAP II (Strenge 1986). LADTAP XL© Version 4.0 (Simpkins 2004) included improvements to the LADTAP worksheet as well as the addition of the IRRIDOSE methods.

Since 2004, several minor changes have been incorporated into LADTAP XL© leading up to Version 2013 which included reference and typical site-specific human usage parameters (Stone and Jannik 2013), updated ingestion dose coefficients (DOE-STD-1196-2011) (DOE 2011b), updated external DC_PAK3 toolbox dose factors (Eckerman and Legget 2013), and updated radionuclide decay factors (ICRP 2008). Version 2017 is a minor update to Version 2013 initially established to amend the documented time build-up parameter issue (Appendix A) documented in Error Notification B-SEN-A-00001 (Appendix B) and has been further used as an opportunity to standardize the time conversion factors and increase usability.

For LADTAP XL© Version 2017, the following changes were made based on Computer Program Modification Tracker number Q-CMT-A-00022 (Appendix B):

- Labeling of the time build-up parameter used to represent the lifetime of SRS has been changed from 'Time Build-up' to 'Assessment Year'
- Dose calculations that reference the time build-up parameter were updated to internally calculate the lifetime of SRS (Assessment Year – 1954)
- Internal time conversions have been updated to approximate 365.25 days/year
- Additional '50-Mile Total Maximum Vegetable and Leafy Vegetable Production' input parameters were added to the IRRIDOSE spreadsheet
- Input cells reformatted to separate calculated inputs from user-defined inputs

Because of the changes made between Version 2013 and Version 2017, this document includes an updated model description, a verification of the methods and input changes made, and an updated user's manual. In accordance with the Software Quality Assurance Plan for Environmental Dosimetry (Q-SQP-A-0002, rev. 5) (Jannik 2017), LADTAP XL© Version 2017 (Software Identification #Q-SWCD-A-00012) is controlled as Software Classification "B" software and has also been updated in the Software Classification Document Database.

Since methods for irrigation and non-irrigation pathways are contained within two separate worksheets within the LADTAP XL© Version 2017 spreadsheet, they are discussed separately here. LADTAP XL© Version 2017 refers to the entire workbook containing both LADTAP and IRRIDOSE spreadsheets. LADTAP methods (section 3.0) refer to all methods except those involving the irrigation pathways (as discussed in IRRIDOSE methods, section 4.0).

3.0 LADTAP Methods

The LADTAP transport model estimates river concentrations assuming a continuous and constant release over a one year period. Radionuclide concentrations are determined by simple volumetric dilution without taking into account nuclide depletion except through radioactive decay. Additional dilution in the Savannah River estuary is further accounted for by use of a tidal-effect dilution factor.

3.1 Receptor Dose

For site analysis and reporting, dose is estimated to a representative and typical person replacing the MEI and average person concepts, respectively, for individual and population dose estimates. At SRS, the representative person uses reference person parameters based on the 95th percentile of national and regional usage data while the typical person uses reference person parameters based on the 50th percentile of national and regional usage data (Stone and Jannik 2013). The analytical methods used for estimating radiation exposure from the various liquid pathways are described in the following sections.

3.1.1 Individual Dose

For the individual dose assessments, the user has the option of defining the individual using 95th percentile reference data ('ref'), 50th percentile reference data ('typ'), or user-defined usage parameters. For Site assessments, the 95th percentile reference person usage parameters are default representing a hypothetical aggregation of human physical and physiological characteristics for representative person dose calculations. The doses from all liquid pathways within LADTAP for the individual are summed to determine the total effective dose (TED) in mrem from all radionuclide *i*:

$$ {}^{LT}\boldsymbol{TED} = \sum_i \boldsymbol{ID}_i^{W} + \sum_i \boldsymbol{ID}_i^{F} + \sum_i \boldsymbol{ID}_i^{Sw} + \sum_i \boldsymbol{ID}_i^{B} + \sum_i \boldsymbol{ID}_i^{Sh} \quad \textbf{(1)} $$

$\sum_i ID_i^W$ ingestion dose to the individual (representative person) from consumption of river water

$\sum_i ID_i^F$ ingestion dose to the individual (representative person) from consumption of fish from the river

$\sum_i ID_i^{Sw}$ exposure dose to the individual (representative person) from swimming in the river

$\sum_i ID_i^B$ exposure dose to the individual (representative person) from recreational boating in the river

$\sum_i ID_i^{Sh}$ exposure dose to the Individual (representative person) from shoreline activities by the river

3.1.2 Population Dose

The total population dose resulting from routine SRS releases is the sum of four contributing categories: 1) Beaufort-Jasper Water and Sewer Authority (BJWSA) water consumers, 2) Savannah I&D water consumers, 3) consumption of fish and invertebrates of Savannah River origin, and 4) recreational activities on the Savannah River. The collective effective dose (CED) calculation expands the fish dose and water dose from equation 1 to specify a greater range of fish ($PD_i^{SF} + PD_i^{CF} + PD_i^{Inv}$) and water ($PD_{i,BJC}^{W} + PD_{i,BJP}^{W} + PD_{i,PW}^{W}$) ingestion pathways. The CED for the population is calculated by summing average doses to the following receptors:

- Drinking water users from Beaufort-Jasper and Savannah I&D water treatment plants
- Recreational users of the Savannah River
- Consumers of fish from the Savannah River
- Consumers of saltwater invertebrates from the Savannah River Estuary

Water from the Savannah River is processed for consumption at three facilities approximately 100 river miles downstream of SRS. The BJWSA operates the Chelsea Water Treatment Plant (BJC) and the Purrysburg Water Treatment Plant (BJP). Several miles further downstream, the City of Savannah Industrial and Domestic Water Supply Plant (Savannah I&D), located near Port Wentworth (PW), GA, withdraws water from the river to supply a business-industrial complex near Savannah, Georgia and some domestic users.

For the population dose assessments, the user has the option of defining the population using 95th percentile reference data ('ref'), 50th percentile reference data ('typ'), or user-defined usage parameters. For Site assessments, the 50th percentile reference person usage parameters are default representing a hypothetical aggregation of human physical and physiological characteristics for typical person dose calculations. The doses from all liquid pathways within LADTAP for the population are summed to determine the CED (person-rem) from all radionuclide *i*:

$$
{}^{LT}\boldsymbol{CED} = \sum_i \boldsymbol{PD_{i,BJC}^{W}} + \sum_i \boldsymbol{PD_{i,BJP}^{W}} + \sum_i \boldsymbol{PD_{i,PW}^{W}} + \sum_i \boldsymbol{PD_i^{SF}} + \sum_i \boldsymbol{PD_i^{CF}} + \sum_i \boldsymbol{PD_i^{Inv}} + \sum_i \boldsymbol{PD_i^{Sw}} + \sum_i \boldsymbol{PD_i^{B}} + \sum_i \boldsymbol{PD_i^{Sh}}) \quad \textbf{(2)}
$$

$\sum_i PD_{i,BJC}^{W}$ ingestion dose to the population in Beaufort-Jasper-Chelsea (BJC) from consumption of the river water filtered through the Beaufort-Jasper water treatment plant

$\sum_i PD_{i,BJP}^{W}$ ingestion dose to the population in Beaufort-Jasper-Purrysburg (BJP) from consumption of the river water filtered through the Beaufort-Jasper water treatment plant

$\sum_i PD_{i,PW}^{W}$ ingestion dose to the population in Port Wentworth (PW) from consumption of the river water filtered through the Savannah I&D water treatment plant

$\sum_i PD_i^{SF}$ ingestion dose to the population from consumption of sport fish from the river

$\sum_i PD_i^{CF}$ ingestion dose to the population from consumption of commercial fish from the river

$\sum_i PD_i^{Inv}$ ingestion dose to the population from consumption of invertebrates from the river estuary

$\sum_i PD_i^{Sw}$ exposure dose to the population from swimming in the river

$\sum_i PD_i^{B}$ exposure dose to the population from recreational boating in the river

$\sum_i PD_i^{Sh}$ exposure dose to the population from shoreline activities by the river

3.2 Determination of Nuclide Concentrations

The LADTAP worksheet implements the liquid-release dose models of USNRC (1977). These dose models involve a complex series of physical, chemical, and biological processes. Some of these processes involve dilution, while others involve physical or biological re-concentration followed by transfer through various pathways to man.

The environmental effects of radioactive releases to surface waters are evaluated through a variety of pathways: 1) water ingestion, 2) aquatic food consumption, and 3) recreational use of relevant water bodies and shorelines. The relative importance of the three main liquid pathways generally depends on the radionuclides of concern and their release amounts. However, for routine SRS liquid releases to the Savannah River, the ingestion pathways involving the consumption of river water and aquatic foods have been demonstrated to be the most significant (Jannik and Hartman 2016).

All individual and population doses are based on the assumption that liquids discharged from an SRS facility are completely mixed in the river before reaching the potentially exposed individuals. This assumption is supported by annual tritium mass-balance measurements indicating that complete mixing occurs in the river prior to reaching River Mile 118.8 (U.S. Highway 301 bridge), which is the assumed location of the representative person (Jannik and Hartman 2016). The dose calculations also are based on the conservative assumption that sediment adsorption does not occur and radionuclides are not depleted during transport (with the exception of radiological decay), even though limited data on cesium-137 indicates that there is a significant reduction in cesium concentration via deposition (Hayes 1983a; 1983b) (ranging from 48% in river water to 98% in finished drinking water).

For annual routine releases, offsite dose varies each year with the amount of radioactivity released and the amount of dilution (flow rate) in the Savannah River. Although daily flow rates are measured at gauging stations at River Mile 118.8, these data are typically not used directly in the dose calculations. This is because daily river flow rates fluctuate widely (i.e., short-term dilution varies from day to day). Instead, "effective" flow rates, which are based on annual-average measured concentrations of tritium and the total quantity of aqueous tritium released from the site and neighboring Plant Vogtle during the year, are used and calculated by:

$$\boldsymbol{F_{eff,j} = \frac{Q_{H3}}{C_{H3,j}}} \qquad \textbf{(3)}$$

$F_{eff,j}$ "effective" flow rate at river water j (cfs)

Q_{H3} annual amount of aqueous tritium released from SRS and Plant Vogtle (Ci/yr)

$C_{H3,j}$ the annual average tritium concentration measured in river water (River Mile 118.8 concentration for individual dose or the raw water concentration from the down river water treatment plants for population dose) (pCi/mL)

For prospective dose assessments, historical flow rates (1954 to current year) are utilized to determine daily and annual average flows (Jannik, Minter, and Dixon 2017). During the past 10 years there has been a downward trend in the average measured flow rate data. Based on these data, the recommended flow rates for prospective studies are shown in Table 2-1.

Table 3-1. Savannah River Flow Rates for Prospective Dose Assessments

Assessment (Flow Average)	Flow Rate (cfs) at Specified Location	
	River Mile 118.8	Water Treatment Plants
Routine (10 yr approximate mean)	7,500	10,000
Minimum Annual Flow of Annual Averages since 1954	4,500	5,000
Accident (daily average)	3,500	3,500

The "effective" flow rate is used to calculate the annual average undecayed concentrations for annual SRS liquid effluents in the Savannah River RM 118.8, Savannah River Estuary, and the water treatment plants that supply water to the surrounding population. The annual average concentration of radionuclide *i* in downriver location *j* is estimated by volumetric dilution. The river concentration at the receptor location is given by:

$$\boldsymbol{\overline{C}_{i,j} = \frac{Q_i}{F_{eff,j}}} \quad \textbf{(4)}$$

$\bar{C}_{i,j}$ annual average undecayed concentration of radionuclide *i* in river water *j* (µCi/mL)

Q_i annual amount of radionuclide *i* released as liquid effluent from SRS (Ci/yr)

$F_{eff,j}$ "effective" flow rate at downriver location *j* (equation 3) (cfs)

3.3 Water Ingestion

3.3.1 Individual Dose

The dose to the individual from drinking river water (ID_i^W) for radionuclide *i* is estimated assuming the river water has not been treated. The representative person reported dose for water consumption is approximated at River Mile 118.8 (near the U.S. Hwy 301 Bridge). The exponential expression yields the concentration of radionuclide *i* at the time the water is consumed.

$$\boldsymbol{ID_i^W = U_W \times DC_i^{Ing} \times \overline{C}_{i,301} \times e^{-(\lambda_i \times t_w)}} \quad \textbf{(5)}$$

ID_i^W ingestion dose to the individual (representative person) from consumption of river water at River Mile 118.8 (Hwy 301) for radionuclide *i* (mrem)

U_W annual individual water consumption rate ('typ', 'ref', or value input) (L/yr)
(Default: 'ref' or 800 L/yr) (Jannik et al. 2017)

DC_i^{Ing} ingestion dose coefficient for radionuclide *i* (rem/µCi)

$\bar{C}_{i,301}$ annual average undecayed concentration of radionuclide *i* at River Mile 118.8 (Hwy 301) (equation 4) (µCi/mL)

λ_i radioactive decay constant of radionuclide *i* (1/d)

t_w elapsed time between release of the radionuclide and ingestion of water (d) (Default: 1.5 d) (Jannik et al. 2017)

For individuals residing in BJC, BJP, and PW, additional and separate individual maximum water ingestion dose calculations are made with the assumption that the water has been processed through one of the downriver water treatment facilities for Beaufort-Jasper and Port Wentworth. The calculations do not consider the possible removal of radionuclides during the treatment process. The individual ingestion dose from consumption of river water is then calculated by:

$$\sum_i \boldsymbol{ID_{i,j}^{W} = U_W \times DC_i^{Ing} \times \bar{C}_{i,j} \times e^{-(\lambda_i \times t_{WTP})}} \quad \textbf{(6)}$$

$ID_{i,j}^{W}$ ingestion dose to the individual within BJC, BJP, and PW from consumption of treated river *j* for radionuclide *i* (mrem)

$\bar{C}_{i,j}$ annual average undecayed concentration of radionuclide *i* at downriver location *j* (equation 4) (µCi/mL)

t_{WTP} elapsed time between release of the radionuclide and ingestion of water for the water treatment plant (d) (Default: 4 d) (Jannik et al. 2017)

All other parameters defined in equation 5.

The transit time from the Savannah River at Steel Creek to the water treatment river intakes is approximately 72 hours. The raw river water is assumed to have an average system retention time of 24 hours before distribution to water consumers. Therefore, a total hold-up time of 96 hours (4 d) is used in the calculation of drinking water dose to the downstream individuals and population. This hold-up time is only significant for nuclides with very short half-lives.

3.3.2 Population Dose

Predictions of population dose are also made with this assumption that the water has been processed through one of the down river water treatment facilities for Beaufort-Jasper-Chelsea and -Purrysburg ($PD_{i,BJC}^{W}$ and $PD_{i,BJP}^{W}$) or Port Wentworth ($PD_{i,PW}^{W}$). The population water ingestion doses are estimated for Beaufort-Jasper and Port Wentworth treatment plant consumers similarly to the BJC, BJP, and PW individual maximum water ingestion dose:

$$\boldsymbol{PD_{i,j}^{W} = \bar{U}_W \times N_j \times DC_i^{Ing} \times \bar{C}_{i,j} \times e^{-(\lambda_i \times t_{WTP})}} \quad \textbf{(7)}$$

$PD_{i,j}^{W}$ ingestion dose to the population within BJC, BJP, and PW from consumption of "treated" river water through downriver location *j* for radionuclide *i* (person-rem)

$\overline{U}_W$ annual population water consumption rate ('typ', 'ref', or value input) (L/yr) (Default: 'typ' or 300 L/yr) (Jannik et al. 2017)

N_j applicable consumer population for downriver location j (persons) (Default: 83,700 persons at BJC, 64,800 persons at BJP, 35,000 persons at Savannah I&D) (Jannik et al. 2017)

All other parameters defined in equation 5 or 6.

In 2017, the operators of the three public drinking water plants estimated the BJWSA consumer population was approximately 83,700 people for the Chelsea Plant and 64,800 people for the Purrysburg Plant. The estimated population served by Savannah I&D was 35,000 people. These estimates are subject to change and should be verified annually.

3.4 Aquatic Food Consumption

Dose from the consumption of aquatic foods is calculated assuming the concentrations of radionuclides in edible tissues are at equilibrium with that in the surrounding water. The concentrations of radionuclides in aquatic foods are assumed to be directly related to the concentrations of the radionuclides in the river water. With the exception of a site-specific factors of 3,000 L/kg for cesium (Jannik 2003) and 3 L/kg for carbon (Hinton et al. 2009), the aquatic animal bioaccumulation factors, which are element-specific equilibrium ratios between concentration in aquatic foods and concentration in water, are based on national or international references and are documented in Jannik et al. (2017).

3.4.1 Individual Dose

The dose to the individual from aquatic food consumption is estimated assuming the consumption of 24 kg/yr of fish harvested from the River Mile 118.8 location. Because the Savannah River is still closed indefinitely to shellfish harvesting, the consumption of fresh water invertebrates is not considered for the individual or the population dose estimates (Hamby 1994). The annual individual internal dose from consumption of aquatic foods is determined by:

$$\boldsymbol{ID_i^F = U_F \times DC_i^{Ing} \times \overline{C}_{i,301} \times BF_i^{Fresh} \times e^{-(\lambda_i \times t_F)}} \qquad \textbf{(8)}$$

ID_i^F ingestion dose to the individual (representative person) from consumption of fish from the Savannah River at River Mile 118.8 (Hwy 301) for radionuclide i (mrem)

U_F annual individual aquatic food consumption rate (kg/yr) (Default: 'ref' or 24 kg/yr) (Jannik et al. 2017)

DC_i^{Ing} ingestion dose coefficient for radionuclide i (rem/µCi)

$\bar{C}_{i,301}$ annual average concentration of radionuclide i in river water at River Mile 118.8 (Hwy 301) (equation 4) (µCi/mL)

BF_i^{Fresh} bioaccumulation factor for radionuclide i in freshwater aquatic animals (L/kg)

λ_i radioactive decay constant of radionuclide i (1/d)

t_F elapsed time between harvest and consumption of fish (d) (Default: 2 d) (Jannik et al. 2017)

3.4.2 Population Dose

The population dose is determined assuming that the total harvest is consumed by the 50-mile population. Most of the 50-mile population receives no river water downstream of SRS for domestic purposes. However, this population is assumed to use the river for the harvesting of fish and invertebrates and for recreational purposes. In the case of a small population or large annual harvest, some of the harvested seafood is assumed to be exported from the 50-mile region. Only the aquatic foods needed to support the 50-mile population are assumed to be consumed. The annual average consumption rate of aquatic foods (3.7 kg/yr of fish and 1.5 kg/yr of saltwater invertebrates) is a prorated amount of aquatic foods harvested (Stone and Jannik 2013). Population dose from the consumption of aquatic foods is estimated by adding the dose from the sport fish harvest (PD_i^{SF}), the commercial fish harvest (PD_i^{CF}), and the saltwater invertebrate harvest (PD_i^{Inv}):

$$\boldsymbol{PD_i^{Aquatic} = PD_i^{SF} + PD_i^{CF} + PD_i^{Inv}} \quad \textbf{(9)}$$

The population dose is determined by adding the dose from equations 10 through 12. In LADTAP, it is conservatively assumed that all fish and invertebrates harvested commercially from the Savannah River are consumed by the population within 50-miles of SRS.

Sport Fish

The population dose from ingestion of sport fish is estimated by the following equation:

$$\boldsymbol{PD_i^{SF} = \overline{U}_{SF} \times DF_i^{Ing} \times \overline{C}_{i,301} \times BF_i^{fresh} \times e^{-(\lambda_i \times t_{SF})}} \quad \textbf{(10)}$$

PD_i^{SF} ingestion dose to the population from consumption of sport fish from the Savannah River at River Mile 118.8 (Hwy 301) for radionuclide *i* (person-rem)

$\overline{U}_{SF}$ the lesser amount of the actual sport fish typically harvested in the Savannah River during the year (8,220 person-kg/yr from Jannik et al. 2017) and the total 50-mile population fish consumption for the year (assumed to be 3.7 kg/yr x 781,060 persons or 2,890,000 kg-person/yr) (kg-person/yr)

t_{SF} elapsed time between harvest and consumption of sport fish (d)
(Default: 10 d) (Jannik et al. 2017)

All other parameters defined in equation 8.

Commercial Fish

The population dose for ingestion of commercial fish is estimated by the following equation:

$$\boldsymbol{PD_i^{CF} = \overline{U}_{CF} \times DC_i^{Ing} \times \overline{C}_{i,301} \times BF_i^{fresh} \times e^{-(\lambda_i \times t_{C/I})}} \quad \textbf{(11)}$$

PD_i^{CF} ingestion dose to the population from consumption of commercial fish from the Savannah River at River Mile 118.8 (Hwy 301) for radionuclide *i* (person-rem)

$\overline{U}_{CF}$ the lesser amount of the actual commercial fish harvested in the Savannah River during the year

(57,000 person-kg/yr from Jannik et al. 2017) and the difference between the total 50-mile population fish consumption for the year (assumed to be 3.7 kg/yr x 781,060 persons or 2,890,000 kg-person) (kg-person/yr)

$t_{C/I}$ elapsed time between harvest and consumption of commercial fish (d)
(Default: 13 d) (Jannik et al. 2017)

All other parameters defined in equation 8.

Saltwater Invertebrates

The population dose from the ingestion of saltwater invertebrates is estimated by the following equation:

$$\boldsymbol{PD_i^{Inv} = \overline{U}_{Inv} \times DC_i^{Ing} \times \overline{C}_{i,301} \times BF_i^{Salt} \times e^{-(\lambda_i \times t_{C/I})}} \qquad \textbf{(12)}$$

PD_i^{Inv} ingestion dose to the population from consumption of invertebrates from the Savannah River Estuary (person-rem)

$\overline{U}_{Inv}$ the lesser amount of the actual saltwater invertebrates harvested near the Savannah River Estuary during the year (380,000 person-kg/yr from Jannik et al. 2017) and the total 50-mile population invertebrate consumption for the year (assumed to be 1.5 kg/yr x 781,060 persons or 1,170,000 kg-person) (kg-person/yr)

BF_i^{Salt} bioaccumulation factor for radionuclide *i* in saltwater invertebrates (L/kg)

All other parameters defined in equation 8 or 11.

3.5 Recreational Use of the Savannah River

LADTAP considers four exposure modes when estimating individual and population external dose during recreational use of the Savannah River; (1) exposure to radionuclide deposits on the shoreline, (2) exposure to suspended nuclides while swimming, (3) exposure to suspended nuclides while boating, and (4) absorption of tritium through the skin while swimming.

3.5.1 Shoreline

3.5.1.1 Individual Dose

The calculation of dose from shoreline deposits is complex because it involves estimations of sediment load, transport, and concentrations of radionuclides associated with suspended and deposited materials (Soldat 1974). However, the following equation simplifies the estimation of radiation dose to an individual from exposure to shoreline sediments:

$$\boldsymbol{ID_i^{Sh} = T_{w-s} \times U_{Sh} \times W_{Sh} \times DC_i^{GrdSh} \times \overline{C}_{i,301} \times \tau_i \times [e^{-(\lambda_i \times t_{rec})}] \times [1 - e^{-(\lambda_i \times t_{bldup})}]} \qquad \textbf{(13)}$$

ID_i^{Sh} exposure dose to the individual (representative person) from shoreline activities by the Savannah River at River Mile 118.8 (Hwy 301) for radionuclide *i* (mrem)

T_{w-s} water-to-sediment transfer coefficient (100 L/m^2-d) (Simpson 1980)

U_{Sh} annual shoreline usage factor specifying the time of exposure to shoreline sediments (hr/yr) (Default: 20 hr/yr) (Jannik et al. 2017)

W_{Sh} shoreline width factor, dimensionless (Default: 0.2) (Simpson 1980)

DC_i^{GrdSh} ground shine dose coefficient for radionuclide *i* (mrem-m^2/µCi-yr)

$\bar{C}_{i,301}$ annual average concentration of radionuclide *i* in river water at River Mile 118.8 (Hwy 301) (equation 4) (µCi/mL)

τ_i half-life of radionuclide *i* (d)

λ_i radioactive decay constant of radionuclide *i* (1/d)

t_{rec} elapsed time between release of the radionuclide and the point of exposure (d) (Default: 1 d) (Jannik et al. 2017)

t_{bldup} build-up time for which sediment or soil is exposed to the contaminated water (d) ((current year - 1954) x 365.25 d/y)

It is assumed that the buildup and decay of radionuclides in the Savannah River shoreline sediments has occurred over the entire operating period of SRS facilities (current year – 1954). To avoid any issues, the user is expected to input the year of assessment and the operational period of SRS is calculated internally.

3.5.1.2 Population Dose

The population dose estimate from shoreline (PD_i^{Sh}) (person-rem) exposure is determined by substituting into equation 13 the average population exposure time of 822,000 person-hr/yr (Jannik et al. 2017) for the individual shoreline usage (U_{Sh}).

3.5.2 Swimming and Boating

3.5.2.1 Individual Dose

Predictions of external dose while swimming in the Savannah River are determined assuming uniform nuclide concentrations and complete submersion (4π geometry). Boating doses are estimated assuming a 2π geometry with no shielding considerations. The same water submersion dose factors (EPA 1993) are used for both swimming and boating estimates. The external dose received by the individual from swimming or boating is estimated by:

$$\boldsymbol{ID_i^{Sw/B} = U_{Sw/B} \times G_{Sw/B} \times DC_i^{Sub} \times \bar{C}_{i,301} \times e^{-(\lambda_i \times t_{rec})}} \quad \textbf{(14)}$$

$ID_i^{Sw/B}$ exposure dose to the individual (representative person) from recreational swimming or boating in the Savannah River at River Mile 118.8 (Hwy 301) for radionuclide *i* (mrem)

$U_{Sw/B}$ annual swimming/boating usage factor (Swimming Default: 14 hr/yr) (Boating Default: 44 person-hr/yr) (Jannik et al. 2017)

$G_{Sw/B}$ geometry factor, dimensionless (Swimming Default: 1) (Boating Default: 0.5)

DC_i^{Sub} water submersion dose coefficient for radionuclide i (mrem-m^3/µCi-yr)

$\bar{C}_{i,301}$ annual average concentration of radionuclide i in river water at River Mile 118.8 (Hwy 301) (equation 4) (µCi/mL)

λ_i radioactive decay constant of radionuclide i (1/d)

t_{rec} elapsed time between release of the radionuclide and the point of exposure (d) (Default: 1 d) (Jannik et al. 2017)

3.5.2.2 Population Dose

The population dose estimates from swimming and boating ($PD_i^{Sw/B}$) (person-rem) exposure are performed by substituting into equation 14 the average population usage times of 295,000 person-hr/yr for swimming and 3,110,000 person-hr/yr for boating (Jannik et al. 2017) for the individual swimming and boating usage ($U_{Sw/B}$).

3.5.2.3 Tritium Skin Absorption from Swimming

Because tritium may cause a significant dose from skin absorption relative to the external dose from swimming for all other radionuclides, LADTAP was written to consider a more conservative tritium dose estimate via skin absorption while swimming (Hamby 1991). The absorption dose factor for tritium is approximated using tritium's ingestion dose factor. The individual dose from absorbing tritium through the skin while swimming is estimated by:

$$\boldsymbol{ID_{H3}^{Sw} = U_{Sw} \times A_{skin} \times DC_{H3}^{Ing} \times \bar{C}_{H3,301}} \quad \textbf{(15)}$$

ID_{H3}^{Sw} skin absorption dose due to tritium to the individual (representative person) from recreational swimming in the Savannah River at River Mile 118.8 (Hwy 301) (mrem)

U_{Sw} annual usage factor for swimming (Default: 14 hr/yr)

A_{skin} water absorption rate for total body submersion (35 mL/hr) (Hamby 1991)

DC_{H3}^{Ing} ingestion dose coefficient for tritium to approximate tritium skin absorption dose factor (rem/µCi) (Stone and Jannik 2013)

$\bar{C}_{H3,301}$ annual average concentration of tritium in river water at River Mile 118.8 (Hwy 301) (equation 4) (µCi/mL)

Because of its relatively long half-life, radioactive decay of tritium is not considered. The population dose from the absorption of tritium while swimming is determined by substituting into equation 15 the average population swimming usage time of 295,000 person-hrs for the individual swimming usage time (U_{Sw})

4.0 IRRIDOSE Methods

IRRIDOSE is the second worksheet within the LADTAP XL© Version 2017 spreadsheet and considers the irrigation of water originating from the Savannah River. Dose is estimated using a three-stage process: 1) radionuclide concentrations in the irrigation water are calculated then, 2) radionuclide concentrations in foodstuffs are determined, and lastly 3) potential doses to an individual and the affected population are estimated.

4.1 Receptor Dose

The analytical methods used for estimating radiation exposure to an individual or population from the various irrigation pathways are described in the following sections and based on the ingestion of exposed vegetation, milk, and meat through irrigation of the Savannah River. Each dose pathway equations used are provided in detail in the following sections.

4.1.1 Individual Ingestion Dose

For site assessments, the 95th percentile reference person usage parameters should be used for the individual assessment for representative person dose estimates. The doses from all irrigation pathways within IRRIDOSE for the individual are summed to determine the total effective dose (${}^{IR}TED$) in mrem:

$$\boldsymbol{{}^{IR}TED = \sum_i ID_i^{Veg} + \sum_i ID_i^{Milk} + \sum_i ID_i^{Meat}} \qquad \textbf{(16)}$$

$\sum_i ID_i^{Veg}$ ingestion dose to the individual (representative person) from consumption of exposed vegetation through irrigation of the Savannah River

$\sum_i ID_i^{Milk}$ ingestion dose to the individual (representative person) from consumption of milk from cows exposed to radiation through consumption of irrigated fodder and water from the Savannah River

$\sum_i ID_i^{Meat}$ ingestion dose to the individual (representative person) from consumption of meat (pigs, chickens, and cows) conservatively focused on the beef pathway from cows exposed to radiation through consumption of exposed fodder and water from the Savannah River

4.1.2 Population Ingestion Dose

Dose to a population consuming irrigated foodstuffs can be calculated by one of two methods: the population count method or the irrigated land area method. The two methods are provided so that population dose can be calculated if the analysis calls for the irrigation of a given area of land or the irrigation of crops necessary to support a family farm. For site assessments, the irrigated land area method should be used along with 50th percentile reference person usage parameter. In both methods, the doses from all irrigation pathways are summed to determine the collective effective dose (${}^{IR}CED$) in person-rem:

$$\boldsymbol{{}^{IR}CED = \sum_i PD_i^{Veg} + \sum_i PD_i^{Milk} + \sum_i PD_i^{Meat}} \qquad \textbf{(17)}$$

PD_i^{Veg} ingestion dose to the population from consumption of exposed vegetation through irrigation of the Savannah River

PD_i^{Milk} ingestion dose to the population from consumption of milk from cows exposed to radiation through consumption of irrigated fodder and water from the Savannah River

PD_i^{Meat} ingestion dose to the population from consumption of meat (pigs, chickens, and cows) conservatively focused on the beef pathway from cows exposed to radiation through consumption of exposed fodder and water from the Savannah River

4.1.2.1 Population Count Method

Population dose can be estimated by assuming that the consumption of vegetables, meat, and milk by a given number of people is supported by a family farm irrigated with water from the Savannah River. The 'given number of people' is approximated to be 10% of the total 50-mile population. In other words, the population count method assumes each person within the given population to consume a pre-evaluated amount of vegetables, meat, and milk per year (Jannik et al. 2017) to calculate the population dose. The specific equations used within IRRIDOSE are detailed in sections 4.5.2, 4.6.2, and 4.7.2. The generic equation for this method is as follows where *X* represents the irrigation pathway for radionuclide *i*:

$$\boldsymbol{PD_i^X = DC_i^{Ing} \times [X]_i \times Pop_E \times \bar{U}_X} \quad \textbf{(18)}$$

4.1.2.2 Irrigated Land Area Method

Population dose can also be estimated by assuming that the consumption of vegetable, milk, and meat is equal to the total farm or garden production based on the land area and pre-evaluated vegetable, meat, and milk annual productivity. The land area is assumed to produce, simultaneously, the foodstuffs of each ingestion pathway discussed above. The 50-mile total vegetable production will now be more conservatively estimated based on the land area and production yields (Moore, K. R. 2017) versus referencing the total 50-mile production documented in Jannik et al. (2017). Beef and milk cattle are assumed to graze on the irrigated land with production yields equal to the average productions yields within 50-mile radius of the SRS. The specific equations used within IRRIDOSE are detailed in sections 4.5.3, 4.6.3, and 4.7.3. The generic equation for this method is as follows where *X* represents the irrigation pathway for radionuclide *i*:

$$\boldsymbol{PD_i^X = DC_i^{Ing} \times [X]_i \times P_X} \quad \textbf{(19)}$$

4.2 Nuclide Concentrations in the Irrigation Water

Concentrations of radionuclides in the Savannah River released from SRS facilities are determined using the same dilution model as LADTAP including radioactive decay from elapsed time between release and exposure. Releases are assumed to occur at a constant rate throughout the release period (one year) and are diluted instantaneously by the Savannah River. Complete mixing and dilution is assumed to have occurred by the time the contaminated water is used for irrigation. Rainfall dilution is not considered. Estimates of nuclide concentrations in the Savannah River are given by:

$$\boldsymbol{\bar{C}_i^{IW} = \frac{Q_i \times e^{-(\lambda_i \times t_d)}}{F_{eff,301}}} \quad \textbf{(20)}$$

$\bar{C}_i^{IW}$ concentration of radionuclide *i* in irrigated water from river water at River Mile 118.8 (Hwy 301) (pCi/L)

Q_i annual amount of radionuclide *i* released to the Savannah River (Ci/yr)

$F_{eff,301}$ "effective" flow rate at River Mile 118.8 (Hwy 301) (equation 3) (cfs)

λ_i radioactive decay constant of radionuclide *i* (1/d)

t_d elapsed time between release of the radionuclide and the point of exposure (d) (Default: 2 d) (Jannik et al. 2017)

4.3 <u>Nuclide Concentration in Vegetation</u>

Within the IRRIDOSE spreadsheet, vegetation refers to the exposed grass consumed by cows (fodder) and exposed edible plants consumed by a person (vegetable crops). Nuclide concentration in vegetation are calculated assuming that two uptake paths exist; 1) via direct deposition on vegetation surfaces, and 2) via uptake through the vegetation root system. The following sections detail the nuclide concentrations in vegetation via direct deposition and root uptake.

4.3.1 Fodder Concentration

$$[\boldsymbol{Fodder}]_i = \overline{\boldsymbol{C}}_i^{IW} \times \boldsymbol{I} \times (\boldsymbol{leaf_F} + \boldsymbol{root}) \times \boldsymbol{e}^{-(\lambda_i \times t_F)} \quad \textbf{(21)}$$

where:

$$\boldsymbol{leaf_i^F} = \frac{\boldsymbol{r} \times (\boldsymbol{1} - \boldsymbol{e}^{-(\lambda_{wi} \times t_{FE})})}{\boldsymbol{P_F \lambda_{wi}}} \quad \textbf{(22)}$$

$$\boldsymbol{root_i} = \frac{\boldsymbol{T_i^{s-v}} \times (\boldsymbol{1} - \boldsymbol{e}^{-(\lambda_i \times t_{soil})})}{\boldsymbol{\rho \lambda_i}} \quad \textbf{(23)}$$

$[Fodder]_i$ concentration of radionuclide *i* in fodder from irrigation of the Savannah River at River Mile 118.8 (Hwy 301) (pCi/kg)

C_i^{IW} concentration of radionuclide *i* in irrigated water from river water at River Mile 118.8 (Hwy 301) (pCi/L) (equation 20)

I irrigation rate (L/m^2-d) (Default: 3.6 L/ m^2-d) (Jannik et al. 2017)

λ_i radioactive decay constant for radionuclide *i* (1/d)

t_F hold-up time for pasture grass used as fodder (d) (Default: 0 d) (Jannik et al. 2017)

r retention of radionuclide on plant surface (unitless) (Default: 0.25) (Jannik et al. 2017)

λ_{wi} weathering and radiological decay constant (0.0495 + λ_i) (1/d) (Jannik et al. 2017)

t_{FE} duration of exposure to irrigated water for pasture grass used as fodder (d) (Default : 30 d) (Jannik et al. 2017)

P_F production yield of pasture grass used as fodder (kg/m^2) (Default : 0.7 kg/m^2) (Jannik et al. 2017)

T_i^{s-V} soil-to-vegetable transfer factor (unitless)

t_{soil} build-up time of radionuclides in soil (d) (based on LADTAP's 'Assessment Year' parameter)

ρ surface soil density (kg/m^2) (Default: 240 kg/m^2) (Jannik et al. 2017)

4.3.2 Vegetable Crop Concentrations

Changes made to the fodder concentration equation to calculate the concentration in vegetables grown for human consumption include vegetation hold-up time (t_F)(equation 21), vegetation exposure duration (t_{FE})(equation 22), and vegetation production yield (P_F)(equation 22).

The vegetation hold-up time for estimated fodder concentration is normally zero indicating that cattle consume grass directly from grazing while the vegetation hold-up time for vegetable crop concentration estimates varies indicating the time between harvest and consumption for the individual and the population. For individual dose calculations, hold-up times are assumed to be relatively short since the representative person is someone with a backyard garden. The following equation is used to estimate concentrations of radionuclides in vegetable crops for the individual:

$$[\boldsymbol{Veg}]_i^{Ind} = \boldsymbol{C}_i^{IW} \times \boldsymbol{I} \times (\boldsymbol{leaf}_V + \boldsymbol{root}) \times \boldsymbol{e}^{-(\lambda_i \times t_V)} \quad \textbf{(24)}$$

For population calculations ($[Veg]_i^{Pop}$), equation 24 is applied with a longer, average transport time ($\bar{t}_V$).

$$[\boldsymbol{Veg}]_i^{Pop} = \boldsymbol{C}_i^{IW} \times \boldsymbol{I} \times (\boldsymbol{leaf}_V + \boldsymbol{root}) \times \boldsymbol{e}^{-(\lambda_i \times \bar{t}_V)} \quad \textbf{(25)}$$

where:

$$\boldsymbol{leaf}_i^V = \frac{\boldsymbol{r} \times (\boldsymbol{1} - \boldsymbol{e}^{-(\lambda_{wi} \times t_{VE})})}{\boldsymbol{P_V \lambda_{wi}}} \quad \textbf{(26)}$$

$[Veg]_i$ concentration of radionuclide *i* in vegetable crops estimated for an individual and the population (pCi/kg)

t_V transport time for vegetable crops to be consumed by an individual (representative person) (d) (Default: 1 d) (Jannik et al. 2017)

$\bar{t}_V$ transport time for vegetable crops to be consumed by the population (d) (Default: 6 d) (Jannik et al. 2017)

t_{VE} duration of exposure to irrigated water for consumable vegetable crops (d) (Default: 70 d) (Jannik et al. 2017)

P_V production yield of consumable vegetable crops (kg/m^2) (Default: 2.2 kg/m^2) (Jannik et al. 2017)

All other parameters defined in equation 21-23.

4.3.3 Tritium Concentration in Vegetation

All concentrations of nuclides in vegetation are determined using the method described above with the exception of tritium. The model for estimating tritium concentration in vegetation following irrigation is based on this conservative concept; the concentration of tritium in vegetation is assumed to be equal to the concentration of tritium in the water used for irrigation, C_{H3}^{IW} (from equation 20).

$$[\boldsymbol{Veg}]_{\boldsymbol{H3}}^{\boldsymbol{Ind}} = [\boldsymbol{Veg}]_{\boldsymbol{H3}}^{\boldsymbol{Pop}} = [\boldsymbol{Fodder}]_{\boldsymbol{H3}} = \boldsymbol{C}_{\boldsymbol{H3}}^{\boldsymbol{IW}} = \frac{\boldsymbol{Q}_{\boldsymbol{H3}} \times \boldsymbol{e}^{-(\boldsymbol{\lambda}_{\boldsymbol{H3}} \times \boldsymbol{t}_{\boldsymbol{d}})}}{\boldsymbol{F}_{\boldsymbol{eff},\boldsymbol{301}}} \quad \textbf{(27)}$$

All vegetation pathways are assumed to have the same tritium concentrations dependent on the tritium concentrations in the irrigated water. Radiological decay relative to the vegetation transport is not considered since the half-life of tritium is very long. This assumption is very conservative in that dilution by rainfall also is not considered.

4.4 Nuclide Concentration in Meat and Milk

The model allows the user to consider ingestion of both water and fodder consumed by cattle contaminated from the release of radioactivity to the Savannah River. This is conservative because pasture grass is generally not irrigated and water for cattle is usually supplied by surface ponds or groundwater surfaces. Concentrations of radionuclides in the beef and milk from cattle grazing on contaminated pasture grass and consuming contaminated river water are determined as follows:

$$[\boldsymbol{Beef}]_{\boldsymbol{i}}/[\boldsymbol{Milk}]_{\boldsymbol{i}} = \boldsymbol{T}_{\boldsymbol{i}}^{\boldsymbol{F-B/M}}[\left(\boldsymbol{F}_{\boldsymbol{F}} \times [\boldsymbol{Fodder}]_{\boldsymbol{i}} \times \boldsymbol{R}_{\boldsymbol{F}}^{\boldsymbol{B/M}}\right) + \left(\boldsymbol{F}_{\boldsymbol{IW}} \times \boldsymbol{C}_{\boldsymbol{i}}^{\boldsymbol{IW}} \times \boldsymbol{R}_{\boldsymbol{IW}}^{\boldsymbol{B/M}}\right)]\boldsymbol{e}^{-(\boldsymbol{\lambda}_{\boldsymbol{i}} \times \boldsymbol{t}_{\boldsymbol{B/M}})} \quad \textbf{(28)}$$

$[Beef]_i/[Milk]_i$ concentration of radionuclide *i* in beef (pCi/kg) or milk (pCi/L)

$T_i^{F-B/M}$ transfer fraction from fodder to beef (d/kg) or milk (d/L)

F_F fraction of fodder taken from irrigated pasture (unitless) (Default: 1)

$[Fodder]_i$ concentration of radionuclide *i* in fodder (pCi/kg) (equation 21)

$R_F^{B/M}$ cattle consumption rate of fodder for beef or milk production (kg/d) (Default: 36 kg/d for beef and 52 kg/d for milk) (Jannik et al. 2017)

F_{IW} fraction of water taken from Savannah River (unitless) (Default: 1)

C_i^{IW} concentration of radionuclide *i* in irrigated water from river water at River Mile 118.8 (Hwy 301) (pCi/L) (equation 16)

$R_{IW}^{B/M}$ cattle consumption rate of water (L/d)
(Default: 28 L/d for beef and 50 L/d for milk) (Jannik et al. 2017)

λ_i radioactive decay constant for radionuclide *i* (1/d)

$t_{B/M}$ harvest to consumption time for beef or milk (d)
(Default: 6 d for beef and 3 d for milk) (Jannik et al. 2017)

4.5 Vegetation Pathway

The dose to an individual or the population due to consumption of vegetables irrigated with contaminated water is calculated by the following equations:

4.5.1 Individual Dose

$$\boldsymbol{ID_i^{Veg} = DC_i^{Ing} \times [Veg]_i^{Ind} \times (U_V + U_{LV})} \tag{29}$$

ID_i^{veg} annual individual (representative person) dose from consumption of vegetable crops (mrem/y)

DC_i^{Ing} ingestion dose coefficient for radionuclide *i* (mrem/pCi)

$[Veg]_i^{Ind}$ concentration of radionuclide *i* in vegetable crops estimated for a backyard garden (pCi/kg) (equation 20)

U_V annual vegetable consumption rate for an individual (kg/y)
(Default: 289 kg/y) (Jannik et al. 2017)

U_{LV} annual leafy vegetable consumption rate for an individual (kg/y)
(Default: 31 kg/y) (Jannik et al. 2017)

4.5.2 Population Dose using Population Count

$$\boldsymbol{PD_i^{Veg} = DC_i^{Ing} \times [Veg]_i^{Pop} \times Pop_E \times (\bar{U}_V + \bar{U}_{LV})} \tag{30}$$

PD_i^{veg} annual population dose from vegetables for radionuclide *i* (mrem/y)

$[Veg]_i^{Pop}$ concentration of radionuclide *i* in vegetable crops estimated for a family farm (pCi/kg) (equation 21)

Pop_E exposed population, 10% of the 50-Mile population (people)

$\bar{U}_V$ annual average vegetable consumption rate of the population (kg/y)
(Default: 89 kg/yr) (Jannik et al. 2017)

$\bar{U}_{LV}$ annual average leafy vegetable consumption rate of the population (kg/y)
(Default: 11 kg/yr) (Jannik et al. 2017)

All other parameters defined in equation 29.

4.5.3 Population Dose using Irrigated Land Area

$$\boldsymbol{PD_i^{Veg} = DC_i^{Ing} \times [Veg]_i^{Pop} \times (P_V + P_{LV})} \tag{31}$$

where:

$$\boldsymbol{P_V = Land \times Y_{Veg} \times F_V} \tag{32}$$

$$\boldsymbol{P_{LV} = Land \times Y_{Veg} \times F_{LV}} \tag{33}$$

P_V annual production of vegetable within the irrigated area (kg/y) (See Appendix C)

P_{LV} annual production of leafy vegetable within the irrigated area (kg/y) (See Appendix C)

$Land$ irrigated land area used for annual harvesting (acres) (Default: 1000 acres)

Y_{Veg} annual vegetable crop production yield per area (kg/m^2) (Default: 2.2 kg/m^2) (Jannik et al. 2017)

F_V fraction of harvest assumed to be vegetable (unitless) (Default: 0.8)

F_{LV} fraction of harvest assumed to be leafy vegetable (unitless) (Default: 0.2)

All other parameters defined in equation 29 or 30.

4.6 Milk Pathway

The dose to an individual or the population due to consumption of milk from cows exposed to radiation through consumption of fodder irrigated with water from the Savannah River and drinking water from the Savannah River is calculated by the following equations:

4.6.1 Individual Dose

$$\boldsymbol{ID_i^{Milk} = DC_i^{Ing} \times [Milk]_i \times U_{Milk}} \quad \textbf{(34)}$$

ID_i^{Milk} annual individual (representative person) dose from ingestion of milk produced by a cow exposed to radionuclide i (mrem/y)

DC_i^{Ing} ingestion dose coefficient for radionuclide i (mrem/pCi)

$[Milk]_i$ concentration of radionuclide i in exposed cow milk (pCi/L) (equation 28)

U_{Milk} annual milk consumption rate for an individual (L/y) (Default: 260 L/yr) (Jannik et al. 2017)

4.6.2 Population Dose using Population Count

$$\boldsymbol{PD_i^{Milk} = DC_i^{Ing} \times [Milk]_i \times Pop_E \times \bar{U}_{Milk}} \quad \textbf{(35)}$$

PD_i^{Milk} annual population dose from ingestion of milk produced by a cow exposed to radionuclide i (person-rem)

Pop_E exposed population, 10% of the 50-Mile population (persons)

$\bar{U}_{Milk}$ annual average milk consumption rate (L/y) (Default: 69 L/yr) (Jannik et al. 2017)

All other parameters defined in equation 34.

4.6.3 Population Dose using Irrigated Land Area

$$\boldsymbol{PD_i^{Milk} = DC_i^{Ing} \times [Milk]_i \times P_{Milk}} \quad \textbf{(36)}$$

where:

$$\boldsymbol{P_{Milk} = Land \times Y_{Milk}} \quad \textbf{(37)}$$

P_{Milk} annual production of milk within the irrigated area (L/y)

$Land$ irrigated land area used for annual harvesting (acres) (Default: 1000 acres)

Y_{Milk} annual volumetric milk production yield per area (L/m^2) (Default: 0.34 kg/m^2) (Jannik et al. 2017)

All other parameters defined in equation 35.

4.7 Meat Pathway

The dose to an individual or the population due to the consumption of pigs, chickens, and beef with focus on the beef pathway from cows exposed to radiation through consumption of fodder irrigated with water from the Savannah River and drinking water from the Savannah River is calculated by the following equations:

4.7.1 Individual Dose

$$\boldsymbol{ID_i^{Meat} = DC_i^{Ing} \times [Beef]_i \times U_{Meat}} \quad \textbf{(38)}$$

ID_i^{Meat} annual individual (representative person) dose from consumption of pigs, chickens, and beef with focus on the exposed beef pathway for radionuclide *i* (mrem/y)

DC_i^{Ing} ingestion dose coefficient for radionuclide *i* (mrem/pCi)

$[Beef]_i$ concentration of radionuclide *i* in cow beef through vegetation exposure (pCi/kg) (equation 28)

U_{Meat} annual meat (pig, chicken, & cow) consumption rate for an individual (kg/y) (Default: 81 kg/yr) (Jannik et al. 2017)

4.7.2 Population Dose using Population Count

$$\boldsymbol{PD_i^{Meat} = DC_i^{Ing} \times [Beef]_i \times Pop_E \times \bar{U}_{Meat}} \quad \textbf{(39)}$$

PD_i^{Meat} annual population dose from consumption of pigs, chickens, and beef with focus on the beef pathway (mrem/y)

Pop_E exposed population, 10% of the 50-Mile population (persons)

$\bar{U}_{Meat}$ annual average meat (pig, chicken, & cow) consumption rate of the population (kg/y) (Default: 32 kg/yr) (Jannik et al. 2017)

All other parameters defined in equation 38.

4.7.3 Population Dose using Irrigated Land Area

$$PD_i^{Meat} = DC_i^{Ing} \times [Beef]_i \times P_{Meat} \tag{40}$$

where:

$$P_{Meat} = Land \times Y_{Meat} \tag{41}$$

P_{Meat} production of meat (pig, chicken, & cow) within the irrigated area (kg/y)

$Land$ irrigated land area used for annual harvesting (acres) (Default: 1000 acres)

Y_{Meat} annual meat production yield per area (kg/m^2) (Default: 0.01 kg/m^2) (Jannik et al. 2017)

All other parameters defined in equation 38.

5.0 Verification of Models

The entire workbook is referred to as LADTAP XL© Version 2017. Each worksheet has a separate name (LADTAP and IRRIDOSE) and verification is performed independently for each. For the LADTAP and IRRIDOSE spreadsheets, comparisons are made with previous LADTAP XL© Version 2013 using five test cases to ensure no inadvertent changes were made. Hand calculations were performed previously by Simpkins (2004) to ensure proper application of methods.

5.1 Verification of LADTAP XL© Version 2017

LADTAP XL© Version 2017 was initiated to update the time build-up parameter within the LADTAP spreadsheet used to calculate the population shoreline exposure dose (Appendix A). Per computer program modification tracker #Q-CMT-A-00022, updates previously mentioned in section 1.0 were made to LADTAP XL© Version 2013 and LADTAP XL© Version 2017 was released through office memorandum SRNL-L3200-2017-00030 (Appendix B). Test case inputs and results of LADTAP XL© Version 2017 compared to Version 2013 were included in this memorandum, and now provided in Appendix B, to show that Version 2017 produced comparable and expected results to Version 2013. In general, the time standardization produced a minor and consistent overall decrease in individual and population TED for the LADTAP and IRRIDOSE spreadsheet output. For most cases within LADTAP, the ingestion pathway dominates the TED, but for cases when the ingestion pathway is zero, a significant increase in TED was noted for certain radionuclides sensitive to the shoreline exposure dose pathway. However, the output is still below reportable limits for Site assessments and analysis so no further actions were needed. Within IRRIDOSE, a '50-Mile Total Vegetable Production' input cell and a '50-Mile Total Leafy Vegetable Production' input cell were initially added to provide testing insurance for demonstrating how these annually updated parameters (normally updated within Jannik et al. (2017)) impact the IRRIDOSE population TED estimates. However, due to underreporting by SRS surrounding counties, these values will now be conservatively calculated using the irrigated land area (1000 acres) and an expected vegetable crop yield per area factor (currently 2.2 kg/m^2) (Jannik et al. 2017) (Appendix C). This method will act as the conservative default for approximating the 50-mile total vegetable and leafy vegetable production using a production area of 1,000 acres.

6.0 User Manual

6.1 First Time User Instructions

The programming for LADTAP XL© Version 2017 is contained in one EXCEL© File entitled 'LADTAP XL Version 2017.xlsx. Simply copying this file to one's computer installs the program. The spreadsheet has been locked to avoid inadvertent changes to cells performing calculations. The technical lead (or designee) of the Environmental Dosimetry Group keeps the passwords. Following installation, it is recommended that the user execute all test cases to ensure the spreadsheets are operating correctly.

6.2 Input Instructions

Table 6-1 and Table 6-2 show the input templates for the LADTAP and IRRIDOSE worksheets in their entirety. In viewing the actual spreadsheet, the user has the ability to change all parameters shown in red. All other cells have been locked to prevent user access. The spreadsheet is set up such that default values are included for each parameter except the source term. Each parameter is discussed in detail below, first for the LADTAP worksheet and then for the IRRIDOSE worksheet.

6.3 LADTAP Input Parameter Descriptions

Effective River Flow Rate (cfs) – Enter the average annual Savannah River flow rate. Five values are requested: (1) measured (or effective) flow at Highway 301 Bridge, (2) effective flow rate at the two BJWSA treatment plants, (3) effective flow rate at Savannah I&D, and (4) estimated flow at the Savannah River Estuary. Estuary flow rates are estimated by increasing the measured (or effective) flow rate at Highway 301 by 10 percent. The default value is 7,500 cfs for Hwy 301 and 10,000 for the other locations. Valid range: 3,500-25,000 cfs.

Annual Max. Ind. Shoreline Usage (hr) – Enter the number of hours per year the Reference Person is expected to be on the shoreline. Default: 20 hr. Valid range: 0-8760 hr.

Annual Max Individual Swimming Usage (hr) – Enter the number of hours per year the Reference Person is expected to be swimming. Default: 14 hr. Valid range: 0-8760 hr.

Annual Max Individual Boating Usage (hr) – Enter the number of hours per year the Reference Person is expected to be boating. Default: 44 hr. Valid range: 0-8760 hr.

Ind. Fish Usage (Typ, Ref, Value) (kg/yr) – Enter either typical (typ), reference (ref), or a user-defined value to specify the amount of fish consumed per year for the individual assessment. Consumption rates are 3.7 kg/yr for the Typical Person (typ) and 24 kg/yr for the Reference Person (ref). Default: 24 kg/yr or 'ref'.

Ind. Water Usage (Typ, Ref, Value) (L/yr) – Enter either typical (typ), reference (ref), or a user-defined value to specify the amount of water consumed per year for the individual assessment. Consumption rates are 300 L/yr for the Typical Person (typ) and 800 L/yr for the Reference Person (ref). Default: 800 L/yr or 'ref'.

Recreation Transport Time (d) – Transport times are used to estimate the decay between the release and the exposure to the Reference and/or Typical Person. The recreation transport time includes the time period for water to flow from the release to where the individual will be exposed. Default: 1 d. Valid range: 0-10 d.

Water Transport Time (d) – Transport times are used to estimate the decay between the release and the consumption of the water for the individual (Reference Person) located at the Highway 301 Bridge. Default: 1.5 d. Valid range: 0-10 d.

Fish/Invertebrate Transport Time – Transport times are used to estimate the decay between the release and the consumption of the food for the individual (Reference Person). Default: 2 d. Valid range: 0-10 d.

Beaufort-Jasper Chelsea Population – Enter the number of drinking water consumers on the BJWSA Chelsea domestic water system. Current Value: 83,700 persons. Valid Range: 0-1E+06 persons.

Beaufort-Jasper Purrysburg Population – Enter the number of drinking water consumers on the BJWSA Purrysburg domestic water system. Current value: 64,800 people. Valid Range: 0-1E+06 people.

Savannah I&D Population – Enter the number of drinking water consumers on the Savannah I&D domestic/industrial water system. Current value: 35,000 people. Valid Range: 0-1E+06 people.

50-mile Population – Enter the population within 50-miles of the Savannah River Site. Current (2010 census) value: 781,060 people. Valid Range: 0-1E+06 people.

Drinking Water Plant Travel Time (d) – Transport times are used to estimate the decay between the release and the consumption of water at the water treatment plants. Default value: 4 d. Valid range: 0-10 d.

Population Water Usage (Typ, Ref, value) (L/yr) – Enter either typical (typ), reference (ref) or a user-defined value to specify the amount of water consumed by individuals for the purpose of estimating population doses. Consumption rates are 300 L/yr for the Typical Person (typ) and 800 L/yr for the Reference Person (ref). Default: 300 L/yr or 'typ'.

Population Fish Usage (Typ, Ref, value) (kg/yr) – Enter either typical (typ), reference (ref) or a user-defined value to specify the amount of fish consumed by individuals for the purpose of estimating population doses. Consumption rates are 3.7 kg/yr for the Typical Person (typ) and 24 kg/yr for the Reference Person (ref). Default: 3.7 kg/yr or 'typ'.

Population Invertebrate Usage (Typ, Ref, value) (kg/yr)– Enter either typical (typ), reference (ref) or a user-defined value to specify the amount of invertebrates consumed by individuals for the purpose of estimating population doses. Consumption rates are 1.5 kg/yr for the Typical Person (typ) and 9 kg/yr for the Reference Person (ref). Default: 1.5 kg/yr or 'typ'.

Annual Sport Fish Harvest (edible) (kg/yr) – Total amount of edible sport fish harvested from the Savannah River in an average year. Default value: 8,220 kg/yr. Valid Range: 0-1E+06 kg/yr.

Annual Commercial Fish Harvest (edible) (kg/yr) – Total amount of edible commercial fish harvested from the Savannah River in an average year. Default value: 57,000 kg/yr. Valid Range: 0-1E+06 kg/yr.

Annual Invertebrate Harvest (edible) (kg/yr) – Total amount of edible invertebrates harvested from the Savannah River in an average year. Default value: 380,000 kg/yr. Valid Range: 0-1E+06 kg/yr.

Sport Fish Transport (d) – Transport time which allows for decay between release and consumption of sport fish. Default value: 10 d. Valid Range: 0-30 d.

Commercial Invertebrate Transport Time (d) – Transport time which allows for decay between release and consumption of commercial fish or invertebrates. Default value: 13 d. Valid Range: 0-30 d.

Estuary Dilution Factor – Unitless factor accounting for increased dilution in the Savannah River Estuary. Nuclide concentrations in the estuary are calculated using volumetric dilution and the dilution factor. The estuary concentrations are used to estimate concentration of nuclides in the saltwater invertebrates consumed by the 50-mile population. Default value: 3. Valid Range: 1-10.

Population Shoreline Usage (person-hr) – Enter the number of hours per year the population is expected to be on the shoreline. Default value: 822,000 person-hr. Valid Range: 0-1.5E+06 person-hr.

Population Swimming Usage (person-hr) – Enter the number of hours per year the population is expected to be swimming in the Savannah River. Default value: 295,000 person-hr. Valid Range: 0-1.5E+06 person-hr.

Population Boating Usage(person-hr) – Enter the number of hours per year the population is expected to be boating on the Savannah River. Default value: 3,110,000 person-hr. Valid Range: 0-1.5E+06 person-hr.

Assessment Year – Enter the appropriate year of assessment. Default: current year.

Source Term (Ci/yr) – Enter the release amount in Ci/yr for each of the radionuclides listed. The release rate is assumed to be constant and continuous over the one-year period.

Total 50-Mile Fish Consumption (kg/yr) – Value calculated by LADTAP indicating the maximum amount of fish consumed by the 50-mile population. The value is the product of the 50-mile population and the fish consumption rate.

Total 50-Mile Invertebrate Consumption (kg/yr) – Value calculated by LADTAP indicating the maximum amount of invertebrates consumed by the 50-mile population. The value is the product of the 50-mile population and the invertebrate consumption rate.

Table 6-1. Default Input Parameters for LADTAP

Parameter	Value	Units	Comments
Effective River Flow Rate (Hwy 301):	7,500	cfs	
Flow Rate at Beaufort-Jasper-Chelsea:	10,000	cfs	
Flow Rate at Beaufort-Jasper-Purrysburg:	10,000	cfs	
Flow Rate at Port Wentworth:	10,000	cfs	
Flow Rate at the Estuary:	10,000	cfs	
Annual Max. Ind. Shoreline Usage:	20	hr	
Annual Max. Ind. Swimming Usage:	14	hr	
Annual Max. Ind. Boating Usage:	44	hr	
Ind. Fish Usage (Typ, Ref, value):	ref	24	kg/yr
Ind. Water Usage (Typ, Ref, value):	ref	800	L/yr
Recreation Transport Time:	1	d	
Ind. Water Transport Time:	1.5	d	
Ind. Fish/Invertebrate Transport Time:	2	d	
Beaufort-Jasper-Chelsea Population:	8.37E+04	persons	
Beaufort-Jasper-Purrysburg Population:	6.48E+04	persons	
Savannah I&D Population:	3.50E+04	persons	
50-Mile Population:	781060	persons	
Drinking Water Plant Travel Time:	4	(d)	
Pop. Water Usage (Typ, Ref, value):	typ	300	L/yr
Pop. Fish Usage (Typ, Ref, value):	typ	3.7	kg/yr
Pop. Invertebrate Usage (Typ, Ref, value):	typ	1.5	kg/yr
Annual Sport Fish Harvest (edible):	8.22E+03	kg/yr	
Annual Commercial Fish Harvest (edible):	5.70E+04	kg/yr	
Annual Invertebrate Harvest (edible):	3.80E+05	kg/yr	
Sport Fish Transport Time:	10	d	
Commercial/Invertebrate Transport Time:	13	d	
Estuary Dilution Factor:	3	unitless	
Population Shoreline Usage:	8.22E+05	person-hrs	
Population Swimming Usage:	2.95E+05	person-hrs	
Population Boating Usage:	3.11E+06	person-hrs	
Assessment Year:	2017		

6.4 IRRIDOSE Input Parameter Descriptions

50Mile Total Vegetable Production (kg/yr) – The production value of non-leafy vegetables harvested annually for population consumption within the 50-mile area. The default value should be 80% of the approximated 1,000 acres and the current year crop yield in the 50-mile radius. Value used only if population doses are calculated for estimated current year production. Current value: 7.1E+06 kg/yr.

50Mile Total Leafy Vegetable Production (kg/yr) – The production value of leafy vegetables harvested annually for population consumption within the 50-mile area. The default value should be 20% of the approximated 1,000 acres and the current year crop yield in the 50-mile radius. Value used only if population doses are calculated for estimated current year production. Current value: 1.8E+06 kg/yr.

Irrigated Land Area (acres) – Enter the area of land irrigated on which food crops, fodder and cattle are raised. Value used only if population doses are calculated by the irrigated land area method. Each commodity is produced on the total number of acres specified; e.g., if 1000 acres is entered for this parameter, it is assumed that 1000 acres supports the growth of vegetable crops, another 1000 acres supports the production of milk, another 1000 acres supports the production of meat. Default value: 1,000. Valid range: 0-200,000 acres.

Pop Dose Determined By – Enter 'pop' or 'area' to specify calculations of population dose by the population count method or by the irrigated land method. Entry of something other than a valid response results in no calculations of population dose. Default: 'area'.

River Transit Time (days) – Enter the time period that elapses between release and irrigation; normally taken as the time required for the released radionuclides to become available at the Hwy 301 Bridge. Default value: 2 d. Valid Range: 0-5 d.

Irrigation Rate ($L/m^2/d$) – Enter the rate at which the crops are irrigated. The expected value is equivalent to watering rate of approximately 1 inch per week. Default value: 3.6 L/m^2-d. Valid Range: 0.07-7 L/m^2d.

Weathering Constant (1/d) – Enter the exponential rate constant that depicts the removal of radionuclides from the surface of vegetation due to weathering. The expected value corresponds to a weathering half-life of 14 days. Default value: 0.0495 1/d. Valid Range: 0.002-0.693 d^{-1}.

Crop Exposure Time (d) – Enter the time that edible crops are exposed to contaminated water via irrigation. Default value: 70 d. Valid Range: 0-365 d.

Grass Exposure Time (d) – Enter the time that grass used as fodder is exposed to contaminated water via irrigation. Bermuda grass is the most common field grass used as fodder in South Carolina and it is harvested every 30 days. Default value: 30 d. Valid Range: 0-365 d.

Vegetable Crop Yield (kg/m^2) – Enter the amount of vegetable produced per square meter. This varies by type of vegetable produced but an average value is to be entered. Default value: 2.2 kg/m^2. Valid Range: 0-10 kg/m^2.

Pasture Grass Yield (kg/m^2) – Enter the amount of pasture grass produced per square meter. Default value: 0.7 kg/m^2. Valid Range: 0-10 kg/m^2.

Milk Production Yield (L/m^2) – Enter the amount of milk produced per square meter. Default value: 0.34 L/m^2. Valid Range: 0-10 L/m^2.

Meat Production Yield (kg/m^2) – Enter the amount of meat (beef) produced per square meter. Default value: 0.01 kg/m^2. Valid Range: 0-10 kg/m^2.

Soil Surface Density (kg/m^2) – Enter the density of the soil assuming infinite thinness. Default value: 240 kg/m^2. Valid range: 100-500 kg/m^2.

Pasture Grass Hold-up Time (d) – Enter the time between contamination of grass and consumption by beef or milk cattle. Default value: 0 d. Valid Range: 0-365 d.

Vegetable Transport Time (d) – Enter the time between harvest and the consumption of vegetable crops. These values differ for individual and population dose estimates. Individual default value: 1 d. Population default value: 6 d. Valid Range: 0-30 d.

Milk Transport Time(d) – Enter the time between milking and consumption of cows' milk. Default value: 3 d. Valid Range: 0-7 d.

Meat Transport Time (d) – Enter the time period between slaughter and consumption of beef cattle. Default value: 6 d. Valid Range: 0-30 d.

Fraction Fodder from Field – Enter the fraction of cattle's food intake that is taken from an irrigated field or considered to be contaminated. Default value: 1.0. Valid Range: 0-1.

Cattle Fodder Consumption Rate (kg/d) – Enter the amount of irrigated pasture grass consumed per day. Default values: 36 kg/d for beef and 52 kg/d for milk. Valid Range: 0-100 kg/d.

Fraction of water from river – Enter the fraction of the cattle's water intake that is from the Savannah River or considered to be contaminated. Default value: 1.0. Valid Range: 0-1.

Cattle Water Consumption Rate (L/d) – Beef and milk cattle consumption rates of water used for irrigation. Default values: 28 L/d for beef and 50 L/d for milk. Valid Range: 0-200 L/d.

Individual Consumption Rates (kg/yr) – Enter the individual (Representative Person) consumption rates of produce, leafy vegetables, meat and milk. Default values: 289 kg/y for non-leafy vegetables, 31 kg/y for leafy vegetables, 81 kg/y for meat, and 260 L/y for milk. Valid ranges are as follows: vegetables 0-900 kg/yr, leafy vegetables 0-260 kg/yr, meat 0-470 kg/yr, and milk 0-500 L/yr.

Population Consumption Rates (kg/yr) – Enter the population (Typical Person) consumption rates of produce, leafy vegetables, meat and milk. Default values: 89 kg/y for non-leafy vegetables, 11 kg/y for leafy vegetables, 32 kg/y for meat, and 69 L/y for milk. Valid ranges are as follows: vegetables 0-900 kg/yr, leafy vegetables 0-260 kg/yr, meat 0-470 kg/yr and milk 0-500 L/yr.

Fraction Retention – Enter the fraction of deposited radionuclides that remain on the edible surface of vegetation after irrigation. Default value: 0.25. Valid range 0-1.

Exposed Population (people) – This parameter has been set equal to the calculate 10% of the 50-mile population entered in the LADTAP spreadsheet to approximate the number of people supported by the irrigated farm land. This value is utilized only if population doses are calculated by the population count method. Current value: 78,106 persons. Valid Range: 0-100,000 persons.

Savannah River Flow Rate (cfs) – This parameter has been set equal to the river flow rate entered in the LADTAP worksheet. Default value: 9,700 cfs. Valid Range: 3,500-25,000 cfs.

Buildup Time in Soil (d) – This parameter has been set equal to calculate the number of days radionuclides have been allowed to buildup in the soil since the beginning of SRS operations to date. This value is determined by subtracting the assessment year entered in the LADTAP worksheet from 1954 and then converting years to days. Valid Range: 0-36,500 d.

Production within irrigated area (kg/y) – These values are calculated by IRRIDOSE based on the irrigated land area input, foodstuffs yields, and maximum production values. Current Values: vegetables 5.30E+06 kg/yr, leafy vegetables 1.40E+06 kg/yr, meat 4.05E+04 kg/yr, and milk 6.07E+05 kg/yr.

Table 6-2. Default Input Parameters for IRRIDOSE

Parameter	Value	Units	Comments
50Mile Total Vegetable Production:	7100000	kg/yr	**5.30E+06***
50Mile Total Leafy Veg Production:	1800000	kg/yr	**1.40E+06***
Irrigated land area:	1000	acres	
Pop dose determined by:	area		POP or AREA
River transit time:	2	d	
Irrigation rate:	3.6	L/sq.m/d	102 L/sq.m/mo
Weathering removal constant:	0.0495	1/d	14 d half-life
Crop exposure time:	70	d	
Grass exposure time:	30	d	
Vegetable crop yield:	2.2	kg/sq.m	
Pasture grass yield:	0.7	kg/sq.m	
Milk production yield:	0.34	L/sq.m	
Meat production yield:	0.01	kd/sq.m	
Surface density of soil:	240	kg/sq.m	
Pasture grass hold-up time:	0	d	
Veg transport time (individual):	1	d	d
Veg transport time (population):	6	d	d
Milk transport time:	3	d	d
Meat transport time:	6	d	d
Fraction of fodder from irrigated field:	1.00		
Cattle consumption rate of fodder:	36	kg/d	beef
	52	kg/d	milk
Fraction of water from Savannah River:	1.00		
Cattle consumption rate of water:	28	L/d	beef
	50	L/d	milk
Individual consumption rates:	289	kg/yr	veg
	31	kg/yr	leafy
	81	kg/yr	meat
	260	L/yr	milk
Population consumption rates:	89	kg/yr	veg
	11	kg/yr	leafy
	32	kg/yr	meat
	69	L/yr	milk
Fractional retention on leaves:	0.25		all nuclides

7.0 Conclusion

LADTAP XL© Version 2017 has been verified and is ready for execution. The changes made to the input parameters, time conversion factors, and time build-up parameter caused changes to the output results that are expected. Layout changes did not affect the computational aspects of LADTAP or IRRIDOSE. The code is operating as expected.

8.0 References

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Appendix A. SRNL-TR-2017-00063

SRNL-TR-2017-00063

INTER-OFFICE MEMORANDUM

March 1, 2017

TO: G. T. Jannik, 999-W
K. L. Dixon, 773-42A

FROM: K. R. Moore, 999-W

LADTAP XL© Version 2013 Nonconformance Build-up Parameter in Population Shoreline Exposure Dose

LADTAP XL© Version 2013 is an EXCEL© spreadsheet used at the Savannah River Site (SRS) to estimate dose to offsite individuals and populations resulting from routine releases of radioactive materials to the Savannah River. It has been recently discovered that the calculations used for population shoreline exposure dose were not conforming to the user-defined time build-up parameter. In response to STAR action #3 (2017-CTS-001733) and to maintain compliance with the DOE O 458.1 (DOE 2011), corrections have been made to the current LADTAP XL© Version 2013 and LADTAP XL© Version 2011 spreadsheet to conduct a comparison for the reported total effective dose (TED) in 2010, 2011, 2013, 2014, and 2015. While the update produced a significant change for the estimated population shoreline exposure dose (Table 1), the change to the overall population dose from all liquid pathways is minimal (Table 2) and under the annually calculated population TED (Table 3) for liquid effluents released into the Savannah River.

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Distribution:

cc: J.J. Mayer, 999-W
B. H. Stagich, 999-W

Table 1. Population River Recreation Exposure Dose from Water Pathway (mrem-person/yr)

		LADTAP XL Conformity	LADTAP XL Nonconformity	% Increase
2010	Shoreline	1.1E-02	8.9E-03	20.96%
	Swimming	1.5E-04	1.5E-04	0.00%
	Boating	1.3E-05	1.3E-05	0.00%
	Total 2010 River Recreation Dose	**1.1E-02**	**9.1E-03**	**20.57%**
2011	Shoreline	2.2E-02	1.8E-02	22.08%
	Swimming	1.7E-04	1.7E-04	0.00%
	Boating	2.7E-05	2.7E-05	0.00%
	Total 2011 River Recreation Dose	**2.3E-02**	**1.8E-02**	**21.84%**
2013	Shoreline	9.8E-03	7.9E-03	23.60%
	Swimming	1.7E-04	1.7E-04	0.00%
	Boating	8.4E-06	8.4E-06	0.00%
	Total 2013 River Recreation Dose	**1.0E-02**	**8.1E-03**	**23.08%**
2014	Shoreline	9.6E-03	7.7E-03	25.41%
	Swimming	7.5E-05	7.5E-05	0.00%
	Boating	8.5E-06	8.5E-06	0.00%
	Total 2014 River Recreation Dose	**9.7E-03**	**7.8E-03**	**25.13%**
2015	Shoreline	1.4E-02	1.1E-02	25.87%
	Swimming	1.2E-04	1.2E-04	0.00%
	Boating	1.1E-05	1.1E-05	0.00%
	Total 2015 River Recreation Dose	**1.4E-02**	**1.1E-02**	**25.57%**

Table 2. Total Population Water Pathway Dose (mrem-person/yr)

		LADTAP XL Conformity	LADTAP XL Nonconformity	% Increase
2010	Aquatic Food Consumption	5.4E-01	5.4E-01	0.00%
	River Recreation	1.1E-02	9.1E-03	20.57%
	BJC Water Consumption	6.0E-01	6.0E-01	0.00%
	BJP Water Consumption	5.7E-01	5.7E-01	0.00%
	PW Water Consumption	2.3E-01	2.3E-01	0.00%
	Total 2010 Water Pathway Dose	**1.9E+00**	**1.9E+00**	**0.10%**
2011	Aquatic Food Consumption	3.7E-01	3.7E-01	0.00%
	River Recreation	2.3E-02	1.8E-02	21.84%
	BJC Water Consumption	6.6E-01	6.6E-01	0.00%
	BJP Water Consumption	5.3E-01	5.3E-01	0.00%
	PW Water Consumption	2.3E-01	2.3E-01	0.00%
	Total 2011 Water Pathway Dose	**1.8E+00**	**1.8E+00**	**0.22%**
2013	Aquatic Food Consumption	1.8E-01	1.8E-01	0.00%
	River Recreation	1.0E-02	8.1E-03	23.08%
	BJC Water Consumption	4.9E-01	4.9E-01	0.00%
	BJP Water Consumption	3.4E-01	3.4E-01	0.00%
	PW Water Consumption	1.6E-01	1.6E-01	0.00%
	Total 2013 Water Pathway Dose	**1.2E+00**	**1.2E+00**	**0.16%**
2014	Aquatic Food Consumption	1.3E-01	1.3E-01	0.00%
	River Recreation	9.7E-03	7.8E-03	25.13%
	BJC Water Consumption	3.5E-01	3.5E-01	0.00%
	BJP Water Consumption	2.7E-01	2.7E-01	0.00%
	PW Water Consumption	1.5E-01	1.5E-01	0.00%
	Total 2014 Water Pathway Dose	**9.1E-01**	**9.1E-01**	**0.21%**
2015	Aquatic Food Consumption	1.8E-01	1.8E-01	0.00%
	River Recreation	1.4E-02	1.1E-02	25.57%
	BJC Water Consumption	4.9E-01	4.9E-01	0.00%
	BJP Water Consumption	3.8E-01	3.8E-01	0.00%
	PW Water Consumption	2.1E-01	2.1E-01	0.00%
	Total 2015 Water Pathway Dose	**1.3E+00**	**1.3E+00**	**0.23%**

Table 3. Total Reported Population Dose for Liquid Effluents Released to the Savannah River (mrem-person/yr)

		LADTAP XL Conformity	LADTAP XL Nonconformity	% Increase
2010	Water Pathway Dose	1.9E+00	1.9E+00	0.10%
	Irrigation Pathway Dose	1.5E+00	1.5E+00	0.00%
	2010 Reported Population Dose	**3.4E+00**	**3.4E+00**	**0.05%**
2011	Water Pathway Dose	1.8E+00	1.8E+00	0.22%
	Irrigation Pathway Dose	1.3E+00	1.3E+00	0.00%
	2011 Reported Population Dose	**3.1E+00**	**3.1E+00**	**0.13%**
2013	Water Pathway Dose	1.2E+00	1.2E+00	0.16%
	Irrigation Pathway Dose	1.3E+00	1.3E+00	0.00%
	2013 Reported Population Dose	**2.4E+00**	**2.4E+00**	**0.08%**
2014	Water Pathway Dose	9.1E-01	9.1E-01	0.21%
	Irrigation Pathway Dose	1.1E+00	1.1E+00	0.00%
	2014 Reported Population Dose	**2.0E+00**	**2.0E+00**	**0.10%**
2015	Water Pathway Dose	1.3E+00	1.3E+00	0.23%
	Irrigation Pathway Dose	1.3E+00	1.3E+00	0.00%
	2015 Reported Population Dose	**2.6E+00**	**2.6E+00**	**0.11%**

Appendix B. SRNL-L3200-2017-00030

SAVANNAH RIVER NATIONAL LABORATORY
OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

SRNL-L3200-2017-00030

March 16, 2017

TO: G. T. Jannik, 999-W

FROM: K. R. Moore, 999-W

LADTAP XL© Version 2017 Release

Due to the recent Error Notification (B-SEN-A-00001) (Appendix A), LADTAP XL© is now released as LADTAP XL© Version 2017 as per computer program modification tracker #Q-CMT-A-00022 (Appendix B). Version 2017 updates include:

1) cell identification for build-up time parameter now labeled as 'Assessment Year',
2) 'Assessment Year' input cell referenced within shoreline exposure dose and IRRIDOSE build-up time in soil calculations,
3) internal calculations made within cells that reference the assessment year to determine build-up time,
4) maximum land production user-defined input cells added, and
5) standardized the time conversion factor 365.25 days in one year.

In response to STAR item #4 (2017-CTS-001733), LADTAP XL© Version 2017 was executed alongside Version 2013 using five SQAP test cases to showcase the updates influence on the total effective dose (TED) output. Table 1 & 2 provides the test case input used for the LADTAP and IRRIDOSE spreadsheets within LADTAP XL, respectively. Tables 3-7 include the individual and population pathway dose and TED for cases 1-5, respectively. Appendix C has been included to show a full comparison of nuclide effective doses (ED) for each test case.

Test case 1 (Table 3) was designed to showcase the direct change due to standardizing the time conversion factor (update 5). Based on the five test cases, this is approximately between a 0.05 – 0.07% (Tables 3-7) decrease in TED for all pathways. The following equations rearrange the individual ED equation for direct use of the Savannah River (Jannik 2013) (equation 1) for radionuclide *i* to generally understand how standardizing the time parameter conversion factors (CF) effects each dose pathway. Equation 2 separates the time CF from the unchanged dose pathway variables (*X*). Equation 3 rearranges and simplifies equation 2 to address the overall impact of each CF on the nuclide ED.

$$^{LT}ED_{Ind,i} = D_{Fish,i} + D_{Water,i} + D_{Swim,i} + D_{Boat,i} + D_{Shore,i} \tag{1}$$

$$^{LT}ED_{Ind,i} = \boldsymbol{CF_{yr\to sec}} \cdot X_{Fish,i} + \boldsymbol{CF_{yr\to sec}} \cdot X_{Water,i} + \boldsymbol{CF_{yr\to sec}} \cdot \boldsymbol{CF_{yr\to hr}} \cdot X_{Swim,i} + \boldsymbol{CF_{yr\to sec}} \cdot \boldsymbol{CF_{yr\to hr}} \cdot X_{Boat,i} + \boldsymbol{CF_{yr\to sec}} \cdot \boldsymbol{CF_{yr\to hr}}(1 - e^{-\lambda \cdot t \cdot \boldsymbol{CF_{yr\to d}}}) \cdot X_{Shore,i} \tag{2}$$

$$^{LT}ED_{Ind,i} = \boldsymbol{CF_{yr\to sec}} \left(X_{Fish,i} + X_{Water,i} + \boldsymbol{CF_{yr\to hr}}\left(X_{Swim,i} + X_{Boat,i} + \left(1 - e^{-\lambda \cdot t \cdot \boldsymbol{CF_{yr\to d}}}\right) \cdot X_{Shore,i}\right)\right) \tag{3}$$

A similar method can be applied to the population liquid, population land, and individual land ED calculations. The main time parameter influence for the TED is the year to second CF used to convert the annual nuclide release rate to determine the radionuclide water concentrations. Depending on the radionuclides dominant pathways, the individual liquid ED ranged from -0.14% and -0.07% (Table C-1) and the individual land ED ranged -0.07% and 0.00% (Table C-2). The percent changes for the individual ED within the LADTAP and IRRIDOSE spreadsheets were approximately constant across the test cases for each radionuclide concluding that the only parameter update to influence the individual TED was the time conversion standardization. Tables 8 & 9 provide select nuclide ED comparisons from appendix tables C-1 & C-2 for reference.

Test case 2-5 compare the population ED changes due to the amended time build-up parameter for shoreline exposure which were all addressed in updates 1-3. This change is specific to the LADTAP spreadsheet and increases the population TED for build-up times greater than 40 years (post 1994). Select radionuclides were more influenced by the parameter updates due to greater sensitivity to the shoreline pathway (Table C-3). Provided as an example, La-138 experienced the greatest percent increase for test case 2 (42.90%) with the shoreline exposure dose making up 90.21% of the nuclide ED (Table 10).

Because test case 3 approximates zero aquatic animal ingestion, leaving only the external dose pathways and allowing shoreline exposure dose to contribute more to the TED, the population liquid TED experienced a greater percent change in test case 3 than in test cases 2, 4, & 5. Test case 3 also showcases the impact of updating the maximum vegetable and leafy vegetable land production values (updated with the annual site-specific land and water use) within the IRRIDOSE spreadsheet. This update directly affects the area calculations which establish limits for the maximum amount of harvested vegetable and leafy vegetables within the irrigated area of production. For radionuclides insensitive to the vegetable consumption pathway, minimal change was noted from Version 2013 to 2017 which included: Na-24, K-43, Cu-64, Ta-180, & Am-237.

Test Case 5 was included to show that the population calculations within the IRRIDOSE spreadsheet experienced no significant changes. A full list comparison of population nuclide ED due to the irrigation pathway can be found in Table C-4.

Table 1. LADTAP XL© SQAP Test Cases – LADTAP Spreadsheet Input

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5
Measured River Flow Rate (Hwy 301) (cfs):	10000	4000	20000	12000	4000
Flow Rate at Beaufort-Jasper-Chelsea (cfs):	10000	5600	25000	14000	4000
Flow rate at Beaufort-Jasper-Purrysburg (cfs):	10000	5600	25000	14000	4000
Flow Rate at Port Wentworth (cfs):	10000	5040	28000	16000	4000
Flow Rate at the Estuary (cfs):	10000	7000	30000	16000	4000
Annual Max. Ind. Shoreline Usage (hr):	23	23	23	23	23
Annual Max. Ind. Swimming Usage (hr):	8.9	8.9	8.9	8.9	8.9
Annual Max. Ind. Boating Usage (hr):	21	21	21	21	21
Ind. Fish Usage (Avg, Max,value) (kg/yr):	19	9	0	19	19
Ind. Water Usage (Avg, Max, value) (L/yr):	370	370	730	730	730
Recreation Transport Time (MEI) (d):	1	1	1	1	1
Water Transport Time (MEI) (d):	1.5	1.5	1.5	1.5	1.5
Fish/Invertebrate Transport Time (MEI) (d):	2	2	2	2	2
Beaufort-Jasper Population (pers):	75000	75000	75000	75000	75000
Beaufort-Jasper-Purrysburg Population (pers):	10000	75000	75000	75000	75000
Port Wentworth Population (pers):	10000	10000	10000	10000	10000
50-Mile Population (pers):	620000	620000	620000	620000	620000
BJ/PW Travel Time (d):	4	4	4	4	4
Pop. Water Usage (Avg, Max, value) (L/yr):	337	730	337	730	337
Pop. Fish Usage (Avg, Max, value) (kg/yr):	9	19	0	9	9
Pop. Invert Usage (Avg, Max, value) (kg/yr):	2	8	0	2	2
Annual Sport Fish Harvest (edible) (kg/yr):	35000	35000	35000	35000	35000
Annual Com Fish Harvest (edible) (kg/yr):	2700	2700	2700	2700	2700
Annual Invertebrate Harvest (edible) (kg/yr):	390000	390000	390000	390000	390000
Sport Fish Transport Time (d):	10	10	10	10	10
Commercial/Invertebrate Transport Time (d):	13	13	13	13	13
Estuary Dilution Factor:	3	3	3	3	3
Population Shoreline Usage (pers-hr):	960000	960000	960000	960000	960000
Population Swimming Usage (pers-hr):	160000	160000	160000	160000	160000
Population Boating Usage (pers-hr):	1100000	1100000	1100000	1100000	1100000
Assessment year/Build-up Time (yr):	1994/40	2014/60	2054/100	2014/60	2054/100
Source Term (Ci/yr):	1 Ci for each rad	1 Ci for each rad	1 Ci for each rad	1 Ci for each rad	1 Ci for each rad

Table 2. LADTAP XL© SQAP Test Cases –IRRIDOSE Spreadsheet Input

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5
50Mile Total Vegetable Production (kg/yr):	4250000	4250000	10000	4250000	100000
50Mile Total Leafy Veg Production (kg/yr):	1060000	1060000	10000	1060000	100000
Irrigated land area (acres):	1000	1000	1000	1000	1000
Pop dose determined by:	area	area	area	area	pop
River transit time (d):	1	1	1	2	2
Irrigation rate (L/m^2d):	3.4	4.4	5.4	3.6	3.6
Weathering removal constant (1/d):	0.0495	0.0495	0.0495	0.0495	0.0495
Crop exposure time (d):	30	30	30	70	70
Grass exposure time (d):	30	30	30	30	30
Vegetable crop yield (kg/m^2):	2	2	2	2.2	2.2
Pasture grass yield(kg/m^2):	2	2	2	0.7	0.7
Milk production yield (L/m^2):	0.34	0.34	0.34	0.34	0.34
Meat production yield (kg/m^2):	0.01	0.01	0.01	0.01	0.01
Surface density of soil (kg/m^2):	240	240	240	240	240
Pasture grass hold-up time (d):	0	0	0	0	0
Veg transport time (individual) (d):	14	1	14	1	1
Veg transport time (population) (d):	14	1	14	6	6
Milk transport time (d):	3	1	3	3	3
Meat transport time (d):	6	1	6	6	6
Fraction of fodder from irrigated field:	1	1	1	1	1
Cattle consumption rate of fodder					
Beef (kg/d):	50	50	50	36	36
Milk (kg/d):	50	50	50	52	52
Fraction of water from Savannah River:	1	1	1	1	1
Cattle consumption rate of water					
Beef (kg/d):	50	50	50	28	28
Milk (kg/d):	60	60	60	50	50
Individual consumption rates					
Veg (kg/yr):	276	200	276	276	276
Leafy Veg (kg/yr):	43	20	43	43	43
Meat (kg/yr):	81	50	81	81	81
Milk (L/yr):	230	200	230	230	230
Population consumption rates					
Veg (kg/yr):	163	10	163	163	163
Leafy Veg (kg/yr):	21	10	21	21	21
Meat (kg/yr):	43	10	43	43	43
Milk (L/yr):	120	10	120	120	120
Fractional retention on leaves:	0.25	0.25	0.25	0.25	0.25

Table 3. SQAP Test Case 1 – Time Parameter Standardized to 365.25 days/yr

	Comparison of LADTAP TED			**Comparison of IRRIDOSE TED**			**Comparison of Land and Water TED**		
	V.2013	V.2017	%change	V.2013	V.2017	%change	V.2013	V.2017	%change
Individual (mrem)	1.64E+01	1.64E+01	**-0.07%**	2.08E+01	2.08E+01	**-0.06%**	3.72E+01	3.72E+01	**-0.06%**
Population (person-rem)	1.78E+03	1.78E+03	**-0.07%**	3.35E+02	3.35E+02	**-0.06%**	2.12E+03	2.12E+03	**-0.07%**

Table 4. SQAP Test Case 2 – Effective Flow Rate 4,000 cfs, Time Build-up Parameter 60 years

	Comparison of LADTAP TED			**Comparison of IRRIDOSE TED**			**Comparison of Land and Water TED**		
	V.2013	V.2017	%change	V.2013	V.2017	%change	V.2013	V.2017	%change
Individual (mrem)	2.39E+01	2.39E+01	**-0.07%**	5.03E+01	5.03E+01	**-0.05%**	7.42E+01	7.42E+01	**-0.06%**
Population (person-rem)	3.94E+03	3.95E+03	**0.18%**	1.16E+03	1.16E+03	**-0.05%**	5.10E+03	5.11E+03	**0.13%**

Table 5. SQAP Test Case 3 – Effective Flow Rate 20,000 cfs, Time Build-up Parameter 100 years, Zero Aquatic Animal Consumption, Maximum Vegetable Production 10,000 kg/yr

	Comparison of LADTAP TED			**Comparison of IRRIDOSE TED**			**Comparison of Land and Water TED**		
	V.2013	V.2017	%change	V.2013	V.2017	%change	V.2013	V.2017	%change
Individual (mrem)	3.28E+00	3.28E+00	**-0.07%**	2.00E+01	2.00E+01	**-0.05%**	2.33E+01	2.32E+01	**-0.05%**
Population (person-rem)	1.82E+02	1.87E+02	**3.09%**	3.17E+02	5.00E+00	**-98.42%**	4.98E+02	1.92E+02	**-61.43%**

Table 6. SQAP Test Case 4 – Effective Flow Rate 12,000 cfs, Time Build-up Parameter 60 years

	Comparison of LADTAP TED			**Comparison of IRRIDOSE TED**			**Comparison of Land and Water TED**		
	V.2013	V.2017	%change	V.2013	V.2017	%change	V.2013	V.2017	%change
Individual (mrem)	1.62E+01	1.62E+01	**-0.07%**	2.22E+01	2.22E+01	**-0.06%**	3.84E+01	3.84E+01	**-0.06%**
Population (person-rem)	1.64E+03	1.64E+03	**0.13%**	3.52E+02	3.52E+02	**-0.06%**	1.99E+03	1.99E+03	**0.10%**

Table 7. SQAP Test Case 5 – Effective Flow Rate 4,000 cfs, Time Build-up Parameter 100 years, IRRIDOSE Population Dose Determined by Population Calculations

	Comparison of LADTAP TED			**Comparison of IRRIDOSE TED**			**Comparison of Land and Water TED**		
	V.2013	V.2017	%change	V.2013	V.2017	%change	V.2013	V.2017	%change
Individual (mrem)	4.91E+01	4.91E+01	**-0.07%**	7.40E+01	7.40E+01	**-0.05%**	1.23E+02	1.23E+02	**-0.06%**
Population (person-rem)	4.91E+03	4.93E+03	**0.52%**	1.31E+03	1.31E+03	**-0.05%**	6.22E+03	6.25E+03	**0.40%**

Table 8. SQAP Test Cases 1-5 Select Radionuclide Effective Dose (ED) Individual - LADTAP

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**
H-3	3.39E-06	3.38E-06	**-0.07%**	8.25E-06	8.24E-06	**-0.07%**	3.18E-06	3.17E-06	**-0.07%**	5.43E-06	5.43E-06	**-0.07%**	1.63E-05	1.63E-05	**-0.07%**
Sr-90	6.84E-03	6.83E-03	**-0.07%**	1.63E-02	1.63E-02	**-0.07%**	5.81E-03	5.81E-03	**-0.07%**	1.03E-02	1.03E-02	**-0.07%**	3.11E-02	3.11E-02	**-0.07%**
I-129	4.73E-02	4.72E-02	**-0.07%**	8.07E-02	8.07E-02	**-0.07%**	1.85E-02	1.85E-02	**-0.07%**	5.45E-02	5.44E-02	**-0.07%**	1.64E-01	1.64E-01	**-0.07%**
Cs-137	3.19E-01	3.18E-01	**-0.07%**	3.85E-01	3.85E-01	**-0.07%**	3.98E-03	3.98E-03	**-0.09%**	2.68E-01	2.68E-01	**-0.07%**	8.05E-01	8.04E-01	**-0.07%**
Pu-239	1.12E-01	1.12E-01	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	4.36E-02	4.35E-02	**-0.07%**	1.29E-01	1.29E-01	**-0.07%**	3.88E-01	3.88E-01	**-0.07%**

Table 9. SQAP Test Cases 1-5 Select Radionuclide Effective Dose (ED) for Individual - IRRIDOSE

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**	**V.2013**	**V.2017**	**% change**
H-3	5.48E-06	5.48E-06	**-0.07%**	1.02E-05	1.02E-05	**-0.07%**	2.74E-06	2.74E-06	**-0.07%**	4.57E-06	4.56E-06	**-0.07%**	1.37E-05	1.37E-05	**-0.07%**
Sr-90	1.17E-01	1.17E-01	**-0.04%**	3.07E-01	3.07E-01	**-0.04%**	1.24E-01	1.23E-01	**-0.05%**	1.27E-01	1.27E-01	**-0.05%**	4.32E-01	4.32E-01	**-0.05%**
I-129	1.97E-01	1.97E-01	**-0.05%**	5.16E-01	5.16E-01	**-0.04%**	2.21E-01	2.21E-01	**-0.03%**	2.53E-01	2.53E-01	**-0.05%**	9.06E-01	9.06E-01	**-0.04%**
Cs-137	2.00E-02	2.00E-02	**-0.06%**	4.61E-02	4.61E-02	**-0.06%**	1.66E-02	1.66E-02	**-0.06%**	2.56E-02	2.56E-02	**-0.06%**	7.84E-02	7.83E-02	**-0.06%**
Pu-239	2.53E-01	2.53E-01	**-0.07%**	5.65E-01	5.64E-01	**-0.07%**	2.01E-01	2.01E-01	**-0.07%**	2.54E-01	2.54E-01	**-0.07%**	7.64E-01	7.63E-01	**-0.07%**

Table 10. SQAP La-138 Test Cases 2 Radionuclide Effective Dose (ED) for Population by Pathway (person-rem)

	Sport Fish Ingestion	**Commercial Fish Ingestion**	**Invertebrate Ingestion**	**Shoreline Exposure**	**Swimming Exposure**	**Boating Exposure**	**BJC Water Ingestion**	**BJP Water Ingestion**	**PW Water Ingestion**	**All Pathway Dose**
2013	1.84E-03	1.42E-04	1.05E-02	8.11E-01	7.52E-05	2.58E-04	5.55E-02	5.55E-02	8.22E-03	9.43E-01
2017	1.84E-03	1.42E-04	1.05E-02	1.22E+00	7.51E-05	2.58E-04	5.55E-02	5.55E-02	8.22E-03	1.35E+00
%Change	-0.07%	-0.07%	-0.07%	**49.90%**	-0.14%	-0.14%	-0.07%	-0.07%	-0.07%	**42.90%**
2017 Pathway Sensitivity	0.14%	0.01%	0.78%	**90.21%**	0.01%	0.02%	4.11%	4.11%	0.61%	

References:

Jannik, G.T., Stone, D.K., and Dixon, K.L. (2013). LADTAP XL© Version 2013: A Spreadsheet for Estimating Dose Results from Aqueous Releases. SRNL-STI-2013-00697. Savannah River National Laboratory. Aiken, SC.

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APPENDIX A

OSR 19-323 (Rev. 05-31-2016)

Error Notification

ORIGINATION (Originator completes within 2 working days of Discovery Date in block 3)		
1. Error Notification No. B-SEN-A-00001	2. Source of Error Time Build-up Parameter and Max. Production Values	3. Discovery Date 02/02/2017
4. Affected Document(s) SRNL-STI-2013-00697	5. Release/Revision/Version 2013	
6. Title LADTAP XL Version 2013		
7. Error Description (attach any supporting documentation) SRS uses the environmental dosimetry code LADTAP XL Version 2013 (SRNL-STI-2013-00697) to calculate receptor dose for radiological liquid effluents to the Savannah River. LADTAP XL is two Excel spreadsheets that implement dose determining calculations for direct (LADTAP) and indirect (IRRIDOSE) use of the Savannah River based on user-defined input. It was discovered that the user-defined time build-up cell within the LADTAP spreadsheet was not being referenced in the population shoreline exposure dose calculations and instead, a constant 40 year time frame was being used. This error dates back to Version 2010 when the time build-up parameter was initially updated to represent the operational life of SRS. A second error was noted in the IRRIDOSE spreadsheet; the maximum vegetable and leafy vegetable production values were not updated for the 2015 Annual Environmental Report.		
8. Originator/Title Kelsey Minter / Environmental Dosimetry Limited Service Employee	9. Date SME Notified 02/02/2017	
APPLICABILITY (SME completes within 5 working days of the date in block 9)		
10. Applicability/Potential Impact Determination (include identification of affected facilities/organizations; list STAR records created in block 16) These errors are applicable to the population dose calculations in LADTAP XL Version 2013. They have a minor impact on the overall doses that have been previously reported in the Annual Site Environmental Report.		
11. Recommendation (error avoidance and/or remedial action) Revise the applicable LADTAP population dose spreadsheet equations and input page.		
12. Subject Matter Expert/Title Tim Jannik / Principal Technical Advisor	13. Date 02/09/2017	
14. SME Immediate Manager/Title Jack Mayer / Manager, Environmental Sciences and Biotechnology	15. Date 02/09/2017	
STAR Records Created		
16. List all STAR Records Created 2017-CTS-001733		

APPENDIX B

Computer Program Modification Tracker

Part I – Initiate/Approve			
Title LADTAP XL Version 2017			Computer Program Modification Tracker No. Q-CMT-A-00022
System Affected N/A	Work Request/DCP/DCF/Project/MT No. N/A		Required Completion Date 03/17/2017
Originator (Print) Kelsey Minter	Address 999-W	Phone 803-819-5049	Department ES & BT

Reason for Requested Change

1) Update referenced time build-up cell within population shoreline exposure dose calculations
2) Standardize time conversion factor
3) maximum vegetable and leafy vegetable production input
4) Input layout upgraded

Description of Requested Change

Update the build-up time coefficient within the population shoreline exposure dose calculations to reference a user-defined 'assessment year' input cell. All associated calculations will be updated to convert the user-defined assessment year into the number of years the plant has been active (i.e. build-up time). All time conversions will be standardized to approximate 1 year to equal 365.25 days. Input layout will also be updated and two additional input cells will be added to the IRRIDOSE spreadsheet.

Design Authority (Print) K.M. Minter	Signature	Date
Approval (Print) G.T. Jannik	Signature	Date

Part II – Analysis

Affected CIs	Revision/Generation
LADTAP and IRRIDOSE input label and layout	Version 2017
LADTAP Individual and Population Shoreline Dose Calculations	Version 2017
IRRIDOSE Time in Soil Calculations	Version 2017
LADTAP and IRRIDOSE all pathways dose calculations	Version 2017
IRRIDOSE 'production within irrigated area' calculations	Version 2017

Analysis By (Print) K.M. Minter	Signature	Date

Part III – Design

Design Reference Documents

SRNL-STI-2013-00697

Design Complete – Design Agency (Print) G.T. Jannik	Signature	Date
Design Reviewer (Print) G.T. Jannik	Signature	Date
Design Reviewer (Print) Brooke Stagich	Signature	Date
FOSC (Print)	Signature	Date

Computer Program Modification Tracker (Con't)

Part IV – Implement		
New Cls N/A		
Test References SRNL-L3200-2017-00030		
Implementation Complete – Design Agency (Print) K.M.Minter	Signature	Date
Reviewer (Print) G.T.Jannik	Signature	Date
Reviewer (Print) B.H.Stagich	Signature	Date
Approval – Load/Test (Print) N/A	Signature	Date
Approval – Load/Test (Print) N/A	Signature	Date
Part V – Load and Test		
Load Confirmed (Print) N/A	Signature	Date
Load/Tested – Design Agency (Print) N/A	Signature	Date
Accepted – Design Authority (Print) N/A	Signature	Date
Accepted – Owner (Print) N/A	Signature	Date
Part VI – Revise the Baseline		
Computer Program Baselined – Design Agency (Print) N/A	Signature	Date
Software Document Baselined – Design Agency (Print) N/A	Signature	Date
Part VII – Rejection		
Rejection – Owner (Print) N/A	Signature	Date
Design Agency (Print) N/A	Signature	Date
Part VIII – Additional Information		

APPENDIX C

Table C-1. SQAP Test Cases 1-5 Radionuclide Effective Dose (ED) Individual - LADTAP

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
H-3	3.39E-06	3.38E-06	**-0.07%**	8.25E-06	8.24E-06	**-0.07%**	3.18E-06	3.17E-06	**-0.07%**	5.43E-06	5.43E-06	**-0.07%**	1.63E-05	1.63E-05	**-0.07%**
Be-7	3.38E-05	3.37E-05	**-0.07%**	4.93E-05	4.93E-05	**-0.07%**	6.09E-06	6.08E-06	**-0.08%**	3.24E-05	3.24E-05	**-0.07%**	9.72E-05	9.71E-05	**-0.07%**
Be-10	1.49E-03	1.49E-03	**-0.07%**	2.14E-03	2.14E-03	**-0.07%**	2.66E-04	2.66E-04	**-0.07%**	1.45E-03	1.45E-03	**-0.07%**	4.40E-03	4.40E-03	**-0.07%**
C-14	1.12E-04	1.12E-04	**-0.07%**	2.61E-04	2.60E-04	**-0.07%**	9.58E-05	9.58E-05	**-0.07%**	1.72E-04	1.72E-04	**-0.07%**	5.17E-04	5.16E-04	**-0.07%**
Na-22	4.25E-03	4.25E-03	**-0.09%**	7.58E-03	7.58E-03	**-0.10%**	1.26E-03	1.26E-03	**-0.10%**	4.03E-03	4.02E-03	**-0.09%**	1.21E-02	1.21E-02	**-0.09%**
Na-24	5.59E-05	5.59E-05	**-0.07%**	9.33E-05	9.33E-05	**-0.08%**	1.80E-05	1.80E-05	**-0.08%**	5.94E-05	5.94E-05	**-0.07%**	1.78E-04	1.78E-04	**-0.07%**
Al-26	1.97E-02	1.97E-02	**-0.07%**	6.83E-02	6.82E-02	**-0.07%**	2.21E-02	2.21E-02	**-0.07%**	2.41E-02	2.41E-02	**-0.07%**	1.15E-01	1.15E-01	**-0.07%**
P-32	3.39E+00	3.39E+00	**-0.07%**	4.02E+00	4.01E+00	**-0.07%**	4.77E-04	4.77E-04	**-0.07%**	2.83E+00	2.82E+00	**-0.07%**	8.48E+00	8.47E+00	**-0.07%**
Si-32	2.48E-04	2.48E-04	**-0.07%**	4.56E-04	4.55E-04	**-0.07%**	1.21E-04	1.21E-04	**-0.07%**	3.06E-04	3.06E-04	**-0.07%**	9.20E-04	9.19E-04	**-0.07%**
S-35	1.10E-03	1.10E-03	**-0.07%**	1.34E-03	1.34E-03	**-0.07%**	2.60E-05	2.60E-05	**-0.07%**	9.42E-04	9.41E-04	**-0.07%**	2.83E-03	2.82E-03	**-0.07%**
Cl-36	7.26E-04	7.25E-04	**-0.07%**	1.31E-03	1.31E-03	**-0.07%**	2.84E-04	2.84E-04	**-0.07%**	7.91E-04	7.91E-04	**-0.07%**	2.57E-03	2.56E-03	**-0.07%**
K-40	2.10E-01	2.10E-01	**-0.07%**	2.54E-01	2.53E-01	**-0.07%**	3.01E-03	3.01E-03	**-0.07%**	1.76E-01	1.76E-01	**-0.07%**	5.33E-01	5.32E-01	**-0.07%**
K-43	1.83E-03	1.83E-03	**-0.07%**	2.19E-03	2.19E-03	**-0.07%**	1.66E-05	1.66E-05	**-0.07%**	1.54E-03	1.54E-03	**-0.07%**	4.62E-03	4.61E-03	**-0.07%**
Ca-41	7.33E-05	7.33E-05	**-0.07%**	1.47E-04	1.46E-04	**-0.07%**	4.48E-05	4.47E-05	**-0.07%**	9.79E-05	9.78E-05	**-0.07%**	2.94E-04	2.93E-04	**-0.07%**
Ca-45	2.56E-04	2.56E-04	**-0.07%**	5.11E-04	5.11E-04	**-0.07%**	1.56E-04	1.56E-04	**-0.07%**	3.42E-04	3.41E-04	**-0.07%**	1.02E-03	1.02E-03	**-0.07%**
Ca-47	3.98E-04	3.98E-04	**-0.07%**	8.07E-04	8.06E-04	**-0.07%**	2.49E-04	2.49E-04	**-0.07%**	5.34E-04	5.34E-04	**-0.07%**	1.60E-03	1.60E-03	**-0.07%**
Ti-44	1.29E-02	1.29E-02	**-0.07%**	1.83E-02	1.83E-02	**-0.07%**	1.75E-03	1.75E-03	**-0.08%**	1.19E-02	1.19E-02	**-0.07%**	3.65E-02	3.64E-02	**-0.07%**
V-49	2.31E-05	2.31E-05	**-0.07%**	3.24E-05	3.24E-05	**-0.07%**	3.81E-06	3.81E-06	**-0.07%**	2.24E-05	2.24E-05	**-0.07%**	6.72E-05	6.71E-05	**-0.07%**
Cr-51	2.31E-05	2.31E-05	**-0.07%**	3.80E-05	3.80E-05	**-0.07%**	7.65E-06	7.64E-06	**-0.07%**	2.53E-05	2.53E-05	**-0.07%**	7.59E-05	7.58E-05	**-0.07%**
Mn-53	8.46E-05	8.45E-05	**-0.07%**	1.08E-04	1.08E-04	**-0.07%**	6.26E-06	6.26E-06	**-0.07%**	7.56E-05	7.56E-05	**-0.07%**	2.27E-04	2.27E-04	**-0.07%**
Mn-54	1.98E-03	1.98E-03	**-0.07%**	2.75E-03	2.75E-03	**-0.08%**	2.20E-04	2.19E-04	**-0.10%**	1.76E-03	1.76E-03	**-0.07%**	5.28E-03	5.28E-03	**-0.07%**
Fe-55	8.21E-04	8.20E-04	**-0.07%**	1.08E-03	1.08E-03	**-0.07%**	8.32E-05	8.32E-05	**-0.07%**	7.52E-04	7.52E-04	**-0.07%**	2.26E-03	2.26E-03	**-0.07%**
Fe-60	2.21E-01	2.21E-01	**-0.07%**	2.91E-01	2.91E-01	**-0.07%**	2.24E-02	2.24E-02	**-0.07%**	2.02E-01	2.02E-01	**-0.07%**	6.07E-01	6.07E-01	**-0.07%**
Co-58	7.92E-04	7.92E-04	**-0.07%**	1.20E-03	1.20E-03	**-0.08%**	1.74E-04	1.74E-04	**-0.08%**	7.84E-04	7.83E-04	**-0.07%**	2.35E-03	2.35E-03	**-0.07%**
Co-60	7.15E-03	7.14E-03	**-0.10%**	1.36E-02	1.36E-02	**-0.11%**	2.35E-03	2.35E-03	**-0.11%**	6.65E-03	6.65E-03	**-0.09%**	2.00E-02	1.99E-02	**-0.09%**
Ni-59	2.55E-05	2.54E-05	**-0.07%**	4.65E-05	4.64E-05	**-0.07%**	1.22E-05	1.22E-05	**-0.07%**	3.12E-05	3.11E-05	**-0.07%**	9.37E-05	9.37E-05	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ni-63	6.31E-05	6.30E-05	**-0.07%**	1.15E-04	1.15E-04	**-0.07%**	2.99E-05	2.99E-05	**-0.07%**	7.72E-05	7.71E-05	**-0.07%**	2.32E-04	2.31E-04	**-0.07%**
Cu-64	2.45E-05	2.45E-05	**-0.07%**	3.38E-05	3.38E-05	**-0.07%**	3.45E-06	3.45E-06	**-0.07%**	2.32E-05	2.32E-05	**-0.07%**	6.97E-05	6.96E-05	**-0.07%**
Zn-65	1.28E-01	1.28E-01	**-0.07%**	1.52E-01	1.52E-01	**-0.07%**	7.64E-04	7.63E-04	**-0.07%**	1.07E-01	1.07E-01	**-0.07%**	3.21E-01	3.21E-01	**-0.07%**
Ge-68	5.32E-02	5.32E-02	**-0.07%**	6.33E-02	6.33E-02	**-0.07%**	2.55E-04	2.54E-04	**-0.07%**	4.45E-02	4.45E-02	**-0.07%**	1.34E-01	1.34E-01	**-0.07%**
Se-75	1.57E-01	1.57E-01	**-0.07%**	1.87E-01	1.86E-01	**-0.07%**	5.17E-04	5.17E-04	**-0.07%**	1.31E-01	1.31E-01	**-0.07%**	3.94E-01	3.93E-01	**-0.07%**
Se-79	2.22E-01	2.22E-01	**-0.07%**	2.64E-01	2.63E-01	**-0.07%**	7.08E-04	7.07E-04	**-0.07%**	1.85E-01	1.85E-01	**-0.07%**	5.56E-01	5.56E-01	**-0.07%**
Rb-87	7.94E-02	7.93E-02	**-0.07%**	9.44E-02	9.44E-02	**-0.07%**	3.11E-04	3.10E-04	**-0.07%**	6.64E-02	6.64E-02	**-0.07%**	1.99E-01	1.99E-01	**-0.07%**
Sr-89	6.25E-04	6.24E-04	**-0.07%**	1.46E-03	1.46E-03	**-0.07%**	5.36E-04	5.36E-04	**-0.07%**	9.60E-04	9.59E-04	**-0.07%**	2.88E-03	2.88E-03	**-0.07%**
Sr-90	6.84E-03	6.83E-03	**-0.07%**	1.63E-02	1.63E-02	**-0.07%**	5.81E-03	5.81E-03	**-0.07%**	1.03E-02	1.03E-02	**-0.07%**	3.11E-02	3.11E-02	**-0.07%**
Y-90	1.08E-03	1.08E-03	**-0.07%**	1.78E-03	1.78E-03	**-0.07%**	3.79E-04	3.79E-04	**-0.07%**	1.21E-03	1.21E-03	**-0.07%**	3.63E-03	3.63E-03	**-0.07%**
Y-91	1.50E-03	1.50E-03	**-0.07%**	2.43E-03	2.43E-03	**-0.07%**	4.87E-04	4.87E-04	**-0.07%**	1.65E-03	1.65E-03	**-0.07%**	4.95E-03	4.95E-03	**-0.07%**
Mo-93	5.51E-04	5.51E-04	**-0.07%**	1.35E-03	1.35E-03	**-0.07%**	5.05E-04	5.04E-04	**-0.07%**	8.58E-04	8.58E-04	**-0.07%**	2.64E-03	2.64E-03	**-0.07%**
Mo-99	8.87E-05	8.87E-05	**-0.07%**	2.13E-04	2.13E-04	**-0.07%**	8.04E-05	8.03E-05	**-0.07%**	1.40E-04	1.40E-04	**-0.07%**	4.19E-04	4.19E-04	**-0.07%**
Nb-93m	4.50E-04	4.49E-04	**-0.07%**	5.72E-04	5.72E-04	**-0.07%**	2.83E-05	2.83E-05	**-0.07%**	3.97E-04	3.97E-04	**-0.07%**	1.19E-03	1.19E-03	**-0.07%**
Nb-94	1.59E-02	1.59E-02	**-0.07%**	4.56E-02	4.56E-02	**-0.07%**	1.32E-02	1.32E-02	**-0.07%**	1.78E-02	1.78E-02	**-0.07%**	7.90E-02	7.89E-02	**-0.07%**
Nb-95	1.83E-03	1.83E-03	**-0.07%**	2.34E-03	2.34E-03	**-0.07%**	1.20E-04	1.20E-04	**-0.07%**	1.62E-03	1.62E-03	**-0.07%**	4.85E-03	4.85E-03	**-0.07%**
Zr-93	3.26E-04	3.26E-04	**-0.07%**	5.88E-04	5.88E-04	**-0.07%**	1.51E-04	1.51E-04	**-0.07%**	3.96E-04	3.96E-04	**-0.07%**	1.19E-03	1.19E-03	**-0.07%**
Zr-95	4.36E-04	4.36E-04	**-0.07%**	8.09E-04	8.08E-04	**-0.08%**	2.04E-04	2.03E-04	**-0.07%**	5.17E-04	5.17E-04	**-0.07%**	1.55E-03	1.55E-03	**-0.07%**
Tc-96	3.35E-04	3.35E-04	**-0.07%**	6.31E-04	6.30E-04	**-0.07%**	1.70E-04	1.70E-04	**-0.07%**	4.14E-04	4.13E-04	**-0.07%**	1.24E-03	1.24E-03	**-0.07%**
Tc-97	6.11E-05	6.10E-05	**-0.07%**	1.73E-04	1.73E-04	**-0.07%**	5.39E-05	5.38E-05	**-0.07%**	7.59E-05	7.58E-05	**-0.07%**	3.07E-04	3.06E-04	**-0.07%**
Tc-98	1.01E-02	1.01E-02	**-0.07%**	3.63E-02	3.62E-02	**-0.07%**	1.20E-02	1.20E-02	**-0.07%**	1.26E-02	1.26E-02	**-0.07%**	6.09E-02	6.09E-02	**-0.07%**
Tc-99	2.80E-04	2.80E-04	**-0.07%**	5.14E-04	5.14E-04	**-0.07%**	1.37E-04	1.37E-04	**-0.07%**	3.45E-04	3.45E-04	**-0.07%**	1.04E-03	1.04E-03	**-0.07%**
Ru-97	7.37E-05	7.36E-05	**-0.07%**	1.16E-04	1.16E-04	**-0.07%**	2.09E-05	2.09E-05	**-0.07%**	7.83E-05	7.82E-05	**-0.07%**	2.35E-04	2.35E-04	**-0.07%**
Ru-103	5.48E-04	5.47E-04	**-0.07%**	8.52E-04	8.51E-04	**-0.07%**	1.46E-04	1.45E-04	**-0.07%**	5.70E-04	5.70E-04	**-0.07%**	1.71E-03	1.71E-03	**-0.07%**
Ru-106	5.60E-03	5.60E-03	**-0.07%**	8.56E-03	8.56E-03	**-0.07%**	1.45E-03	1.45E-03	**-0.07%**	5.86E-03	5.85E-03	**-0.07%**	1.76E-02	1.76E-02	**-0.07%**
Pd-107	1.23E-05	1.23E-05	**-0.07%**	2.52E-05	2.52E-05	**-0.07%**	8.00E-06	7.99E-06	**-0.07%**	1.68E-05	1.68E-05	**-0.07%**	5.04E-05	5.04E-05	**-0.07%**
Ag-108m	1.34E-02	1.33E-02	**-0.07%**	4.23E-02	4.23E-02	**-0.07%**	1.28E-02	1.28E-02	**-0.07%**	1.56E-02	1.56E-02	**-0.07%**	7.02E-02	7.01E-02	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ag-110m	4.05E-03	4.05E-03	**-0.08%**	6.10E-03	6.10E-03	**-0.08%**	7.60E-04	7.59E-04	**-0.09%**	3.81E-03	3.81E-03	**-0.08%**	1.14E-02	1.14E-02	**-0.08%**
Cd-113m	4.44E-02	4.44E-02	**-0.07%**	5.78E-02	5.77E-02	**-0.07%**	3.89E-03	3.89E-03	**-0.07%**	4.02E-02	4.02E-02	**-0.07%**	1.21E-01	1.20E-01	**-0.07%**
Cd-115m	7.29E-03	7.29E-03	**-0.07%**	9.50E-03	9.49E-03	**-0.07%**	6.44E-04	6.44E-04	**-0.07%**	6.61E-03	6.60E-03	**-0.07%**	1.98E-02	1.98E-02	**-0.07%**
In-115	2.80E+00	2.80E+00	**-0.07%**	3.32E+00	3.32E+00	**-0.07%**	5.37E-03	5.37E-03	**-0.07%**	2.34E+00	2.34E+00	**-0.07%**	7.01E+00	7.01E+00	**-0.07%**
Sb-122	6.48E-04	6.47E-04	**-0.07%**	1.09E-03	1.09E-03	**-0.07%**	2.39E-04	2.39E-04	**-0.07%**	7.36E-04	7.35E-04	**-0.07%**	2.21E-03	2.21E-03	**-0.07%**
Sb-124	1.54E-03	1.54E-03	**-0.07%**	2.60E-03	2.59E-03	**-0.07%**	5.39E-04	5.39E-04	**-0.07%**	1.70E-03	1.70E-03	**-0.07%**	5.09E-03	5.09E-03	**-0.07%**
Sb-125	9.40E-04	9.39E-04	**-0.09%**	1.79E-03	1.79E-03	**-0.10%**	3.66E-04	3.65E-04	**-0.10%**	9.66E-04	9.65E-04	**-0.09%**	2.90E-03	2.89E-03	**-0.09%**
Te-123	1.99E-03	1.99E-03	**-0.07%**	2.65E-03	2.65E-03	**-0.07%**	2.26E-04	2.25E-04	**-0.07%**	1.84E-03	1.84E-03	**-0.07%**	5.53E-03	5.52E-03	**-0.07%**
Te-125m	1.59E-03	1.59E-03	**-0.07%**	2.13E-03	2.13E-03	**-0.07%**	1.82E-04	1.82E-04	**-0.07%**	1.47E-03	1.47E-03	**-0.07%**	4.42E-03	4.42E-03	**-0.07%**
Sn-126	1.52E-01	1.52E-01	**-0.07%**	1.82E-01	1.82E-01	**-0.07%**	1.38E-03	1.38E-03	**-0.07%**	1.28E-01	1.28E-01	**-0.07%**	3.84E-01	3.84E-01	**-0.07%**
I-129	4.73E-02	4.72E-02	**-0.07%**	8.07E-02	8.07E-02	**-0.07%**	1.85E-02	1.85E-02	**-0.07%**	5.45E-02	5.44E-02	**-0.07%**	1.64E-01	1.64E-01	**-0.07%**
I-131	1.04E-02	1.04E-02	**-0.07%**	1.79E-02	1.79E-02	**-0.07%**	4.16E-03	4.16E-03	**-0.07%**	1.21E-02	1.21E-02	**-0.07%**	3.63E-02	3.63E-02	**-0.07%**
Cs-134	4.44E-01	4.44E-01	**-0.07%**	5.31E-01	5.31E-01	**-0.07%**	3.21E-03	3.21E-03	**-0.08%**	3.73E-01	3.72E-01	**-0.07%**	1.12E+00	1.12E+00	**-0.07%**
Cs-135	6.27E-02	6.27E-02	**-0.07%**	7.48E-02	7.48E-02	**-0.07%**	4.00E-04	3.99E-04	**-0.07%**	5.26E-02	5.26E-02	**-0.07%**	1.58E-01	1.58E-01	**-0.07%**
Cs-137	3.19E-01	3.18E-01	**-0.07%**	3.85E-01	3.85E-01	**-0.07%**	3.98E-03	3.98E-03	**-0.09%**	2.68E-01	2.68E-01	**-0.07%**	8.05E-01	8.04E-01	**-0.07%**
La-137	1.89E-04	1.89E-04	**-0.07%**	6.04E-04	6.03E-04	**-0.07%**	1.91E-04	1.91E-04	**-0.07%**	2.29E-04	2.29E-04	**-0.07%**	1.04E-03	1.04E-03	**-0.07%**
La-138	8.39E-03	8.38E-03	**-0.07%**	3.02E-02	3.01E-02	**-0.07%**	9.93E-03	9.92E-03	**-0.07%**	1.04E-02	1.04E-02	**-0.07%**	5.06E-02	5.06E-02	**-0.07%**
La-140	5.67E-04	5.67E-04	**-0.07%**	9.69E-04	9.69E-04	**-0.07%**	2.20E-04	2.20E-04	**-0.07%**	6.51E-04	6.51E-04	**-0.07%**	1.95E-03	1.95E-03	**-0.07%**
Ba-140	5.46E-04	5.45E-04	**-0.07%**	1.32E-03	1.32E-03	**-0.07%**	5.07E-04	5.07E-04	**-0.07%**	8.71E-04	8.70E-04	**-0.07%**	2.61E-03	2.61E-03	**-0.07%**
Ce-141	3.31E-04	3.31E-04	**-0.07%**	5.86E-04	5.85E-04	**-0.07%**	1.44E-04	1.44E-04	**-0.07%**	3.94E-04	3.94E-04	**-0.07%**	1.18E-03	1.18E-03	**-0.07%**
Ce-144	2.53E-03	2.53E-03	**-0.07%**	4.46E-03	4.46E-03	**-0.07%**	1.09E-03	1.09E-03	**-0.07%**	3.01E-03	3.00E-03	**-0.07%**	9.02E-03	9.01E-03	**-0.07%**
Sm-146	2.73E-02	2.73E-02	**-0.07%**	4.65E-02	4.64E-02	**-0.07%**	1.06E-02	1.06E-02	**-0.07%**	3.15E-02	3.14E-02	**-0.07%**	9.44E-02	9.43E-02	**-0.07%**
Sm-147	2.49E-02	2.49E-02	**-0.07%**	4.24E-02	4.24E-02	**-0.07%**	9.68E-03	9.67E-03	**-0.07%**	2.87E-02	2.87E-02	**-0.07%**	8.62E-02	8.61E-02	**-0.07%**
Sm-151	5.26E-05	5.26E-05	**-0.07%**	8.96E-05	8.95E-05	**-0.07%**	2.04E-05	2.04E-05	**-0.07%**	6.06E-05	6.06E-05	**-0.07%**	1.82E-04	1.82E-04	**-0.07%**
Pm-147	1.41E-04	1.41E-04	**-0.07%**	2.40E-04	2.40E-04	**-0.07%**	5.48E-05	5.48E-05	**-0.07%**	1.63E-04	1.63E-04	**-0.07%**	4.88E-04	4.88E-04	**-0.07%**
Eu-152	5.27E-03	5.26E-03	**-0.10%**	1.16E-02	1.16E-02	**-0.11%**	2.10E-03	2.10E-03	**-0.13%**	4.86E-03	4.86E-03	**-0.10%**	1.50E-02	1.49E-02	**-0.11%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Eu-154	5.49E-03	5.49E-03	**-0.09%**	1.04E-02	1.04E-02	**-0.11%**	1.66E-03	1.65E-03	**-0.12%**	4.97E-03	4.96E-03	**-0.10%**	1.50E-02	1.49E-02	**-0.10%**
Eu-155	5.96E-04	5.95E-04	**-0.08%**	8.81E-04	8.81E-04	**-0.08%**	1.01E-04	1.00E-04	**-0.09%**	5.53E-04	5.52E-04	**-0.08%**	1.66E-03	1.66E-03	**-0.08%**
Gd-152	2.07E-02	2.07E-02	**-0.07%**	3.53E-02	3.52E-02	**-0.07%**	8.04E-03	8.04E-03	**-0.07%**	2.39E-02	2.39E-02	**-0.07%**	7.16E-02	7.16E-02	**-0.07%**
Ho-166m	1.15E-02	1.15E-02	**-0.07%**	4.08E-02	4.08E-02	**-0.07%**	1.33E-02	1.33E-02	**-0.07%**	1.42E-02	1.42E-02	**-0.07%**	6.79E-02	6.79E-02	**-0.07%**
Lu-176	3.95E-03	3.95E-03	**-0.07%**	1.31E-02	1.31E-02	**-0.07%**	4.25E-03	4.24E-03	**-0.07%**	4.89E-03	4.88E-03	**-0.07%**	2.24E-02	2.24E-02	**-0.07%**
Ta-180	3.57E-06	3.57E-06	**-0.07%**	4.96E-06	4.96E-06	**-0.07%**	5.43E-07	5.42E-07	**-0.07%**	3.42E-06	3.42E-06	**-0.07%**	1.03E-05	1.02E-05	**-0.07%**
Hf-182	3.18E-02	3.18E-02	**-0.07%**	4.23E-02	4.23E-02	**-0.07%**	2.45E-03	2.45E-03	**-0.07%**	2.75E-02	2.75E-02	**-0.07%**	8.65E-02	8.65E-02	**-0.07%**
Re-186m	3.43E-03	3.43E-03	**-0.07%**	4.91E-03	4.90E-03	**-0.07%**	5.73E-04	5.73E-04	**-0.07%**	3.27E-03	3.27E-03	**-0.07%**	1.00E-02	1.00E-02	**-0.07%**
Re-187	7.23E-06	7.23E-06	**-0.07%**	9.90E-06	9.89E-06	**-0.07%**	9.97E-07	9.96E-07	**-0.07%**	6.85E-06	6.84E-06	**-0.07%**	2.05E-05	2.05E-05	**-0.07%**
Ir-192n	2.93E-04	2.93E-04	**-0.07%**	6.11E-04	6.11E-04	**-0.07%**	1.94E-04	1.94E-04	**-0.07%**	4.01E-04	4.00E-04	**-0.07%**	1.21E-03	1.21E-03	**-0.07%**
Pt-193	2.17E-05	2.17E-05	**-0.07%**	3.69E-05	3.68E-05	**-0.07%**	7.96E-06	7.95E-06	**-0.07%**	2.44E-05	2.44E-05	**-0.07%**	7.37E-05	7.37E-05	**-0.07%**
Hg-194	7.51E-02	7.51E-02	**-0.07%**	8.93E-02	8.92E-02	**-0.07%**	2.37E-04	2.37E-04	**-0.07%**	6.28E-02	6.28E-02	**-0.07%**	1.88E-01	1.88E-01	**-0.07%**
Hg-203	3.38E-02	3.38E-02	**-0.07%**	4.02E-02	4.02E-02	**-0.07%**	1.11E-04	1.11E-04	**-0.07%**	2.83E-02	2.82E-02	**-0.07%**	8.48E-02	8.47E-02	**-0.07%**
Pb-202	7.32E-03	7.31E-03	**-0.07%**	1.29E-02	1.29E-02	**-0.07%**	3.16E-03	3.16E-03	**-0.07%**	8.70E-03	8.69E-03	**-0.07%**	2.61E-02	2.61E-02	**-0.07%**
Pb-205	1.25E-04	1.24E-04	**-0.07%**	2.22E-04	2.22E-04	**-0.07%**	5.49E-05	5.48E-05	**-0.07%**	1.48E-04	1.48E-04	**-0.07%**	4.48E-04	4.47E-04	**-0.07%**
Pb-210	3.57E-01	3.57E-01	**-0.07%**	6.29E-01	6.28E-01	**-0.07%**	1.54E-01	1.54E-01	**-0.07%**	4.24E-01	4.24E-01	**-0.07%**	1.27E+00	1.27E+00	**-0.07%**
Bi-207	7.26E-03	7.25E-03	**-0.09%**	2.23E-02	2.23E-02	**-0.10%**	5.50E-03	5.49E-03	**-0.11%**	7.73E-03	7.72E-03	**-0.10%**	2.80E-02	2.80E-02	**-0.11%**
Bi-210	3.86E-04	3.85E-04	**-0.07%**	7.52E-04	7.51E-04	**-0.07%**	2.21E-04	2.21E-04	**-0.07%**	5.03E-04	5.03E-04	**-0.07%**	1.51E-03	1.51E-03	**-0.07%**
Bi-210m	7.15E-03	7.14E-03	**-0.07%**	1.69E-02	1.69E-02	**-0.07%**	5.16E-03	5.15E-03	**-0.07%**	9.16E-03	9.15E-03	**-0.07%**	3.17E-02	3.17E-02	**-0.07%**
Po-210	1.54E-01	1.54E-01	**-0.07%**	2.54E-01	2.54E-01	**-0.07%**	5.34E-02	5.34E-02	**-0.07%**	1.72E-01	1.72E-01	**-0.07%**	5.17E-01	5.16E-01	**-0.07%**
Ra-223	3.64E-02	3.64E-02	**-0.07%**	8.31E-02	8.30E-02	**-0.07%**	3.00E-02	2.99E-02	**-0.07%**	5.50E-02	5.49E-02	**-0.07%**	1.65E-01	1.65E-01	**-0.07%**
Ra-224	1.73E-02	1.72E-02	**-0.07%**	3.96E-02	3.95E-02	**-0.07%**	1.43E-02	1.43E-02	**-0.07%**	2.62E-02	2.61E-02	**-0.07%**	7.85E-02	7.84E-02	**-0.07%**
Ra-225	4.09E-02	4.08E-02	**-0.07%**	9.31E-02	9.31E-02	**-0.07%**	3.36E-02	3.35E-02	**-0.07%**	6.16E-02	6.16E-02	**-0.07%**	1.85E-01	1.85E-01	**-0.07%**
Ra-226	8.37E-02	8.37E-02	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	6.86E-02	6.85E-02	**-0.07%**	1.26E-01	1.26E-01	**-0.07%**	3.78E-01	3.78E-01	**-0.07%**
Ra-228	2.95E-01	2.95E-01	**-0.07%**	6.72E-01	6.72E-01	**-0.07%**	2.42E-01	2.42E-01	**-0.07%**	4.45E-01	4.45E-01	**-0.07%**	1.33E+00	1.33E+00	**-0.07%**
Ac-227	1.37E-01	1.37E-01	**-0.07%**	2.42E-01	2.41E-01	**-0.07%**	5.93E-02	5.92E-02	**-0.07%**	1.63E-01	1.63E-01	**-0.07%**	4.89E-01	4.89E-01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Th-227	2.78E-03	2.78E-03	**-0.07%**	6.10E-03	6.09E-03	**-0.07%**	2.10E-03	2.10E-03	**-0.07%**	4.04E-03	4.04E-03	**-0.07%**	1.21E-02	1.21E-02	**-0.07%**
Th-228	2.32E-02	2.32E-02	**-0.07%**	5.09E-02	5.08E-02	**-0.07%**	1.75E-02	1.75E-02	**-0.07%**	3.37E-02	3.37E-02	**-0.07%**	1.01E-01	1.01E-01	**-0.07%**
Th-229	1.23E-01	1.23E-01	**-0.07%**	2.69E-01	2.69E-01	**-0.07%**	9.28E-02	9.27E-02	**-0.07%**	1.78E-01	1.78E-01	**-0.07%**	5.36E-01	5.35E-01	**-0.07%**
Th-230	5.07E-02	5.07E-02	**-0.07%**	1.11E-01	1.11E-01	**-0.07%**	3.83E-02	3.82E-02	**-0.07%**	7.37E-02	7.37E-02	**-0.07%**	2.21E-01	2.21E-01	**-0.07%**
Th-231	3.25E-05	3.25E-05	**-0.07%**	7.35E-05	7.35E-05	**-0.07%**	2.62E-05	2.62E-05	**-0.07%**	4.87E-05	4.86E-05	**-0.07%**	1.46E-04	1.46E-04	**-0.07%**
Th-232	5.57E-02	5.57E-02	**-0.07%**	1.22E-01	1.22E-01	**-0.07%**	4.20E-02	4.20E-02	**-0.07%**	8.10E-02	8.10E-02	**-0.07%**	2.43E-01	2.43E-01	**-0.07%**
Th-234	8.96E-04	8.95E-04	**-0.07%**	1.97E-03	1.96E-03	**-0.07%**	6.78E-04	6.77E-04	**-0.07%**	1.30E-03	1.30E-03	**-0.07%**	3.91E-03	3.91E-03	**-0.07%**
Pa-230	2.72E-04	2.71E-04	**-0.07%**	5.63E-04	5.63E-04	**-0.07%**	1.77E-04	1.77E-04	**-0.07%**	3.68E-04	3.68E-04	**-0.07%**	1.10E-03	1.10E-03	**-0.07%**
Pa-231	1.30E-01	1.30E-01	**-0.07%**	2.67E-01	2.67E-01	**-0.07%**	8.48E-02	8.48E-02	**-0.07%**	1.78E-01	1.78E-01	**-0.07%**	5.34E-01	5.34E-01	**-0.07%**
Pa-233	2.98E-04	2.97E-04	**-0.07%**	6.14E-04	6.14E-04	**-0.07%**	1.94E-04	1.94E-04	**-0.07%**	4.06E-04	4.06E-04	**-0.07%**	1.22E-03	1.22E-03	**-0.07%**
U-232	6.50E-02	6.49E-02	**-0.07%**	1.58E-01	1.58E-01	**-0.07%**	6.11E-02	6.11E-02	**-0.07%**	1.04E-01	1.04E-01	**-0.07%**	3.13E-01	3.13E-01	**-0.07%**
U-233	9.69E-03	9.68E-03	**-0.07%**	2.36E-02	2.36E-02	**-0.07%**	9.11E-03	9.10E-03	**-0.07%**	1.56E-02	1.55E-02	**-0.07%**	4.67E-02	4.66E-02	**-0.07%**
U-234	9.35E-03	9.34E-03	**-0.07%**	2.28E-02	2.28E-02	**-0.07%**	8.79E-03	8.78E-03	**-0.07%**	1.50E-02	1.50E-02	**-0.07%**	4.51E-02	4.50E-02	**-0.07%**
U-235	9.86E-03	9.86E-03	**-0.07%**	2.54E-02	2.54E-02	**-0.07%**	9.59E-03	9.59E-03	**-0.07%**	1.55E-02	1.55E-02	**-0.07%**	4.90E-02	4.90E-02	**-0.07%**
U-236	8.80E-03	8.80E-03	**-0.07%**	2.15E-02	2.14E-02	**-0.07%**	8.28E-03	8.27E-03	**-0.07%**	1.41E-02	1.41E-02	**-0.07%**	4.24E-02	4.24E-02	**-0.07%**
U-237	1.47E-04	1.47E-04	**-0.07%**	3.58E-04	3.58E-04	**-0.07%**	1.38E-04	1.38E-04	**-0.07%**	2.35E-04	2.35E-04	**-0.07%**	7.05E-04	7.05E-04	**-0.07%**
U-238	8.43E-03	8.43E-03	**-0.07%**	2.06E-02	2.05E-02	**-0.07%**	7.93E-03	7.92E-03	**-0.07%**	1.35E-02	1.35E-02	**-0.07%**	4.06E-02	4.06E-02	**-0.07%**
Np-236	9.49E-03	9.48E-03	**-0.07%**	1.90E-02	1.90E-02	**-0.07%**	5.19E-03	5.19E-03	**-0.07%**	1.16E-02	1.16E-02	**-0.07%**	3.71E-02	3.71E-02	**-0.07%**
Np-237	4.00E-02	4.00E-02	**-0.07%**	7.30E-02	7.30E-02	**-0.07%**	1.91E-02	1.91E-02	**-0.07%**	4.89E-02	4.89E-02	**-0.07%**	1.47E-01	1.47E-01	**-0.07%**
Np-239	2.12E-04	2.12E-04	**-0.07%**	3.96E-04	3.95E-04	**-0.07%**	1.08E-04	1.08E-04	**-0.07%**	2.65E-04	2.65E-04	**-0.07%**	7.96E-04	7.95E-04	**-0.07%**
Am-237	1.16E-12	1.16E-12	**-0.14%**	2.90E-12	2.89E-12	**-0.14%**	5.82E-13	5.81E-13	**-0.14%**	9.70E-13	9.68E-13	**-0.14%**	2.91E-12	2.91E-12	**-0.14%**
Am-241	4.86E-01	4.86E-01	**-0.07%**	6.24E-01	6.24E-01	**-0.07%**	3.62E-02	3.61E-02	**-0.07%**	4.35E-01	4.35E-01	**-0.07%**	1.30E+00	1.30E+00	**-0.07%**
Am-242m	4.41E-01	4.41E-01	**-0.07%**	5.66E-01	5.66E-01	**-0.07%**	3.27E-02	3.27E-02	**-0.07%**	3.94E-01	3.94E-01	**-0.07%**	1.18E+00	1.18E+00	**-0.07%**
Am-243	4.82E-01	4.82E-01	**-0.07%**	6.20E-01	6.19E-01	**-0.07%**	3.61E-02	3.61E-02	**-0.07%**	4.31E-01	4.31E-01	**-0.07%**	1.30E+00	1.29E+00	**-0.07%**
Pu-237	5.86E-05	5.86E-05	**-0.07%**	1.01E-04	1.01E-04	**-0.07%**	2.30E-05	2.30E-05	**-0.07%**	6.72E-05	6.71E-05	**-0.07%**	2.02E-04	2.01E-04	**-0.07%**
Pu-238	1.02E-01	1.02E-01	**-0.07%**	1.74E-01	1.74E-01	**-0.07%**	3.98E-02	3.97E-02	**-0.07%**	1.18E-01	1.18E-01	**-0.07%**	3.54E-01	3.54E-01	**-0.07%**
Pu-239	1.12E-01	1.12E-01	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	4.36E-02	4.35E-02	**-0.07%**	1.29E-01	1.29E-01	**-0.07%**	3.88E-01	3.88E-01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Pu-240	1.12E-01	1.12E-01	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	4.36E-02	4.35E-02	**-0.07%**	1.29E-01	1.29E-01	**-0.07%**	3.88E-01	3.88E-01	**-0.07%**
Pu-241	2.03E-03	2.03E-03	**-0.07%**	3.45E-03	3.45E-03	**-0.07%**	7.88E-04	7.87E-04	**-0.07%**	2.34E-03	2.34E-03	**-0.07%**	7.01E-03	7.01E-03	**-0.07%**
Pu-242	1.07E-01	1.07E-01	**-0.07%**	1.82E-01	1.82E-01	**-0.07%**	4.14E-02	4.14E-02	**-0.07%**	1.23E-01	1.23E-01	**-0.07%**	3.69E-01	3.69E-01	**-0.07%**
Pu-244	1.06E-01	1.06E-01	**-0.07%**	1.81E-01	1.81E-01	**-0.07%**	4.14E-02	4.14E-02	**-0.07%**	1.23E-01	1.23E-01	**-0.07%**	3.68E-01	3.68E-01	**-0.07%**
Cm-241	4.76E-04	4.76E-04	**-0.07%**	8.22E-04	8.21E-04	**-0.07%**	1.87E-04	1.87E-04	**-0.07%**	5.46E-04	5.46E-04	**-0.07%**	1.64E-03	1.64E-03	**-0.07%**
Cm-242	7.42E-03	7.41E-03	**-0.07%**	1.26E-02	1.26E-02	**-0.07%**	2.88E-03	2.88E-03	**-0.07%**	8.55E-03	8.55E-03	**-0.07%**	2.57E-02	2.56E-02	**-0.07%**
Cm-243	7.06E-02	7.06E-02	**-0.07%**	1.21E-01	1.21E-01	**-0.07%**	2.76E-02	2.76E-02	**-0.07%**	8.13E-02	8.13E-02	**-0.07%**	2.44E-01	2.44E-01	**-0.07%**
Cm-244	5.88E-02	5.88E-02	**-0.07%**	1.00E-01	1.00E-01	**-0.07%**	2.28E-02	2.28E-02	**-0.07%**	6.78E-02	6.77E-02	**-0.07%**	2.03E-01	2.03E-01	**-0.07%**
Cm-245	9.49E-02	9.48E-02	**-0.07%**	1.63E-01	1.63E-01	**-0.07%**	3.74E-02	3.74E-02	**-0.07%**	1.09E-01	1.09E-01	**-0.07%**	3.30E-01	3.30E-01	**-0.07%**
Cm-246	9.39E-02	9.38E-02	**-0.07%**	1.60E-01	1.60E-01	**-0.07%**	3.65E-02	3.65E-02	**-0.07%**	1.08E-01	1.08E-01	**-0.07%**	3.25E-01	3.24E-01	**-0.07%**
Cm-247	8.85E-02	8.85E-02	**-0.07%**	1.55E-01	1.55E-01	**-0.07%**	3.62E-02	3.61E-02	**-0.07%**	1.02E-01	1.02E-01	**-0.07%**	3.12E-01	3.12E-01	**-0.07%**
Cm-248	3.60E-01	3.60E-01	**-0.07%**	6.31E-01	6.31E-01	**-0.07%**	1.47E-01	1.47E-01	**-0.07%**	4.16E-01	4.16E-01	**-0.07%**	1.27E+00	1.27E+00	**-0.07%**
Cm-250	2.49E+00	2.49E+00	**-0.07%**	4.43E+00	4.42E+00	**-0.07%**	1.04E+00	1.04E+00	**-0.07%**	2.88E+00	2.88E+00	**-0.07%**	8.87E+00	8.86E+00	**-0.07%**
Bk-247	1.56E-01	1.56E-01	**-0.07%**	2.76E-01	2.76E-01	**-0.07%**	6.81E-02	6.81E-02	**-0.07%**	1.85E-01	1.85E-01	**-0.07%**	5.58E-01	5.58E-01	**-0.07%**
Bk-249	4.36E-04	4.36E-04	**-0.07%**	7.68E-04	7.67E-04	**-0.07%**	1.88E-04	1.88E-04	**-0.07%**	5.18E-04	5.18E-04	**-0.07%**	1.55E-03	1.55E-03	**-0.07%**
Cf-249	1.58E-01	1.58E-01	**-0.07%**	2.82E-01	2.82E-01	**-0.07%**	6.99E-02	6.98E-02	**-0.07%**	1.88E-01	1.88E-01	**-0.07%**	5.69E-01	5.68E-01	**-0.07%**
Cf-250	7.77E-02	7.77E-02	**-0.07%**	1.37E-01	1.37E-01	**-0.07%**	3.36E-02	3.36E-02	**-0.07%**	9.24E-02	9.23E-02	**-0.07%**	2.77E-01	2.77E-01	**-0.07%**
Cf-251	1.60E-01	1.60E-01	**-0.07%**	2.83E-01	2.83E-01	**-0.07%**	6.97E-02	6.96E-02	**-0.07%**	1.90E-01	1.90E-01	**-0.07%**	5.72E-01	5.72E-01	**-0.07%**
Cf-252	5.31E-02	5.30E-02	**-0.07%**	9.37E-02	9.36E-02	**-0.07%**	2.30E-02	2.29E-02	**-0.07%**	6.30E-02	6.29E-02	**-0.07%**	1.89E-01	1.89E-01	**-0.07%**
Es-253	3.04E-03	3.03E-03	**-0.07%**	5.36E-03	5.36E-03	**-0.07%**	1.32E-03	1.32E-03	**-0.07%**	3.62E-03	3.62E-03	**-0.07%**	1.09E-02	1.08E-02	**-0.07%**
UI alpha	1.12E-01	1.12E-01	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	4.36E-02	4.35E-02	**-0.07%**	1.29E-01	1.29E-01	**-0.07%**	3.88E-01	3.88E-01	**-0.07%**
UI beta	6.84E-03	6.83E-03	**-0.07%**	1.63E-02	1.63E-02	**-0.07%**	5.81E-03	5.81E-03	**-0.07%**	1.03E-02	1.03E-02	**-0.07%**	3.11E-02	3.11E-02	**-0.07%**

Table C-2. SQAP Test Cases 1-5 Radionuclide Effective Dose (ED) for Individual - IRRIDOSE

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
H-3	5.48E-06	5.48E-06	**-0.07%**	1.02E-05	1.02E-05	**-0.07%**	2.74E-06	2.74E-06	**-0.07%**	4.57E-06	4.56E-06	**-0.07%**	1.37E-05	1.37E-05	**-0.07%**
Be-7	2.21E-05	2.21E-05	**-0.07%**	5.83E-05	5.83E-05	**-0.07%**	1.76E-05	1.76E-05	**-0.07%**	2.44E-05	2.44E-05	**-0.07%**	7.32E-05	7.31E-05	**-0.07%**
Be-10	1.42E-03	1.42E-03	**-0.07%**	3.19E-03	3.19E-03	**-0.06%**	1.16E-03	1.16E-03	**-0.06%**	1.45E-03	1.45E-03	**-0.07%**	4.42E-03	4.42E-03	**-0.06%**
C-14	5.39E-03	5.39E-03	**-0.01%**	1.74E-02	1.74E-02	**-0.01%**	9.36E-03	9.36E-03	**-0.01%**	7.03E-03	7.03E-03	**-0.01%**	3.18E-02	3.18E-02	**-0.01%**
Na-22	6.04E-03	6.04E-03	**-0.07%**	1.43E-02	1.43E-02	**-0.07%**	4.68E-03	4.68E-03	**-0.07%**	8.99E-03	8.99E-03	**-0.07%**	2.70E-02	2.70E-02	**-0.07%**
Na-24	6.28E-07	6.28E-07	**-0.07%**	2.31E-05	2.31E-05	**-0.07%**	3.57E-07	3.57E-07	**-0.07%**	9.90E-07	9.89E-07	**-0.07%**	2.97E-06	2.97E-06	**-0.07%**
Al-26	4.17E-03	4.17E-03	**-0.07%**	9.31E-03	9.30E-03	**-0.07%**	3.33E-03	3.32E-03	**-0.07%**	4.30E-03	4.29E-03	**-0.07%**	1.29E-02	1.29E-02	**-0.07%**
P-32	3.47E-03	3.47E-03	**-0.07%**	1.08E-02	1.08E-02	**-0.07%**	2.60E-03	2.60E-03	**-0.07%**	6.00E-03	6.00E-03	**-0.07%**	1.80E-02	1.80E-02	**-0.07%**
Si-32	1.22E-03	1.22E-03	**-0.04%**	3.23E-03	3.23E-03	**-0.04%**	1.45E-03	1.45E-03	**-0.03%**	1.36E-03	1.36E-03	**-0.04%**	5.10E-03	5.10E-03	**-0.04%**
S-35	6.04E-04	6.04E-04	**-0.07%**	1.32E-03	1.32E-03	**-0.07%**	4.61E-04	4.61E-04	**-0.07%**	8.99E-04	8.98E-04	**-0.07%**	2.70E-03	2.69E-03	**-0.07%**
Cl-36	2.18E-01	2.18E-01	**0.00%**	7.83E-01	7.83E-01	**0.00%**	4.31E-01	4.31E-01	**0.00%**	2.84E-01	2.84E-01	**0.00%**	1.41E+00	1.41E+00	**0.00%**
K-40	9.77E-02	9.77E-02	**-0.01%**	3.23E-01	3.23E-01	**0.00%**	1.80E-01	1.80E-01	**0.00%**	1.25E-01	1.25E-01	**-0.01%**	5.95E-01	5.95E-01	**0.00%**
K-43	1.06E-06	1.06E-06	**-0.07%**	2.80E-05	2.80E-05	**-0.07%**	6.26E-07	6.25E-07	**-0.07%**	2.58E-06	2.58E-06	**-0.07%**	7.75E-06	7.75E-06	**-0.07%**
Ca-41	4.86E-02	4.86E-02	**0.00%**	1.70E-01	1.70E-01	**0.00%**	9.59E-02	9.59E-02	**0.00%**	6.30E-02	6.30E-02	**0.00%**	3.14E-01	3.14E-01	**0.00%**
Ca-45	3.93E-03	3.93E-03	**-0.07%**	9.57E-03	9.56E-03	**-0.07%**	3.10E-03	3.10E-03	**-0.07%**	4.26E-03	4.26E-03	**-0.07%**	1.28E-02	1.28E-02	**-0.07%**
Ca-47	3.14E-04	3.14E-04	**-0.07%**	1.99E-03	1.99E-03	**-0.07%**	2.26E-04	2.26E-04	**-0.07%**	7.06E-04	7.05E-04	**-0.07%**	2.12E-03	2.12E-03	**-0.07%**
Ti-44	6.63E-03	6.63E-03	**-0.07%**	1.49E-02	1.49E-02	**-0.07%**	5.33E-03	5.33E-03	**-0.07%**	6.72E-03	6.71E-03	**-0.07%**	2.03E-02	2.03E-02	**-0.07%**
V-49	2.18E-05	2.18E-05	**-0.07%**	4.98E-05	4.98E-05	**-0.07%**	1.73E-05	1.73E-05	**-0.07%**	2.27E-05	2.27E-05	**-0.07%**	6.81E-05	6.80E-05	**-0.07%**
Cr-51	2.77E-05	2.77E-05	**-0.07%**	8.20E-05	8.19E-05	**-0.07%**	2.18E-05	2.18E-05	**-0.07%**	3.54E-05	3.54E-05	**-0.07%**	1.06E-04	1.06E-04	**-0.07%**
Mn-53	1.10E-04	1.10E-04	**-0.02%**	3.26E-04	3.26E-04	**-0.02%**	1.74E-04	1.74E-04	**-0.01%**	1.34E-04	1.33E-04	**-0.02%**	5.93E-04	5.93E-04	**-0.01%**
Mn-54	7.92E-04	7.91E-04	**-0.07%**	1.82E-03	1.81E-03	**-0.07%**	6.28E-04	6.28E-04	**-0.07%**	8.06E-04	8.05E-04	**-0.07%**	2.42E-03	2.42E-03	**-0.07%**
Fe-55	5.92E-04	5.92E-04	**-0.07%**	1.30E-03	1.30E-03	**-0.07%**	4.67E-04	4.66E-04	**-0.07%**	6.57E-04	6.56E-04	**-0.07%**	1.97E-03	1.97E-03	**-0.07%**
Fe-60	2.09E-01	2.09E-01	**-0.05%**	5.15E-01	5.14E-01	**-0.04%**	2.27E-01	2.27E-01	**-0.04%**	2.41E-01	2.41E-01	**-0.05%**	8.56E-01	8.55E-01	**-0.04%**
Co-58	6.99E-04	6.99E-04	**-0.07%**	1.77E-03	1.77E-03	**-0.07%**	5.55E-04	5.55E-04	**-0.07%**	7.54E-04	7.53E-04	**-0.07%**	2.26E-03	2.26E-03	**-0.07%**
Co-60	5.53E-03	5.53E-03	**-0.07%**	1.24E-02	1.24E-02	**-0.07%**	4.40E-03	4.39E-03	**-0.07%**	5.54E-03	5.53E-03	**-0.07%**	1.66E-02	1.66E-02	**-0.07%**
Ni-59	1.30E-04	1.30E-04	**-0.04%**	3.48E-04	3.48E-04	**-0.03%**	1.65E-04	1.65E-04	**-0.02%**	1.53E-04	1.53E-04	**-0.04%**	5.95E-04	5.94E-04	**-0.03%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ni-63	3.07E-04	3.06E-04	**-0.05%**	7.87E-04	7.86E-04	**-0.04%**	3.38E-04	3.38E-04	**-0.04%**	3.50E-04	3.50E-04	**-0.05%**	1.24E-03	1.24E-03	**-0.04%**
Cu-64	1.25E-08	1.25E-08	**-0.07%**	1.84E-06	1.84E-06	**-0.07%**	7.02E-09	7.02E-09	**-0.07%**	1.08E-07	1.08E-07	**-0.07%**	3.24E-07	3.24E-07	**-0.07%**
Zn-65	1.53E-02	1.53E-02	**-0.07%**	3.21E-02	3.21E-02	**-0.07%**	1.18E-02	1.18E-02	**-0.07%**	2.14E-02	2.14E-02	**-0.07%**	6.43E-02	6.43E-02	**-0.07%**
Ge-68	2.05E-02	2.05E-02	**-0.07%**	4.42E-02	4.42E-02	**-0.07%**	1.55E-02	1.55E-02	**-0.07%**	3.54E-02	3.54E-02	**-0.07%**	1.06E-01	1.06E-01	**-0.07%**
Se-75	3.60E-03	3.60E-03	**-0.07%**	8.57E-03	8.57E-03	**-0.07%**	2.81E-03	2.81E-03	**-0.07%**	4.66E-03	4.66E-03	**-0.07%**	1.40E-02	1.40E-02	**-0.07%**
Se-79	8.94E-03	8.94E-03	**-0.04%**	2.38E-02	2.38E-02	**-0.04%**	1.09E-02	1.09E-02	**-0.03%**	1.14E-02	1.13E-02	**-0.04%**	4.23E-02	4.23E-02	**-0.03%**
Rb-87	1.51E-02	1.51E-02	**-0.01%**	5.03E-02	5.03E-02	**-0.01%**	2.65E-02	2.65E-02	**0.00%**	2.03E-02	2.03E-02	**-0.01%**	9.26E-02	9.26E-02	**-0.01%**
Sr-89	2.47E-03	2.47E-03	**-0.07%**	6.57E-03	6.56E-03	**-0.07%**	1.95E-03	1.95E-03	**-0.07%**	2.90E-03	2.90E-03	**-0.07%**	8.70E-03	8.70E-03	**-0.07%**
Sr-90	1.17E-01	1.17E-01	**-0.04%**	3.07E-01	3.07E-01	**-0.04%**	1.24E-01	1.23E-01	**-0.05%**	1.27E-01	1.27E-01	**-0.05%**	4.32E-01	4.32E-01	**-0.05%**
Y-90	1.64E-05	1.64E-05	**-0.07%**	9.10E-04	9.10E-04	**-0.07%**	1.27E-05	1.27E-05	**-0.07%**	2.50E-04	2.50E-04	**-0.07%**	7.51E-04	7.51E-04	**-0.07%**
Y-91	2.15E-03	2.14E-03	**-0.07%**	5.57E-03	5.56E-03	**-0.07%**	1.70E-03	1.70E-03	**-0.07%**	2.35E-03	2.34E-03	**-0.07%**	7.04E-03	7.03E-03	**-0.07%**
Mo-93	1.07E-02	1.07E-02	**-0.02%**	3.28E-02	3.28E-02	**-0.01%**	1.77E-02	1.77E-02	**-0.01%**	1.34E-02	1.34E-02	**-0.01%**	6.05E-02	6.05E-02	**-0.01%**
Mo-99	7.68E-06	7.67E-06	**-0.07%**	2.14E-04	2.14E-04	**-0.07%**	5.51E-06	5.51E-06	**-0.07%**	6.01E-05	6.01E-05	**-0.07%**	1.80E-04	1.80E-04	**-0.07%**
Nb-93m	1.61E-04	1.61E-04	**-0.07%**	3.61E-04	3.61E-04	**-0.07%**	1.29E-04	1.28E-04	**-0.07%**	1.62E-04	1.62E-04	**-0.07%**	4.86E-04	4.86E-04	**-0.07%**
Nb-94	2.09E-03	2.09E-03	**-0.06%**	4.81E-03	4.81E-03	**-0.06%**	1.82E-03	1.82E-03	**-0.06%**	2.14E-03	2.14E-03	**-0.06%**	6.78E-03	6.77E-03	**-0.06%**
Nb-95	3.95E-04	3.95E-04	**-0.07%**	1.14E-03	1.14E-03	**-0.07%**	3.14E-04	3.14E-04	**-0.07%**	4.56E-04	4.56E-04	**-0.07%**	1.37E-03	1.37E-03	**-0.07%**
Zr-93	8.99E-04	8.99E-04	**-0.07%**	2.03E-03	2.03E-03	**-0.06%**	7.39E-04	7.39E-04	**-0.06%**	9.10E-04	9.10E-04	**-0.06%**	2.79E-03	2.79E-03	**-0.06%**
Zr-95	8.35E-04	8.34E-04	**-0.07%**	2.14E-03	2.14E-03	**-0.07%**	6.63E-04	6.62E-04	**-0.07%**	8.98E-04	8.98E-04	**-0.07%**	2.69E-03	2.69E-03	**-0.07%**
Tc-96	1.10E-04	1.10E-04	**-0.07%**	1.26E-03	1.25E-03	**-0.07%**	8.34E-05	8.34E-05	**-0.07%**	3.97E-04	3.97E-04	**-0.07%**	1.19E-03	1.19E-03	**-0.07%**
Tc-97	5.32E-02	5.32E-02	**0.00%**	1.79E-01	1.79E-01	**0.00%**	1.06E-01	1.06E-01	**0.00%**	6.92E-02	6.92E-02	**0.00%**	3.46E-01	3.46E-01	**0.00%**
Tc-98	1.37E+00	1.37E+00	**0.00%**	4.60E+00	4.60E+00	**0.00%**	2.71E+00	2.71E+00	**0.00%**	1.78E+00	1.78E+00	**0.00%**	8.87E+00	8.87E+00	**0.00%**
Tc-99	5.06E-01	5.06E-01	**0.00%**	1.70E+00	1.70E+00	**0.00%**	1.00E+00	1.00E+00	**0.00%**	6.57E-01	6.57E-01	**0.00%**	3.28E+00	3.29E+00	**0.00%**
Ru-97	1.56E-06	1.56E-06	**-0.07%**	5.53E-05	5.53E-05	**-0.07%**	1.18E-06	1.17E-06	**-0.07%**	1.53E-05	1.53E-05	**-0.07%**	4.59E-05	4.59E-05	**-0.07%**
Ru-103	5.54E-04	5.54E-04	**-0.07%**	1.53E-03	1.53E-03	**-0.07%**	4.39E-04	4.38E-04	**-0.07%**	6.42E-04	6.41E-04	**-0.07%**	1.93E-03	1.92E-03	**-0.07%**
Ru-106	8.47E-03	8.47E-03	**-0.07%**	1.92E-02	1.92E-02	**-0.07%**	6.71E-03	6.71E-03	**-0.07%**	8.84E-03	8.84E-03	**-0.07%**	2.65E-02	2.65E-02	**-0.07%**
Pd-107	9.51E-05	9.51E-05	**-0.05%**	2.56E-04	2.56E-04	**-0.04%**	1.06E-04	1.06E-04	**-0.03%**	1.32E-04	1.32E-04	**-0.05%**	4.65E-04	4.65E-04	**-0.04%**
Ag-108m	2.89E-03	2.89E-03	**-0.07%**	6.50E-03	6.50E-03	**-0.07%**	2.29E-03	2.29E-03	**-0.07%**	3.21E-03	3.20E-03	**-0.07%**	9.64E-03	9.63E-03	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ag-110m	3.23E-03	3.23E-03	**-0.07%**	7.51E-03	7.50E-03	**-0.07%**	2.55E-03	2.55E-03	**-0.07%**	3.64E-03	3.63E-03	**-0.07%**	1.09E-02	1.09E-02	**-0.07%**
Cd-113m	7.38E-02	7.38E-02	**-0.05%**	1.75E-01	1.75E-01	**-0.06%**	6.46E-02	6.46E-02	**-0.07%**	7.32E-02	7.32E-02	**-0.06%**	2.26E-01	2.26E-01	**-0.07%**
Cd-115m	2.90E-03	2.89E-03	**-0.07%**	7.75E-03	7.74E-03	**-0.07%**	2.29E-03	2.29E-03	**-0.07%**	3.37E-03	3.37E-03	**-0.07%**	1.01E-02	1.01E-02	**-0.07%**
In-115	3.53E-02	3.53E-02	**-0.07%**	7.82E-02	7.81E-02	**-0.07%**	2.82E-02	2.82E-02	**-0.07%**	3.82E-02	3.82E-02	**-0.07%**	1.15E-01	1.15E-01	**-0.07%**
Sb-122	1.17E-05	1.17E-05	**-0.07%**	5.86E-04	5.86E-04	**-0.07%**	8.98E-06	8.98E-06	**-0.07%**	1.62E-04	1.62E-04	**-0.07%**	4.86E-04	4.86E-04	**-0.07%**
Sb-124	2.24E-03	2.24E-03	**-0.07%**	5.78E-03	5.78E-03	**-0.07%**	1.78E-03	1.77E-03	**-0.07%**	2.45E-03	2.45E-03	**-0.07%**	7.35E-03	7.34E-03	**-0.07%**
Sb-125	1.29E-03	1.29E-03	**-0.07%**	2.90E-03	2.90E-03	**-0.07%**	1.03E-03	1.02E-03	**-0.07%**	1.32E-03	1.32E-03	**-0.07%**	3.96E-03	3.96E-03	**-0.07%**
Te-123	4.09E-03	4.08E-03	**-0.07%**	1.20E-02	1.20E-02	**-0.07%**	6.36E-03	6.36E-03	**-0.07%**	4.97E-03	4.97E-03	**-0.07%**	2.17E-02	2.17E-02	**-0.07%**
Te-125m	8.95E-04	8.95E-04	**-0.07%**	2.29E-03	2.29E-03	**-0.07%**	7.07E-04	7.06E-04	**-0.07%**	1.03E-03	1.03E-03	**-0.07%**	3.10E-03	3.10E-03	**-0.07%**
Sn-126	1.32E-02	1.32E-02	**-0.06%**	2.85E-02	2.84E-02	**-0.06%**	1.12E-02	1.12E-02	**-0.06%**	1.79E-02	1.78E-02	**-0.06%**	5.54E-02	5.54E-02	**-0.06%**
I-129	1.97E-01	1.97E-01	**-0.05%**	5.16E-01	5.16E-01	**-0.04%**	2.21E-01	2.21E-01	**-0.03%**	2.53E-01	2.53E-01	**-0.05%**	9.06E-01	9.06E-01	**-0.04%**
I-131	6.70E-03	6.70E-03	**-0.07%**	3.38E-02	3.38E-02	**-0.07%**	5.07E-03	5.06E-03	**-0.07%**	1.37E-02	1.37E-02	**-0.07%**	4.12E-02	4.12E-02	**-0.07%**
Cs-134	2.48E-02	2.47E-02	**-0.07%**	5.58E-02	5.57E-02	**-0.07%**	1.93E-02	1.93E-02	**-0.07%**	3.24E-02	3.23E-02	**-0.07%**	9.71E-02	9.70E-02	**-0.07%**
Cs-135	4.23E-03	4.23E-03	**-0.06%**	1.03E-02	1.03E-02	**-0.05%**	4.16E-03	4.16E-03	**-0.04%**	5.50E-03	5.50E-03	**-0.06%**	1.83E-02	1.83E-02	**-0.05%**
Cs-137	2.00E-02	2.00E-02	**-0.06%**	4.61E-02	4.61E-02	**-0.06%**	1.66E-02	1.66E-02	**-0.06%**	2.56E-02	2.56E-02	**-0.06%**	7.84E-02	7.83E-02	**-0.06%**
La-137	1.00E-04	1.00E-04	**-0.07%**	2.27E-04	2.27E-04	**-0.06%**	8.31E-05	8.30E-05	**-0.06%**	1.02E-04	1.02E-04	**-0.06%**	3.13E-04	3.13E-04	**-0.06%**
La-138	1.24E-03	1.24E-03	**-0.07%**	2.80E-03	2.80E-03	**-0.06%**	1.03E-03	1.02E-03	**-0.06%**	1.26E-03	1.26E-03	**-0.06%**	3.87E-03	3.87E-03	**-0.06%**
La-140	8.27E-07	8.27E-07	**-0.07%**	3.18E-04	3.18E-04	**-0.07%**	6.30E-07	6.30E-07	**-0.07%**	7.55E-05	7.55E-05	**-0.07%**	2.27E-04	2.26E-04	**-0.07%**
Ba-140	8.45E-04	8.44E-04	**-0.07%**	3.80E-03	3.79E-03	**-0.07%**	6.70E-04	6.69E-04	**-0.07%**	1.36E-03	1.36E-03	**-0.07%**	4.09E-03	4.09E-03	**-0.07%**
Ce-141	4.97E-04	4.97E-04	**-0.07%**	1.46E-03	1.46E-03	**-0.07%**	3.95E-04	3.94E-04	**-0.07%**	5.81E-04	5.81E-04	**-0.07%**	1.74E-03	1.74E-03	**-0.07%**
Ce-144	5.98E-03	5.98E-03	**-0.07%**	1.38E-02	1.38E-02	**-0.07%**	4.75E-03	4.75E-03	**-0.07%**	6.10E-03	6.10E-03	**-0.07%**	1.83E-02	1.83E-02	**-0.07%**
Sm-146	6.94E-02	6.94E-02	**-0.06%**	1.63E-01	1.63E-01	**-0.06%**	6.40E-02	6.40E-02	**-0.05%**	7.24E-02	7.24E-02	**-0.06%**	2.37E-01	2.37E-01	**-0.05%**
Sm-147	6.34E-02	6.33E-02	**-0.06%**	1.49E-01	1.49E-01	**-0.06%**	5.85E-02	5.84E-02	**-0.05%**	6.61E-02	6.61E-02	**-0.06%**	2.16E-01	2.16E-01	**-0.05%**
Sm-151	1.32E-04	1.31E-04	**-0.06%**	3.05E-04	3.04E-04	**-0.06%**	1.15E-04	1.15E-04	**-0.06%**	1.36E-04	1.35E-04	**-0.06%**	4.27E-04	4.27E-04	**-0.06%**
Pm-147	3.35E-04	3.34E-04	**-0.07%**	7.54E-04	7.53E-04	**-0.07%**	2.66E-04	2.66E-04	**-0.07%**	3.36E-04	3.35E-04	**-0.07%**	1.01E-03	1.01E-03	**-0.07%**
Eu-152	1.60E-03	1.60E-03	**-0.07%**	3.60E-03	3.60E-03	**-0.07%**	1.28E-03	1.28E-03	**-0.07%**	1.61E-03	1.61E-03	**-0.07%**	4.84E-03	4.84E-03	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Eu-154	2.36E-03	2.36E-03	**-0.07%**	5.30E-03	5.29E-03	**-0.07%**	1.88E-03	1.88E-03	**-0.07%**	2.37E-03	2.37E-03	**-0.07%**	7.12E-03	7.12E-03	**-0.07%**
Eu-155	4.01E-04	4.01E-04	**-0.07%**	9.01E-04	9.00E-04	**-0.07%**	3.19E-04	3.19E-04	**-0.07%**	4.04E-04	4.04E-04	**-0.07%**	1.21E-03	1.21E-03	**-0.07%**
Gd-152	5.24E-02	5.24E-02	**-0.06%**	1.23E-01	1.23E-01	**-0.05%**	4.84E-02	4.84E-02	**-0.05%**	5.46E-02	5.46E-02	**-0.06%**	1.79E-01	1.79E-01	**-0.05%**
Ho-166m	2.52E-03	2.52E-03	**-0.06%**	5.92E-03	5.92E-03	**-0.06%**	2.31E-03	2.31E-03	**-0.05%**	2.63E-03	2.62E-03	**-0.06%**	8.57E-03	8.56E-03	**-0.05%**
Lu-176	2.32E-03	2.32E-03	**-0.07%**	5.20E-03	5.19E-03	**-0.06%**	1.90E-03	1.90E-03	**-0.06%**	2.44E-03	2.44E-03	**-0.06%**	7.46E-03	7.45E-03	**-0.06%**
Ta-180	6.05E-14	6.04E-14	**-0.07%**	7.67E-08	7.67E-08	**-0.07%**	3.28E-14	3.28E-14	**-0.07%**	3.58E-09	3.58E-09	**-0.07%**	1.07E-08	1.07E-08	**-0.07%**
Hf-182	3.03E-03	3.03E-03	**-0.07%**	6.78E-03	6.78E-03	**-0.07%**	2.43E-03	2.43E-03	**-0.07%**	3.05E-03	3.05E-03	**-0.07%**	9.20E-03	9.20E-03	**-0.07%**
Re-186m	1.48E-02	1.48E-02	**-0.01%**	4.60E-02	4.60E-02	**-0.01%**	2.56E-02	2.56E-02	**-0.01%**	1.86E-02	1.86E-02	**-0.01%**	8.59E-02	8.59E-02	**-0.01%**
Re-187	3.20E-05	3.20E-05	**-0.01%**	9.98E-05	9.98E-05	**-0.01%**	5.54E-05	5.54E-05	**-0.01%**	4.04E-05	4.04E-05	**-0.01%**	1.86E-04	1.86E-04	**-0.01%**
Ir-192n	1.27E-03	1.27E-03	**-0.06%**	2.98E-03	2.98E-03	**-0.06%**	1.17E-03	1.17E-03	**-0.05%**	1.33E-03	1.33E-03	**-0.06%**	4.34E-03	4.34E-03	**-0.05%**
Pt-193	6.15E-05	6.14E-05	**-0.06%**	1.46E-04	1.46E-04	**-0.06%**	5.21E-05	5.20E-05	**-0.06%**	7.69E-05	7.69E-05	**-0.06%**	2.38E-04	2.38E-04	**-0.06%**
Hg-194	2.20E-02	2.20E-02	**-0.02%**	6.03E-02	6.03E-02	**-0.02%**	3.45E-02	3.45E-02	**-0.01%**	2.57E-02	2.57E-02	**-0.03%**	1.07E-01	1.07E-01	**-0.02%**
Hg-203	2.29E-03	2.29E-03	**-0.07%**	5.04E-03	5.04E-03	**-0.07%**	1.74E-03	1.74E-03	**-0.07%**	3.41E-03	3.41E-03	**-0.07%**	1.02E-02	1.02E-02	**-0.07%**
Pb-202	2.17E-02	2.17E-02	**-0.06%**	5.18E-02	5.17E-02	**-0.05%**	2.08E-02	2.08E-02	**-0.05%**	2.30E-02	2.30E-02	**-0.06%**	7.71E-02	7.70E-02	**-0.05%**
Pb-205	3.65E-04	3.65E-04	**-0.06%**	8.72E-04	8.71E-04	**-0.05%**	3.50E-04	3.50E-04	**-0.05%**	3.88E-04	3.88E-04	**-0.06%**	1.30E-03	1.30E-03	**-0.05%**
Pb-210	9.93E-01	9.93E-01	**-0.06%**	2.25E+00	2.25E+00	**-0.06%**	8.11E-01	8.10E-01	**-0.07%**	1.02E+00	1.02E+00	**-0.06%**	3.09E+00	3.08E+00	**-0.07%**
Bi-207	4.52E-03	4.52E-03	**-0.04%**	1.19E-02	1.19E-02	**-0.04%**	4.90E-03	4.90E-03	**-0.05%**	4.92E-03	4.92E-03	**-0.04%**	1.70E-02	1.70E-02	**-0.05%**
Bi-210	7.78E-05	7.78E-05	**-0.07%**	9.47E-04	9.46E-04	**-0.07%**	6.08E-05	6.08E-05	**-0.07%**	3.03E-04	3.03E-04	**-0.07%**	9.09E-04	9.09E-04	**-0.07%**
Bi-210m	7.29E-02	7.29E-02	**-0.02%**	2.25E-01	2.25E-01	**-0.01%**	1.23E-01	1.23E-01	**-0.01%**	9.13E-02	9.12E-02	**-0.01%**	4.19E-01	4.19E-01	**-0.01%**
Po-210	2.98E-01	2.97E-01	**-0.07%**	7.01E-01	7.01E-01	**-0.07%**	2.35E-01	2.35E-01	**-0.07%**	3.24E-01	3.23E-01	**-0.07%**	9.71E-01	9.70E-01	**-0.07%**
Ra-223	4.64E-02	4.64E-02	**-0.07%**	2.20E-01	2.20E-01	**-0.07%**	3.66E-02	3.66E-02	**-0.07%**	7.99E-02	7.98E-02	**-0.07%**	2.40E-01	2.39E-01	**-0.07%**
Ra-224	2.31E-03	2.31E-03	**-0.07%**	4.77E-02	4.77E-02	**-0.07%**	1.77E-03	1.77E-03	**-0.07%**	1.43E-02	1.42E-02	**-0.07%**	4.28E-02	4.27E-02	**-0.07%**
Ra-225	6.99E-02	6.99E-02	**-0.07%**	2.79E-01	2.79E-01	**-0.07%**	5.53E-02	5.52E-02	**-0.07%**	1.05E-01	1.05E-01	**-0.07%**	3.15E-01	3.15E-01	**-0.07%**
Ra-226	5.65E-01	5.64E-01	**-0.05%**	1.43E+00	1.43E+00	**-0.04%**	6.24E-01	6.23E-01	**-0.04%**	6.28E-01	6.28E-01	**-0.05%**	2.27E+00	2.27E+00	**-0.04%**
Ra-228	1.56E+00	1.56E+00	**-0.07%**	3.50E+00	3.49E+00	**-0.07%**	1.24E+00	1.24E+00	**-0.07%**	1.61E+00	1.61E+00	**-0.07%**	4.83E+00	4.82E+00	**-0.07%**
Ac-227	3.46E-01	3.46E-01	**-0.07%**	7.73E-01	7.72E-01	**-0.07%**	2.75E-01	2.75E-01	**-0.07%**	3.49E-01	3.49E-01	**-0.07%**	1.05E+00	1.05E+00	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Th-227	5.09E-03	5.08E-03	**-0.07%**	1.83E-02	1.83E-02	**-0.07%**	4.04E-03	4.03E-03	**-0.07%**	6.87E-03	6.86E-03	**-0.07%**	2.06E-02	2.06E-02	**-0.07%**
Th-228	9.96E-02	9.95E-02	**-0.07%**	2.25E-01	2.25E-01	**-0.07%**	7.91E-02	7.90E-02	**-0.07%**	1.01E-01	1.01E-01	**-0.07%**	3.03E-01	3.02E-01	**-0.07%**
Th-229	5.42E-01	5.41E-01	**-0.07%**	1.21E+00	1.21E+00	**-0.07%**	4.36E-01	4.36E-01	**-0.07%**	5.47E-01	5.47E-01	**-0.07%**	1.66E+00	1.65E+00	**-0.07%**
Th-230	2.25E-01	2.25E-01	**-0.07%**	5.04E-01	5.04E-01	**-0.07%**	1.81E-01	1.81E-01	**-0.07%**	2.27E-01	2.27E-01	**-0.07%**	6.88E-01	6.87E-01	**-0.07%**
Th-231	6.54E-09	6.54E-09	**-0.07%**	2.25E-05	2.25E-05	**-0.07%**	4.36E-09	4.36E-09	**-0.07%**	4.20E-06	4.19E-06	**-0.07%**	1.26E-05	1.26E-05	**-0.07%**
Th-232	2.47E-01	2.47E-01	**-0.07%**	5.54E-01	5.54E-01	**-0.07%**	1.99E-01	1.99E-01	**-0.07%**	2.50E-01	2.50E-01	**-0.07%**	7.56E-01	7.55E-01	**-0.07%**
Th-234	1.98E-03	1.98E-03	**-0.07%**	6.42E-03	6.42E-03	**-0.07%**	1.57E-03	1.57E-03	**-0.07%**	2.48E-03	2.47E-03	**-0.07%**	7.43E-03	7.42E-03	**-0.07%**
Pa-230	3.94E-04	3.94E-04	**-0.07%**	1.47E-03	1.47E-03	**-0.07%**	3.13E-04	3.12E-04	**-0.07%**	5.46E-04	5.46E-04	**-0.07%**	1.64E-03	1.64E-03	**-0.07%**
Pa-231	4.95E-01	4.95E-01	**-0.07%**	1.10E+00	1.10E+00	**-0.07%**	3.94E-01	3.94E-01	**-0.07%**	5.00E-01	4.99E-01	**-0.07%**	1.50E+00	1.50E+00	**-0.07%**
Pa-233	6.06E-04	6.05E-04	**-0.07%**	1.88E-03	1.88E-03	**-0.07%**	4.81E-04	4.80E-04	**-0.07%**	7.37E-04	7.36E-04	**-0.07%**	2.21E-03	2.21E-03	**-0.07%**
U-232	4.49E-01	4.48E-01	**-0.06%**	1.07E+00	1.07E+00	**-0.06%**	4.02E-01	4.02E-01	**-0.06%**	5.01E-01	5.01E-01	**-0.06%**	1.60E+00	1.60E+00	**-0.06%**
U-233	6.90E-02	6.89E-02	**-0.06%**	1.70E-01	1.69E-01	**-0.05%**	6.86E-02	6.86E-02	**-0.04%**	7.86E-02	7.86E-02	**-0.05%**	2.67E-01	2.67E-01	**-0.05%**
U-234	6.66E-02	6.65E-02	**-0.06%**	1.64E-01	1.64E-01	**-0.05%**	6.62E-02	6.62E-02	**-0.04%**	7.59E-02	7.58E-02	**-0.05%**	2.58E-01	2.58E-01	**-0.05%**
U-235	6.29E-02	6.29E-02	**-0.06%**	1.55E-01	1.55E-01	**-0.05%**	6.26E-02	6.25E-02	**-0.04%**	7.17E-02	7.17E-02	**-0.05%**	2.44E-01	2.43E-01	**-0.05%**
U-236	6.27E-02	6.26E-02	**-0.06%**	1.54E-01	1.54E-01	**-0.05%**	6.23E-02	6.23E-02	**-0.04%**	7.14E-02	7.14E-02	**-0.05%**	2.43E-01	2.43E-01	**-0.05%**
U-237	1.08E-04	1.08E-04	**-0.07%**	7.85E-04	7.84E-04	**-0.07%**	8.37E-05	8.37E-05	**-0.07%**	2.76E-04	2.76E-04	**-0.07%**	8.29E-04	8.29E-04	**-0.07%**
U-238	6.00E-02	6.00E-02	**-0.06%**	1.48E-01	1.47E-01	**-0.05%**	5.97E-02	5.97E-02	**-0.04%**	6.84E-02	6.84E-02	**-0.05%**	2.32E-01	2.32E-01	**-0.05%**
Np-236	2.70E-02	2.70E-02	**-0.06%**	6.33E-02	6.33E-02	**-0.06%**	2.49E-02	2.49E-02	**-0.05%**	2.82E-02	2.82E-02	**-0.06%**	9.24E-02	9.24E-02	**-0.05%**
Np-237	1.25E-01	1.25E-01	**-0.06%**	2.93E-01	2.93E-01	**-0.06%**	1.15E-01	1.15E-01	**-0.05%**	1.31E-01	1.31E-01	**-0.06%**	4.28E-01	4.28E-01	**-0.05%**
Np-239	2.76E-06	2.75E-06	**-0.07%**	2.29E-04	2.29E-04	**-0.07%**	2.12E-06	2.11E-06	**-0.07%**	6.08E-05	6.07E-05	**-0.07%**	1.82E-04	1.82E-04	**-0.07%**
Am-237	1.05E-34	1.05E-34	**-0.07%**	3.34E-19	3.34E-19	**-0.07%**	5.32E-35	5.32E-35	**-0.07%**	1.21E-25	1.21E-25	**-0.07%**	3.63E-25	3.62E-25	**-0.07%**
Am-241	2.11E-01	2.11E-01	**-0.07%**	4.71E-01	4.70E-01	**-0.07%**	1.68E-01	1.68E-01	**-0.07%**	2.13E-01	2.13E-01	**-0.07%**	6.40E-01	6.40E-01	**-0.07%**
Am-242m	1.91E-01	1.91E-01	**-0.07%**	4.27E-01	4.27E-01	**-0.07%**	1.52E-01	1.52E-01	**-0.07%**	1.93E-01	1.93E-01	**-0.07%**	5.80E-01	5.80E-01	**-0.07%**
Am-243	2.09E-01	2.09E-01	**-0.07%**	4.67E-01	4.66E-01	**-0.07%**	1.67E-01	1.66E-01	**-0.07%**	2.11E-01	2.11E-01	**-0.07%**	6.35E-01	6.34E-01	**-0.07%**
Pu-237	8.91E-05	8.91E-05	**-0.07%**	2.43E-04	2.43E-04	**-0.07%**	7.08E-05	7.07E-05	**-0.07%**	9.93E-05	9.92E-05	**-0.07%**	2.98E-04	2.98E-04	**-0.07%**
Pu-238	2.31E-01	2.31E-01	**-0.07%**	5.16E-01	5.15E-01	**-0.07%**	1.83E-01	1.83E-01	**-0.07%**	2.32E-01	2.32E-01	**-0.07%**	6.97E-01	6.96E-01	**-0.07%**
Pu-239	2.53E-01	2.53E-01	**-0.07%**	5.65E-01	5.64E-01	**-0.07%**	2.01E-01	2.01E-01	**-0.07%**	2.54E-01	2.54E-01	**-0.07%**	7.64E-01	7.63E-01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Pu-240	2.53E-01	2.53E-01	**-0.07%**	5.65E-01	5.64E-01	**-0.07%**	2.01E-01	2.01E-01	**-0.07%**	2.54E-01	2.54E-01	**-0.07%**	7.64E-01	7.63E-01	**-0.07%**
Pu-241	4.56E-03	4.56E-03	**-0.07%**	1.02E-02	1.02E-02	**-0.07%**	3.62E-03	3.62E-03	**-0.07%**	4.59E-03	4.58E-03	**-0.07%**	1.38E-02	1.38E-02	**-0.07%**
Pu-242	2.41E-01	2.41E-01	**-0.07%**	5.37E-01	5.37E-01	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	2.42E-01	2.42E-01	**-0.07%**	7.27E-01	7.26E-01	**-0.07%**
Pu-244	2.40E-01	2.40E-01	**-0.07%**	5.35E-01	5.35E-01	**-0.07%**	1.91E-01	1.91E-01	**-0.07%**	2.41E-01	2.41E-01	**-0.07%**	7.24E-01	7.23E-01	**-0.07%**
Cm-241	6.33E-04	6.33E-04	**-0.07%**	1.86E-03	1.86E-03	**-0.07%**	5.03E-04	5.02E-04	**-0.07%**	7.39E-04	7.39E-04	**-0.07%**	2.22E-03	2.22E-03	**-0.07%**
Cm-242	1.51E-02	1.51E-02	**-0.07%**	3.56E-02	3.56E-02	**-0.07%**	1.20E-02	1.20E-02	**-0.07%**	1.56E-02	1.56E-02	**-0.07%**	4.67E-02	4.67E-02	**-0.07%**
Cm-243	1.58E-01	1.58E-01	**-0.07%**	3.54E-01	3.54E-01	**-0.07%**	1.26E-01	1.26E-01	**-0.07%**	1.59E-01	1.59E-01	**-0.07%**	4.78E-01	4.78E-01	**-0.07%**
Cm-244	1.33E-01	1.33E-01	**-0.07%**	2.96E-01	2.96E-01	**-0.07%**	1.05E-01	1.05E-01	**-0.07%**	1.34E-01	1.33E-01	**-0.07%**	4.01E-01	4.00E-01	**-0.07%**
Cm-245	2.14E-01	2.13E-01	**-0.07%**	4.78E-01	4.77E-01	**-0.07%**	1.71E-01	1.70E-01	**-0.07%**	2.15E-01	2.15E-01	**-0.07%**	6.48E-01	6.47E-01	**-0.07%**
Cm-246	2.13E-01	2.13E-01	**-0.07%**	4.76E-01	4.75E-01	**-0.07%**	1.70E-01	1.70E-01	**-0.07%**	2.14E-01	2.14E-01	**-0.07%**	6.45E-01	6.44E-01	**-0.07%**
Cm-247	1.96E-01	1.96E-01	**-0.07%**	4.38E-01	4.38E-01	**-0.07%**	1.56E-01	1.56E-01	**-0.07%**	1.97E-01	1.97E-01	**-0.07%**	5.94E-01	5.94E-01	**-0.07%**
Cm-248	7.97E-01	7.96E-01	**-0.07%**	1.78E+00	1.78E+00	**-0.07%**	6.37E-01	6.36E-01	**-0.07%**	8.03E-01	8.02E-01	**-0.07%**	2.42E+00	2.42E+00	**-0.07%**
Cm-250	5.45E+00	5.45E+00	**-0.07%**	1.22E+01	1.22E+01	**-0.07%**	4.36E+00	4.35E+00	**-0.07%**	5.49E+00	5.49E+00	**-0.07%**	1.65E+01	1.65E+01	**-0.07%**
Bk-247	4.01E-01	4.01E-01	**-0.06%**	9.08E-01	9.07E-01	**-0.06%**	3.32E-01	3.32E-01	**-0.06%**	4.07E-01	4.06E-01	**-0.06%**	1.25E+00	1.25E+00	**-0.06%**
Bk-249	1.04E-03	1.04E-03	**-0.07%**	2.38E-03	2.38E-03	**-0.07%**	8.26E-04	8.25E-04	**-0.07%**	1.06E-03	1.06E-03	**-0.07%**	3.17E-03	3.17E-03	**-0.07%**
Cf-249	3.92E-01	3.92E-01	**-0.07%**	8.76E-01	8.76E-01	**-0.07%**	3.12E-01	3.12E-01	**-0.07%**	3.95E-01	3.94E-01	**-0.07%**	1.19E+00	1.18E+00	**-0.07%**
Cf-250	1.94E-01	1.94E-01	**-0.07%**	4.35E-01	4.34E-01	**-0.07%**	1.54E-01	1.54E-01	**-0.07%**	1.96E-01	1.95E-01	**-0.07%**	5.87E-01	5.86E-01	**-0.07%**
Cf-251	4.00E-01	4.00E-01	**-0.07%**	8.94E-01	8.94E-01	**-0.07%**	3.19E-01	3.19E-01	**-0.07%**	4.03E-01	4.02E-01	**-0.07%**	1.21E+00	1.21E+00	**-0.07%**
Cf-252	1.30E-01	1.30E-01	**-0.07%**	2.93E-01	2.93E-01	**-0.07%**	1.03E-01	1.03E-01	**-0.07%**	1.31E-01	1.31E-01	**-0.07%**	3.94E-01	3.94E-01	**-0.07%**
Es-253	3.43E-03	3.43E-03	**-0.07%**	1.19E-02	1.19E-02	**-0.07%**	2.72E-03	2.72E-03	**-0.07%**	4.49E-03	4.49E-03	**-0.07%**	1.35E-02	1.35E-02	**-0.07%**
UI alpha	2.53E-01	2.53E-01	**-0.07%**	5.65E-01	5.64E-01	**-0.07%**	2.01E-01	2.01E-01	**-0.07%**	2.54E-01	2.54E-01	**-0.07%**	7.64E-01	7.63E-01	**-0.07%**
UI beta	1.16E-01	1.16E-01	**-0.04%**	3.07E-01	3.06E-01	**-0.04%**	1.23E-01	1.23E-01	**-0.05%**	1.27E-01	1.27E-01	**-0.05%**	4.32E-01	4.31E-01	**-0.05%**

Table C-3. SQAP Test Cases 1-5 Radionuclide Effective Dose (ED) for Population - LADTAP

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
H-3	2.80E-04	2.80E-04	**-0.07%**	1.83E-03	1.83E-03	**-0.07%**	1.86E-04	1.86E-04	**-0.07%**	7.21E-04	7.20E-04	**-0.07%**	1.18E-03	1.17E-03	**-0.07%**
Be-7	1.64E-02	1.64E-02	**-0.07%**	2.58E-02	2.58E-02	**-0.07%**	3.32E-04	3.31E-04	**-0.08%**	1.11E-02	1.11E-02	**-0.07%**	4.17E-02	4.17E-02	**-0.07%**
Be-10	8.64E-01	8.64E-01	**-0.07%**	1.34E+00	1.34E+00	**0.02%**	1.43E-02	1.51E-02	**5.14%**	5.81E-01	5.81E-01	**0.00%**	2.20E+00	2.20E+00	**0.10%**
C-14	6.90E-01	6.90E-01	**-0.07%**	1.03E+00	1.03E+00	**-0.07%**	5.62E-03	5.62E-03	**-0.02%**	4.48E-01	4.48E-01	**-0.07%**	1.74E+00	1.74E+00	**-0.07%**
Na-22	1.12E-01	1.12E-01	**-0.10%**	4.88E-01	4.88E-01	**-0.09%**	6.23E-02	6.23E-02	**-0.10%**	1.83E-01	1.83E-01	**-0.09%**	3.68E-01	3.68E-01	**-0.09%**
Na-24	2.63E-04	2.63E-04	**-0.11%**	1.00E-03	1.00E-03	**-0.10%**	1.46E-04	1.46E-04	**-0.11%**	3.68E-04	3.67E-04	**-0.10%**	8.03E-04	8.02E-04	**-0.11%**
Al-26	7.95E-01	7.95E-01	**-0.07%**	2.22E+00	3.11E+00	**40.21%**	3.99E-01	9.35E-01	**134.45%**	7.66E-01	1.06E+00	**38.81%**	2.09E+00	4.77E+00	**128.09%**
P-32	8.24E+00	8.24E+00	**-0.07%**	1.68E+01	1.68E+01	**-0.07%**	2.48E-02	2.48E-02	**-0.07%**	6.16E+00	6.16E+00	**-0.07%**	2.07E+01	2.07E+01	**-0.07%**
Si-32	2.16E+00	2.16E+00	**-0.07%**	3.14E+00	3.14E+00	**-0.07%**	7.09E-03	7.09E-03	**-0.01%**	1.37E+00	1.37E+00	**-0.07%**	5.42E+00	5.42E+00	**-0.07%**
S-35	4.25E-03	4.25E-03	**-0.07%**	1.97E-02	1.97E-02	**-0.07%**	1.50E-03	1.50E-03	**-0.07%**	7.46E-03	7.45E-03	**-0.07%**	1.44E-02	1.44E-02	**-0.07%**
Cl-36	2.06E-02	2.06E-02	**-0.07%**	1.18E-01	1.22E-01	**3.33%**	1.26E-02	1.50E-02	**19.04%**	4.60E-02	4.73E-02	**2.84%**	7.97E-02	9.17E-02	**15.04%**
K-40	5.82E-01	5.81E-01	**-0.07%**	1.89E+00	1.97E+00	**3.83%**	1.03E-01	1.47E-01	**43.14%**	6.75E-01	6.99E-01	**3.58%**	1.64E+00	1.86E+00	**13.43%**
K-43	2.82E-04	2.82E-04	**-0.08%**	1.58E-03	1.58E-03	**-0.07%**	1.73E-04	1.73E-04	**-0.08%**	6.12E-04	6.11E-04	**-0.07%**	1.07E-03	1.07E-03	**-0.08%**
Ca-41	4.06E-03	4.06E-03	**-0.07%**	2.60E-02	2.60E-02	**-0.07%**	2.63E-03	2.63E-03	**-0.07%**	1.02E-02	1.02E-02	**-0.07%**	1.69E-02	1.69E-02	**-0.07%**
Ca-45	1.40E-02	1.40E-02	**-0.07%**	8.98E-02	8.97E-02	**-0.07%**	9.07E-03	9.07E-03	**-0.07%**	3.54E-02	3.54E-02	**-0.07%**	5.82E-02	5.82E-02	**-0.07%**
Ca-47	1.51E-02	1.51E-02	**-0.07%**	9.76E-02	9.76E-02	**-0.07%**	9.98E-03	9.97E-03	**-0.07%**	3.84E-02	3.84E-02	**-0.07%**	6.30E-02	6.30E-02	**-0.07%**
Ti-44	5.48E-01	5.47E-01	**-0.07%**	1.34E+00	1.36E+00	**1.80%**	8.00E-02	9.21E-02	**15.10%**	5.46E-01	5.53E-01	**1.46%**	1.54E+00	1.60E+00	**3.88%**
V-49	4.37E-04	4.36E-04	**-0.07%**	2.37E-03	2.37E-03	**-0.07%**	2.23E-04	2.23E-04	**-0.07%**	9.33E-04	9.32E-04	**-0.07%**	1.66E-03	1.66E-03	**-0.07%**
Cr-51	1.63E-03	1.63E-03	**-0.07%**	5.48E-03	5.48E-03	**-0.07%**	4.17E-04	4.17E-04	**-0.07%**	2.21E-03	2.21E-03	**-0.07%**	5.11E-03	5.11E-03	**-0.07%**
Mn-53	2.49E-03	2.49E-03	**-0.07%**	6.54E-03	6.53E-03	**-0.07%**	3.67E-04	3.67E-04	**-0.07%**	2.66E-03	2.66E-03	**-0.07%**	7.16E-03	7.15E-03	**-0.07%**
Mn-54	5.93E-02	5.93E-02	**-0.08%**	1.56E-01	1.56E-01	**-0.08%**	1.14E-02	1.14E-02	**-0.09%**	6.22E-02	6.21E-02	**-0.07%**	1.68E-01	1.68E-01	**-0.08%**
Fe-55	1.56E-01	1.56E-01	**-0.07%**	2.62E-01	2.61E-01	**-0.07%**	4.88E-03	4.87E-03	**-0.07%**	1.12E-01	1.12E-01	**-0.07%**	4.02E-01	4.02E-01	**-0.07%**
Fe-60	4.22E+01	4.22E+01	**-0.07%**	7.08E+01	7.07E+01	**-0.07%**	1.31E+00	1.31E+00	**-0.07%**	3.03E+01	3.03E+01	**-0.07%**	1.09E+02	1.09E+02	**-0.07%**
Co-58	1.12E-01	1.12E-01	**-0.07%**	2.29E-01	2.29E-01	**-0.07%**	9.60E-03	9.59E-03	**-0.08%**	9.57E-02	9.57E-02	**-0.07%**	3.01E-01	3.01E-01	**-0.07%**
Co-60	7.94E-01	7.94E-01	**-0.08%**	1.65E+00	1.65E+00	**0.01%**	1.12E-01	1.12E-01	**0.19%**	6.67E-01	6.67E-01	**0.00%**	2.11E+00	2.11E+00	**0.00%**
Ni-59	3.23E-03	3.23E-03	**-0.07%**	1.01E-02	1.01E-02	**-0.02%**	7.09E-04	7.11E-04	**0.38%**	4.09E-03	4.09E-03	**-0.02%**	9.88E-03	9.89E-03	**0.09%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ni-63	8.02E-03	8.02E-03	**-0.07%**	2.50E-02	2.50E-02	**-0.07%**	1.76E-03	1.76E-03	**-0.07%**	1.02E-02	1.02E-02	**-0.07%**	2.45E-02	2.45E-02	**-0.07%**
Cu-64	1.71E-05	1.71E-05	**-0.09%**	8.81E-05	8.81E-05	**-0.08%**	1.04E-05	1.04E-05	**-0.09%**	3.38E-05	3.38E-05	**-0.08%**	6.18E-05	6.18E-05	**-0.08%**
Zn-65	1.27E+01	1.27E+01	**-0.07%**	1.87E+01	1.87E+01	**-0.07%**	4.38E-02	4.37E-02	**-0.07%**	8.11E+00	8.10E+00	**-0.07%**	3.18E+01	3.18E+01	**-0.07%**
Ge-68	4.77E-01	4.77E-01	**-0.07%**	9.06E-01	9.05E-01	**-0.07%**	1.48E-02	1.48E-02	**-0.07%**	3.63E-01	3.63E-01	**-0.07%**	1.23E+00	1.23E+00	**-0.07%**
Se-75	1.18E+00	1.18E+00	**-0.07%**	2.22E+00	2.22E+00	**-0.07%**	2.97E-02	2.97E-02	**-0.07%**	8.83E-01	8.82E-01	**-0.07%**	3.02E+00	3.02E+00	**-0.07%**
Se-79	1.76E+00	1.76E+00	**-0.07%**	3.30E+00	3.30E+00	**-0.07%**	4.15E-02	4.15E-02	**-0.06%**	1.31E+00	1.31E+00	**-0.07%**	4.51E+00	4.51E+00	**-0.07%**
Rb-87	2.06E-01	2.06E-01	**-0.07%**	6.02E-01	6.02E-01	**-0.06%**	1.82E-02	1.82E-02	**0.03%**	2.15E-01	2.15E-01	**-0.06%**	5.62E-01	5.62E-01	**-0.05%**
Sr-89	4.57E-02	4.57E-02	**-0.07%**	2.98E-01	2.98E-01	**-0.07%**	3.04E-02	3.04E-02	**-0.07%**	1.17E-01	1.17E-01	**-0.07%**	1.92E-01	1.92E-01	**-0.07%**
Sr-90	5.02E-01	5.01E-01	**-0.07%**	3.19E+00	3.20E+00	**0.31%**	3.30E-01	3.34E-01	**1.42%**	1.25E+00	1.26E+00	**0.26%**	2.07E+00	2.09E+00	**1.11%**
Y-90	2.44E-02	2.44E-02	**-0.07%**	1.24E-01	1.24E-01	**-0.07%**	1.16E-02	1.16E-02	**-0.07%**	4.94E-02	4.93E-02	**-0.07%**	9.07E-02	9.06E-02	**-0.07%**
Y-91	1.94E-01	1.94E-01	**-0.07%**	4.92E-01	4.92E-01	**-0.07%**	2.77E-02	2.77E-02	**-0.07%**	2.03E-01	2.03E-01	**-0.07%**	5.56E-01	5.56E-01	**-0.07%**
Mo-93	4.59E-02	4.59E-02	**-0.07%**	2.79E-01	2.80E-01	**0.42%**	2.82E-02	2.90E-02	**2.84%**	1.10E-01	1.10E-01	**0.35%**	1.86E-01	1.90E-01	**2.14%**
Mo-99	3.79E-03	3.79E-03	**-0.07%**	2.46E-02	2.46E-02	**-0.07%**	2.51E-03	2.51E-03	**-0.07%**	9.71E-03	9.70E-03	**-0.07%**	1.59E-02	1.59E-02	**-0.07%**
Nb-93m	3.77E-03	3.76E-03	**-0.07%**	1.85E-02	1.85E-02	**0.09%**	1.63E-03	1.63E-03	**0.52%**	7.17E-03	7.18E-03	**0.07%**	1.35E-02	1.35E-02	**0.29%**
Nb-94	4.75E-01	4.74E-01	**-0.07%**	1.30E+00	1.83E+00	**41.05%**	2.34E-01	5.55E-01	**136.87%**	4.46E-01	6.24E-01	**39.88%**	1.24E+00	2.84E+00	**129.49%**
Nb-95	1.44E-02	1.44E-02	**-0.07%**	7.17E-02	7.16E-02	**-0.07%**	6.55E-03	6.54E-03	**-0.07%**	2.78E-02	2.78E-02	**-0.07%**	5.18E-02	5.17E-02	**-0.07%**
Zr-93	1.63E-02	1.63E-02	**-0.07%**	9.17E-02	9.17E-02	**-0.07%**	8.88E-03	8.87E-03	**-0.07%**	3.63E-02	3.62E-02	**-0.07%**	6.34E-02	6.34E-02	**-0.07%**
Zr-95	2.07E-02	2.07E-02	**-0.07%**	1.14E-01	1.13E-01	**-0.07%**	1.14E-02	1.14E-02	**-0.07%**	4.47E-02	4.46E-02	**-0.07%**	7.91E-02	7.90E-02	**-0.07%**
Tc-96	1.02E-02	1.02E-02	**-0.07%**	6.43E-02	6.43E-02	**-0.07%**	6.64E-03	6.64E-03	**-0.07%**	2.53E-02	2.53E-02	**-0.07%**	4.19E-02	4.19E-02	**-0.07%**
Tc-97	2.66E-03	2.66E-03	**-0.07%**	1.17E-02	1.33E-02	**14.05%**	1.50E-03	2.49E-03	**65.89%**	4.41E-03	4.95E-03	**12.42%**	8.79E-03	1.37E-02	**56.24%**
Tc-98	4.23E-01	4.22E-01	**-0.07%**	1.19E+00	1.67E+00	**40.82%**	2.16E-01	5.07E-01	**134.79%**	4.08E-01	5.70E-01	**39.51%**	1.11E+00	2.57E+00	**130.79%**
Tc-99	1.27E-02	1.27E-02	**-0.07%**	7.98E-02	7.97E-02	**-0.04%**	8.00E-03	8.01E-03	**0.11%**	3.14E-02	3.14E-02	**-0.04%**	5.22E-02	5.23E-02	**0.07%**
Ru-97	1.08E-03	1.08E-03	**-0.07%**	6.67E-03	6.67E-03	**-0.07%**	6.78E-04	6.78E-04	**-0.07%**	2.63E-03	2.62E-03	**-0.07%**	4.40E-03	4.40E-03	**-0.07%**
Ru-103	1.69E-02	1.69E-02	**-0.07%**	8.52E-02	8.51E-02	**-0.07%**	8.07E-03	8.06E-03	**-0.07%**	3.36E-02	3.36E-02	**-0.07%**	6.22E-02	6.21E-02	**-0.07%**
Ru-106	1.85E-01	1.85E-01	**-0.07%**	9.20E-01	9.20E-01	**-0.07%**	8.45E-02	8.44E-02	**-0.07%**	3.65E-01	3.64E-01	**-0.07%**	6.78E-01	6.77E-01	**-0.07%**
Pd-107	1.56E-03	1.56E-03	**-0.07%**	5.84E-03	5.84E-03	**-0.07%**	4.70E-04	4.69E-04	**-0.07%**	2.36E-03	2.35E-03	**-0.07%**	5.11E-03	5.11E-03	**-0.07%**
Ag-108m	5.32E-01	5.31E-01	**-0.07%**	1.43E+00	1.94E+00	**35.84%**	2.42E-01	5.40E-01	**122.96%**	5.00E-01	6.71E-01	**34.13%**	1.40E+00	2.88E+00	**106.61%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ag-110m	1.36E-01	1.36E-01	**-0.08%**	4.59E-01	4.59E-01	**-0.08%**	4.05E-02	4.05E-02	**-0.08%**	1.81E-01	1.81E-01	**-0.07%**	4.19E-01	4.19E-01	**-0.08%**
Cd-113m	7.33E+00	7.32E+00	**-0.07%**	1.23E+01	1.23E+01	**-0.07%**	2.28E-01	2.28E-01	**-0.06%**	5.27E+00	5.26E+00	**-0.07%**	1.89E+01	1.89E+01	**-0.07%**
Cd-115m	1.02E+00	1.02E+00	**-0.07%**	1.75E+00	1.75E+00	**-0.07%**	3.63E-02	3.63E-02	**-0.07%**	7.48E-01	7.48E-01	**-0.07%**	2.65E+00	2.65E+00	**-0.07%**
In-115	2.51E+01	2.51E+01	**-0.07%**	4.43E+01	4.42E+01	**-0.07%**	3.15E-01	3.15E-01	**-0.04%**	1.78E+01	1.78E+01	**-0.07%**	6.36E+01	6.36E+01	**-0.07%**
Sb-122	1.17E-02	1.17E-02	**-0.07%**	7.37E-02	7.37E-02	**-0.07%**	7.44E-03	7.44E-03	**-0.07%**	2.91E-02	2.90E-02	**-0.07%**	4.82E-02	4.81E-02	**-0.07%**
Sb-124	6.32E-02	6.31E-02	**-0.07%**	3.15E-01	3.14E-01	**-0.07%**	3.01E-02	3.01E-02	**-0.07%**	1.24E-01	1.24E-01	**-0.07%**	2.31E-01	2.31E-01	**-0.07%**
Sb-125	4.01E-02	4.01E-02	**-0.09%**	1.71E-01	1.71E-01	**-0.08%**	1.90E-02	1.90E-02	**-0.09%**	6.59E-02	6.58E-02	**-0.08%**	1.34E-01	1.33E-01	**-0.08%**
Te-123	1.04E-01	1.03E-01	**-0.07%**	2.53E-01	2.53E-01	**-0.06%**	1.32E-02	1.32E-02	**-0.03%**	1.04E-01	1.04E-01	**-0.07%**	2.93E-01	2.92E-01	**-0.06%**
Te-125m	7.42E-02	7.41E-02	**-0.07%**	1.88E-01	1.88E-01	**-0.07%**	1.03E-02	1.03E-02	**-0.07%**	7.71E-02	7.71E-02	**-0.07%**	2.12E-01	2.12E-01	**-0.07%**
Sn-126	1.76E+01	1.76E+01	**-0.07%**	2.59E+01	2.59E+01	**0.00%**	6.37E-02	7.41E-02	**16.36%**	1.12E+01	1.12E+01	**-0.02%**	4.42E+01	4.42E+01	**0.05%**
I-129	1.99E+00	1.99E+00	**-0.07%**	1.11E+01	1.11E+01	**0.00%**	1.08E+00	1.08E+00	**0.33%**	4.41E+00	4.40E+00	**-0.01%**	7.73E+00	7.74E+00	**0.21%**
I-131	3.27E-01	3.27E-01	**-0.07%**	1.98E+00	1.98E+00	**-0.07%**	1.97E-01	1.97E-01	**-0.07%**	7.82E-01	7.81E-01	**-0.07%**	1.32E+00	1.32E+00	**-0.07%**
Cs-134	1.18E+00	1.18E+00	**-0.07%**	3.91E+00	3.91E+00	**-0.07%**	1.81E-01	1.81E-01	**-0.07%**	1.41E+00	1.41E+00	**-0.07%**	3.37E+00	3.36E+00	**-0.07%**
Cs-135	1.63E-01	1.63E-01	**-0.07%**	5.45E-01	5.45E-01	**-0.07%**	2.34E-02	2.34E-02	**-0.02%**	1.96E-01	1.96E-01	**-0.07%**	4.67E-01	4.67E-01	**-0.06%**
Cs-137	9.31E-01	9.30E-01	**-0.07%**	3.02E+00	3.08E+00	**2.15%**	1.73E-01	2.00E-01	**15.68%**	1.08E+00	1.10E+00	**2.00%**	2.63E+00	2.76E+00	**5.12%**
La-137	7.96E-03	7.95E-03	**-0.07%**	2.52E-02	3.25E-02	**28.75%**	3.90E-03	8.26E-03	**111.85%**	9.09E-03	1.15E-02	**26.60%**	2.24E-02	4.42E-02	**97.23%**
La-138	3.51E-01	3.51E-01	**-0.07%**	9.43E-01	1.35E+00	**42.90%**	1.74E-01	4.18E-01	**139.32%**	3.23E-01	4.58E-01	**41.79%**	9.09E-01	2.12E+00	**133.78%**
La-140	7.11E-03	7.11E-03	**-0.07%**	4.53E-02	4.52E-02	**-0.07%**	4.66E-03	4.66E-03	**-0.07%**	1.78E-02	1.78E-02	**-0.07%**	2.94E-02	2.94E-02	**-0.07%**
Ba-140	3.90E-02	3.89E-02	**-0.07%**	2.55E-01	2.54E-01	**-0.07%**	2.60E-02	2.59E-02	**-0.07%**	1.00E-01	1.00E-01	**-0.07%**	1.64E-01	1.64E-01	**-0.07%**
Ce-141	3.23E-02	3.22E-02	**-0.07%**	1.08E-01	1.08E-01	**-0.07%**	8.01E-03	8.00E-03	**-0.07%**	4.36E-02	4.36E-02	**-0.07%**	1.01E-01	1.01E-01	**-0.07%**
Ce-144	2.87E-01	2.87E-01	**-0.07%**	9.02E-01	9.02E-01	**-0.07%**	6.38E-02	6.38E-02	**-0.07%**	3.67E-01	3.67E-01	**-0.07%**	8.81E-01	8.81E-01	**-0.07%**
Sm-146	4.74E+00	4.73E+00	**-0.07%**	1.16E+01	1.16E+01	**-0.07%**	6.22E-01	6.22E-01	**-0.07%**	4.79E+00	4.79E+00	**-0.07%**	1.34E+01	1.34E+01	**-0.07%**
Sm-147	4.33E+00	4.32E+00	**-0.07%**	1.06E+01	1.06E+01	**-0.07%**	5.68E-01	5.68E-01	**-0.07%**	4.37E+00	4.37E+00	**-0.07%**	1.23E+01	1.23E+01	**-0.07%**
Sm-151	9.12E-03	9.12E-03	**-0.07%**	2.23E-02	2.23E-02	**-0.06%**	1.20E-03	1.20E-03	**-0.03%**	9.23E-03	9.22E-03	**-0.07%**	2.59E-02	2.59E-02	**-0.06%**
Pm-147	2.43E-02	2.43E-02	**-0.07%**	5.96E-02	5.95E-02	**-0.07%**	3.21E-03	3.21E-03	**-0.07%**	2.47E-02	2.46E-02	**-0.07%**	6.91E-02	6.90E-02	**-0.07%**
Eu-152	2.55E-01	2.54E-01	**-0.09%**	6.30E-01	6.61E-01	**4.96%**	8.27E-02	9.21E-02	**11.36%**	2.33E-01	2.44E-01	**4.46%**	6.76E-01	7.23E-01	**6.92%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Eu-154	2.81E-01	2.81E-01	**-0.09%**	6.93E-01	7.01E-01	**1.11%**	7.37E-02	7.57E-02	**2.70%**	2.66E-01	2.68E-01	**0.96%**	7.62E-01	7.72E-01	**1.27%**
Eu-155	3.38E-02	3.38E-02	**-0.07%**	8.28E-02	8.28E-02	**-0.05%**	5.35E-03	5.34E-03	**-0.01%**	3.36E-02	3.36E-02	**-0.05%**	9.47E-02	9.47E-02	**-0.05%**
Gd-152	6.46E+00	6.46E+00	**-0.07%**	1.29E+01	1.29E+01	**-0.07%**	4.72E-01	4.72E-01	**-0.07%**	5.43E+00	5.42E+00	**-0.07%**	1.74E+01	1.73E+01	**-0.07%**
Ho-166m	6.11E-01	6.10E-01	**-0.07%**	1.52E+00	2.05E+00	**35.39%**	2.42E-01	5.61E-01	**131.88%**	5.40E-01	7.19E-01	**33.16%**	1.58E+00	3.18E+00	**100.61%**
Lu-176	2.93E-01	2.93E-01	**-0.07%**	7.23E-01	8.84E-01	**22.31%**	8.63E-02	1.83E-01	**112.46%**	2.73E-01	3.27E-01	**19.67%**	7.87E-01	1.27E+00	**61.58%**
Ta-180	7.82E-07	7.82E-07	**-0.11%**	3.12E-06	3.12E-06	**-0.10%**	4.40E-07	4.39E-07	**-0.11%**	1.15E-06	1.15E-06	**-0.09%**	2.45E-06	2.44E-06	**-0.10%**
Hf-182	3.54E-01	3.54E-01	**-0.07%**	8.71E-01	9.51E-01	**9.19%**	6.28E-02	1.11E-01	**77.09%**	3.36E-01	3.63E-01	**7.94%**	9.62E-01	1.20E+00	**25.09%**
Re-186m	5.96E-02	5.95E-02	**-0.07%**	3.02E-01	3.07E-01	**1.50%**	2.89E-02	3.17E-02	**9.78%**	1.18E-01	1.20E-01	**1.27%**	2.18E-01	2.32E-01	**6.46%**
Re-187	1.21E-04	1.21E-04	**-0.07%**	6.34E-04	6.34E-04	**-0.07%**	5.85E-05	5.84E-05	**-0.07%**	2.49E-04	2.49E-04	**-0.07%**	4.52E-04	4.51E-04	**-0.07%**
Ir-192n	2.35E-02	2.35E-02	**-0.07%**	1.18E-01	1.19E-01	**0.16%**	1.11E-02	1.13E-02	**1.29%**	4.71E-02	4.71E-02	**0.12%**	8.70E-02	8.77E-02	**0.80%**
Pt-193	6.01E-03	6.01E-03	**-0.07%**	1.20E-02	1.20E-02	**0.09%**	4.49E-04	4.58E-04	**1.95%**	5.05E-03	5.05E-03	**0.06%**	1.61E-02	1.62E-02	**0.21%**
Hg-194	1.85E+00	1.85E+00	**-0.07%**	2.91E+00	2.91E+00	**-0.07%**	1.39E-02	1.39E-02	**0.16%**	1.23E+00	1.23E+00	**-0.07%**	4.66E+00	4.66E+00	**-0.07%**
Hg-203	7.10E-01	7.10E-01	**-0.07%**	1.13E+00	1.12E+00	**-0.07%**	6.20E-03	6.20E-03	**-0.07%**	4.74E-01	4.74E-01	**-0.07%**	1.79E+00	1.79E+00	**-0.07%**
Pb-202	1.41E+00	1.41E+00	**-0.07%**	3.45E+00	3.44E+00	**-0.07%**	1.86E-01	1.85E-01	**-0.05%**	1.43E+00	1.43E+00	**-0.07%**	4.00E+00	4.00E+00	**-0.06%**
Pb-205	2.38E-02	2.38E-02	**-0.07%**	5.82E-02	5.82E-02	**0.05%**	3.15E-03	3.19E-03	**1.24%**	2.41E-02	2.41E-02	**0.03%**	6.75E-02	6.77E-02	**0.24%**
Pb-210	6.88E+01	6.87E+01	**-0.07%**	1.68E+02	1.68E+02	**-0.07%**	9.05E+00	9.04E+00	**-0.07%**	6.96E+01	6.95E+01	**-0.07%**	1.95E+02	1.95E+02	**-0.07%**
Bi-207	3.95E-01	3.95E-01	**-0.09%**	9.82E-01	1.17E+00	**18.70%**	1.57E-01	2.34E-01	**49.02%**	3.49E-01	4.10E-01	**17.52%**	1.03E+00	1.41E+00	**37.44%**
Bi-210	2.99E-02	2.99E-02	**-0.07%**	1.13E-01	1.13E-01	**-0.07%**	9.19E-03	9.19E-03	**-0.07%**	4.56E-02	4.56E-02	**-0.07%**	9.83E-02	9.82E-02	**-0.07%**
Bi-210m	1.42E+00	1.42E+00	**-0.07%**	3.48E+00	3.57E+00	**2.47%**	2.14E-01	2.67E-01	**24.72%**	1.43E+00	1.46E+00	**1.99%**	4.02E+00	4.28E+00	**6.53%**
Po-210	9.03E+02	9.02E+02	**-0.07%**	1.31E+03	1.31E+03	**-0.07%**	3.10E+00	3.09E+00	**-0.07%**	5.74E+02	5.73E+02	**-0.07%**	2.27E+03	2.26E+03	**-0.07%**
Ra-223	2.80E+00	2.80E+00	**-0.07%**	1.56E+01	1.56E+01	**-0.07%**	1.51E+00	1.51E+00	**-0.07%**	6.18E+00	6.17E+00	**-0.07%**	1.09E+01	1.08E+01	**-0.07%**
Ra-224	8.43E-01	8.42E-01	**-0.07%**	5.23E+00	5.22E+00	**-0.07%**	5.24E-01	5.24E-01	**-0.07%**	2.06E+00	2.06E+00	**-0.07%**	3.45E+00	3.44E+00	**-0.07%**
Ra-225	3.33E+00	3.33E+00	**-0.07%**	1.82E+01	1.82E+01	**-0.07%**	1.75E+00	1.75E+00	**-0.07%**	7.22E+00	7.22E+00	**-0.07%**	1.28E+01	1.28E+01	**-0.07%**
Ra-226	8.48E+00	8.47E+00	**-0.07%**	4.30E+01	4.29E+01	**-0.06%**	4.02E+00	4.02E+00	**-0.03%**	1.71E+01	1.71E+01	**-0.06%**	3.15E+01	3.15E+01	**-0.05%**
Ra-228	2.99E+01	2.99E+01	**-0.07%**	1.52E+02	1.51E+02	**-0.07%**	1.42E+01	1.42E+01	**-0.07%**	6.02E+01	6.02E+01	**-0.07%**	1.11E+02	1.11E+02	**-0.07%**
Ac-227	2.64E+01	2.64E+01	**-0.07%**	6.46E+01	6.46E+01	**-0.07%**	3.48E+00	3.48E+00	**-0.07%**	2.67E+01	2.67E+01	**-0.07%**	7.50E+01	7.49E+01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Th-227	6.58E-01	6.57E-01	**-0.07%**	1.80E+00	1.80E+00	**-0.07%**	1.13E-01	1.12E-01	**-0.07%**	7.41E-01	7.40E-01	**-0.07%**	1.93E+00	1.93E+00	**-0.07%**
Th-228	7.71E+00	7.71E+00	**-0.07%**	1.89E+01	1.89E+01	**-0.07%**	1.03E+00	1.02E+00	**-0.07%**	7.83E+00	7.82E+00	**-0.07%**	2.19E+01	2.19E+01	**-0.07%**
Th-229	4.10E+01	4.09E+01	**-0.07%**	1.00E+02	1.00E+02	**-0.04%**	5.42E+00	5.43E+00	**0.24%**	4.15E+01	4.14E+01	**-0.05%**	1.16E+02	1.16E+02	**0.00%**
Th-230	1.70E+01	1.70E+01	**-0.07%**	4.15E+01	4.15E+01	**-0.07%**	2.25E+00	2.24E+00	**-0.06%**	1.72E+01	1.72E+01	**-0.07%**	4.83E+01	4.82E+01	**-0.07%**
Th-231	4.57E-04	4.57E-04	**-0.07%**	2.97E-03	2.97E-03	**-0.07%**	3.02E-04	3.02E-04	**-0.07%**	1.17E-03	1.17E-03	**-0.07%**	1.91E-03	1.91E-03	**-0.07%**
Th-232	1.87E+01	1.87E+01	**-0.07%**	4.56E+01	4.56E+01	**-0.07%**	2.47E+00	2.47E+00	**-0.06%**	1.89E+01	1.89E+01	**-0.07%**	5.30E+01	5.30E+01	**-0.07%**
Th-234	2.29E-01	2.29E-01	**-0.07%**	6.12E-01	6.11E-01	**-0.07%**	3.70E-02	3.70E-02	**-0.07%**	2.52E-01	2.52E-01	**-0.07%**	6.67E-01	6.67E-01	**-0.07%**
Pa-230	1.46E-02	1.46E-02	**-0.07%**	9.16E-02	9.15E-02	**-0.07%**	9.34E-03	9.33E-03	**-0.07%**	3.60E-02	3.60E-02	**-0.07%**	5.98E-02	5.98E-02	**-0.07%**
Pa-231	7.81E+00	7.81E+00	**-0.07%**	4.93E+01	4.93E+01	**-0.04%**	4.97E+00	4.97E+00	**0.08%**	1.94E+01	1.94E+01	**-0.05%**	3.22E+01	3.22E+01	**0.05%**
Pa-233	1.66E-02	1.66E-02	**-0.07%**	1.05E-01	1.05E-01	**-0.07%**	1.07E-02	1.07E-02	**-0.07%**	4.14E-02	4.14E-02	**-0.07%**	6.86E-02	6.86E-02	**-0.07%**
U-232	5.58E+00	5.58E+00	**-0.07%**	3.55E+01	3.54E+01	**-0.07%**	3.59E+00	3.58E+00	**-0.07%**	1.40E+01	1.40E+01	**-0.07%**	2.31E+01	2.31E+01	**-0.07%**
U-233	8.32E-01	8.31E-01	**-0.07%**	5.29E+00	5.28E+00	**-0.07%**	5.34E-01	5.34E-01	**-0.05%**	2.09E+00	2.08E+00	**-0.07%**	3.45E+00	3.44E+00	**-0.05%**
U-234	8.03E-01	8.02E-01	**-0.07%**	5.10E+00	5.10E+00	**-0.06%**	5.16E-01	5.16E-01	**-0.04%**	2.01E+00	2.01E+00	**-0.06%**	3.33E+00	3.32E+00	**-0.05%**
U-235	8.02E-01	8.01E-01	**-0.07%**	4.93E+00	4.98E+00	**1.03%**	5.09E-01	5.41E-01	**6.29%**	1.94E+00	1.95E+00	**0.86%**	3.25E+00	3.41E+00	**4.91%**
U-236	7.56E-01	7.55E-01	**-0.07%**	4.80E+00	4.80E+00	**-0.06%**	4.86E-01	4.85E-01	**-0.05%**	1.90E+00	1.89E+00	**-0.07%**	3.13E+00	3.13E+00	**-0.05%**
U-237	9.51E-03	9.51E-03	**-0.07%**	6.15E-02	6.14E-02	**-0.07%**	6.26E-03	6.25E-03	**-0.07%**	2.42E-02	2.42E-02	**-0.07%**	3.97E-02	3.97E-02	**-0.07%**
U-238	7.24E-01	7.24E-01	**-0.07%**	4.60E+00	4.60E+00	**-0.07%**	4.65E-01	4.65E-01	**-0.05%**	1.82E+00	1.81E+00	**-0.07%**	3.00E+00	3.00E+00	**-0.05%**
Np-236	4.19E-01	4.18E-01	**-0.07%**	2.48E+00	2.53E+00	**1.80%**	2.58E-01	2.86E-01	**10.69%**	9.73E-01	9.88E-01	**1.52%**	1.66E+00	1.80E+00	**8.31%**
Np-237	1.77E+00	1.77E+00	**-0.07%**	1.11E+01	1.11E+01	**0.01%**	1.11E+00	1.12E+00	**0.41%**	4.37E+00	4.37E+00	**0.00%**	7.27E+00	7.29E+00	**0.30%**
Np-239	4.59E-03	4.59E-03	**-0.07%**	2.99E-02	2.99E-02	**-0.07%**	3.05E-03	3.05E-03	**-0.07%**	1.18E-02	1.18E-02	**-0.07%**	1.92E-02	1.92E-02	**-0.07%**
Am-237	4.23E-11	4.23E-11	**-0.14%**	1.06E-10	1.06E-10	**-0.14%**	2.12E-11	2.11E-11	**-0.14%**	3.53E-11	3.52E-11	**-0.14%**	1.06E-10	1.06E-10	**-0.14%**
Am-241	8.67E+00	8.66E+00	**-0.07%**	2.95E+01	2.95E+01	**-0.04%**	2.12E+00	2.12E+00	**0.13%**	1.18E+01	1.18E+01	**-0.05%**	2.71E+01	2.71E+01	**0.01%**
Am-242m	7.86E+00	7.86E+00	**-0.07%**	2.68E+01	2.68E+01	**-0.07%**	1.92E+00	1.92E+00	**-0.05%**	1.07E+01	1.07E+01	**-0.07%**	2.46E+01	2.45E+01	**-0.06%**
Am-243	8.60E+00	8.60E+00	**-0.07%**	2.93E+01	2.93E+01	**-0.01%**	2.10E+00	2.11E+00	**0.44%**	1.17E+01	1.17E+01	**-0.02%**	2.69E+01	2.69E+01	**0.13%**
Pu-237	4.00E-03	4.00E-03	**-0.07%**	1.55E-02	1.55E-02	**-0.07%**	1.29E-03	1.29E-03	**-0.07%**	6.22E-03	6.21E-03	**-0.07%**	1.32E-02	1.32E-02	**-0.07%**
Pu-238	7.86E+00	7.85E+00	**-0.07%**	2.93E+01	2.92E+01	**-0.07%**	2.33E+00	2.33E+00	**-0.07%**	1.18E+01	1.18E+01	**-0.07%**	2.56E+01	2.56E+01	**-0.07%**
Pu-239	8.61E+00	8.60E+00	**-0.07%**	3.20E+01	3.20E+01	**-0.07%**	2.56E+00	2.55E+00	**-0.07%**	1.29E+01	1.29E+01	**-0.07%**	2.81E+01	2.80E+01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Pu-240	8.61E+00	8.60E+00	**-0.07%**	3.20E+01	3.20E+01	**-0.07%**	2.56E+00	2.55E+00	**-0.06%**	1.29E+01	1.29E+01	**-0.07%**	2.81E+01	2.80E+01	**-0.07%**
Pu-241	1.56E-01	1.55E-01	**-0.07%**	5.79E-01	5.79E-01	**-0.07%**	4.62E-02	4.62E-02	**-0.07%**	2.33E-01	2.33E-01	**-0.07%**	5.07E-01	5.07E-01	**-0.07%**
Pu-242	8.19E+00	8.18E+00	**-0.07%**	3.05E+01	3.05E+01	**-0.07%**	2.43E+00	2.43E+00	**-0.06%**	1.23E+01	1.23E+01	**-0.07%**	2.67E+01	2.67E+01	**-0.07%**
Pu-244	8.17E+00	8.16E+00	**-0.07%**	3.04E+01	3.04E+01	**-0.05%**	2.43E+00	2.43E+00	**0.10%**	1.22E+01	1.22E+01	**-0.05%**	2.66E+01	2.66E+01	**0.01%**
Cm-241	3.94E-02	3.94E-02	**-0.07%**	1.35E-01	1.35E-01	**-0.07%**	1.04E-02	1.03E-02	**-0.07%**	5.45E-02	5.44E-02	**-0.07%**	1.24E-01	1.24E-01	**-0.07%**
Cm-242	7.09E-01	7.09E-01	**-0.07%**	2.31E+00	2.31E+00	**-0.07%**	1.68E-01	1.67E-01	**-0.07%**	9.36E-01	9.35E-01	**-0.07%**	2.20E+00	2.20E+00	**-0.07%**
Cm-243	6.95E+00	6.94E+00	**-0.07%**	2.23E+01	2.23E+01	**-0.01%**	1.61E+00	1.61E+00	**0.26%**	9.04E+00	9.04E+00	**-0.02%**	2.15E+01	2.15E+01	**0.05%**
Cm-244	5.81E+00	5.80E+00	**-0.07%**	1.86E+01	1.86E+01	**-0.07%**	1.34E+00	1.34E+00	**-0.07%**	7.57E+00	7.56E+00	**-0.07%**	1.79E+01	1.79E+01	**-0.07%**
Cm-245	9.34E+00	9.34E+00	**-0.07%**	3.00E+01	3.00E+01	**0.04%**	2.16E+00	2.18E+00	**0.84%**	1.22E+01	1.22E+01	**0.02%**	2.89E+01	2.89E+01	**0.27%**
Cm-246	9.28E+00	9.27E+00	**-0.07%**	2.98E+01	2.98E+01	**-0.06%**	2.14E+00	2.14E+00	**-0.03%**	1.21E+01	1.21E+01	**-0.06%**	2.87E+01	2.87E+01	**-0.05%**
Cm-247	8.63E+00	8.63E+00	**-0.07%**	2.76E+01	2.77E+01	**0.32%**	2.01E+00	2.08E+00	**3.15%**	1.12E+01	1.12E+01	**0.25%**	2.66E+01	2.69E+01	**1.15%**
Cm-248	3.51E+01	3.51E+01	**-0.07%**	1.12E+02	1.13E+02	**0.33%**	8.20E+00	8.46E+00	**3.24%**	4.56E+01	4.57E+01	**0.26%**	1.08E+02	1.10E+02	**1.18%**
Cm-250	2.42E+02	2.41E+02	**-0.07%**	7.73E+02	7.77E+02	**0.52%**	5.67E+01	5.94E+01	**4.77%**	3.13E+02	3.14E+02	**0.42%**	7.44E+02	7.58E+02	**1.77%**
Bk-247	2.99E+01	2.99E+01	**-0.07%**	7.32E+01	7.32E+01	**0.00%**	3.95E+00	3.98E+00	**0.63%**	3.03E+01	3.03E+01	**-0.02%**	8.49E+01	8.50E+01	**0.09%**
Bk-249	8.24E-02	8.24E-02	**-0.07%**	2.03E-01	2.02E-01	**-0.07%**	1.10E-02	1.10E-02	**-0.07%**	8.38E-02	8.38E-02	**-0.07%**	2.34E-01	2.34E-01	**-0.07%**
Cf-249	1.82E+01	1.82E+01	**-0.07%**	5.66E+01	5.67E+01	**0.11%**	4.00E+00	4.06E+00	**1.39%**	2.30E+01	2.30E+01	**0.08%**	5.56E+01	5.58E+01	**0.46%**
Cf-250	9.00E+00	8.99E+00	**-0.07%**	2.80E+01	2.80E+01	**-0.07%**	1.97E+00	1.97E+00	**-0.06%**	1.14E+01	1.14E+01	**-0.07%**	2.75E+01	2.75E+01	**-0.07%**
Cf-251	1.85E+01	1.85E+01	**-0.07%**	5.76E+01	5.76E+01	**0.00%**	4.05E+00	4.07E+00	**0.47%**	2.34E+01	2.34E+01	**-0.02%**	5.66E+01	5.66E+01	**0.13%**
Cf-252	6.10E+00	6.09E+00	**-0.07%**	1.90E+01	1.90E+01	**-0.07%**	1.34E+00	1.34E+00	**-0.07%**	7.74E+00	7.73E+00	**-0.07%**	1.87E+01	1.86E+01	**-0.07%**
Es-253	2.35E+00	2.34E+00	**-0.07%**	3.90E+00	3.90E+00	**-0.07%**	7.14E-02	7.13E-02	**-0.07%**	1.68E+00	1.67E+00	**-0.07%**	6.05E+00	6.04E+00	**-0.07%**
UI alpha	8.61E+00	8.60E+00	**-0.07%**	3.20E+01	3.20E+01	**-0.07%**	2.56E+00	2.55E+00	**-0.07%**	1.29E+01	1.29E+01	**-0.07%**	2.81E+01	2.80E+01	**-0.07%**
UI beta	5.02E-01	5.01E-01	**-0.07%**	3.19E+00	3.20E+00	**0.31%**	3.30E-01	3.34E-01	**1.42%**	1.25E+00	1.26E+00	**0.26%**	2.07E+00	2.09E+00	**1.11%**

Table C-4. SQAP Test Cases 1-5 Radionuclide Effective Dose (ED) for Population - IRRIDOSE

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
H-3	5.85E-05	5.85E-05	**-0.07%**	1.46E-04	1.46E-04	**-0.07%**	2.93E-05	6.24E-06	**-78.67%**	4.88E-05	4.87E-05	**-0.07%**	2.34E-04	2.34E-04	**-0.07%**
Be-7	3.63E-04	3.62E-04	**-0.07%**	1.39E-03	1.39E-03	**-0.07%**	2.88E-04	1.22E-06	**-99.58%**	3.72E-04	3.72E-04	**-0.07%**	1.23E-03	1.22E-03	**-0.07%**
Be-10	2.33E-02	2.33E-02	**-0.07%**	7.61E-02	7.61E-02	**-0.06%**	1.91E-02	7.99E-05	**-99.58%**	2.36E-02	2.35E-02	**-0.07%**	7.89E-02	7.88E-02	**-0.06%**
C-14	5.69E-02	5.68E-02	**-0.01%**	2.58E-01	2.58E-01	**-0.01%**	9.93E-02	1.47E-02	**-85.23%**	7.41E-02	7.41E-02	**-0.01%**	5.46E-01	5.46E-01	**-0.01%**
Na-22	6.83E-02	6.82E-02	**-0.07%**	2.21E-01	2.21E-01	**-0.07%**	5.37E-02	8.93E-03	**-83.36%**	8.34E-02	8.34E-02	**-0.07%**	4.54E-01	4.54E-01	**-0.07%**
Na-24	3.71E-06	3.71E-06	**-0.07%**	2.48E-04	2.48E-04	**-0.07%**	2.11E-06	2.11E-06	**-0.07%**	1.45E-06	1.45E-06	**-0.07%**	1.16E-05	1.16E-05	**-0.07%**
Al-26	6.76E-02	6.75E-02	**-0.07%**	2.19E-01	2.19E-01	**-0.07%**	5.40E-02	3.96E-04	**-99.27%**	6.83E-02	6.82E-02	**-0.07%**	2.30E-01	2.30E-01	**-0.07%**
P-32	2.41E-02	2.41E-02	**-0.07%**	1.22E-01	1.22E-01	**-0.07%**	1.85E-02	6.68E-03	**-63.96%**	3.63E-02	3.63E-02	**-0.07%**	2.84E-01	2.84E-01	**-0.07%**
Si-32	2.04E-02	2.04E-02	**-0.04%**	7.79E-02	7.79E-02	**-0.04%**	2.42E-02	9.78E-05	**-99.59%**	2.27E-02	2.27E-02	**-0.04%**	9.12E-02	9.12E-02	**-0.04%**
S-35	2.75E-03	2.75E-03	**-0.07%**	9.67E-03	9.67E-03	**-0.07%**	2.16E-03	3.87E-04	**-82.12%**	3.23E-03	3.23E-03	**-0.07%**	4.46E-02	4.46E-02	**-0.07%**
Cl-36	2.44E+00	2.44E+00	**0.00%**	1.18E+01	1.18E+01	**0.00%**	4.81E+00	9.04E-01	**-81.20%**	3.24E+00	3.24E+00	**0.00%**	2.42E+01	2.42E+01	**0.00%**
K-40	1.18E+00	1.18E+00	**-0.01%**	5.50E+00	5.50E+00	**0.00%**	2.18E+00	2.08E-01	**-90.45%**	1.54E+00	1.54E+00	**-0.01%**	1.03E+01	1.03E+01	**0.00%**
K-43	5.83E-06	5.83E-06	**-0.07%**	3.52E-04	3.51E-04	**-0.07%**	3.45E-06	3.44E-06	**-0.19%**	4.33E-06	4.33E-06	**-0.07%**	3.31E-05	3.31E-05	**-0.07%**
Ca-41	6.01E-01	6.01E-01	**0.00%**	2.91E+00	2.91E+00	**0.00%**	1.19E+00	1.45E-01	**-87.81%**	7.97E-01	7.97E-01	**0.00%**	5.44E+00	5.44E+00	**0.00%**
Ca-45	4.76E-02	4.76E-02	**-0.07%**	1.62E-01	1.62E-01	**-0.07%**	3.77E-02	4.94E-03	**-86.91%**	4.77E-02	4.77E-02	**-0.07%**	2.17E-01	2.16E-01	**-0.07%**
Ca-47	2.31E-03	2.31E-03	**-0.07%**	3.13E-02	3.13E-02	**-0.07%**	1.72E-03	8.31E-04	**-51.64%**	4.51E-03	4.50E-03	**-0.07%**	2.62E-02	2.62E-02	**-0.07%**
Ti-44	1.10E-01	1.10E-01	**-0.07%**	3.57E-01	3.57E-01	**-0.07%**	8.83E-02	4.34E-04	**-99.51%**	1.11E-01	1.11E-01	**-0.07%**	3.62E-01	3.62E-01	**-0.07%**
V-49	3.50E-04	3.50E-04	**-0.07%**	1.17E-03	1.16E-03	**-0.07%**	2.78E-04	1.43E-06	**-99.49%**	3.53E-04	3.53E-04	**-0.07%**	1.20E-03	1.20E-03	**-0.07%**
Cr-51	3.93E-04	3.93E-04	**-0.07%**	1.75E-03	1.75E-03	**-0.07%**	3.12E-04	5.19E-06	**-98.33%**	4.23E-04	4.23E-04	**-0.07%**	1.69E-03	1.69E-03	**-0.07%**
Mn-53	1.81E-03	1.81E-03	**-0.02%**	7.80E-03	7.80E-03	**-0.02%**	2.87E-03	1.30E-05	**-99.55%**	2.20E-03	2.20E-03	**-0.02%**	1.06E-02	1.06E-02	**-0.01%**
Mn-54	1.30E-02	1.30E-02	**-0.07%**	4.35E-02	4.34E-02	**-0.07%**	1.04E-02	4.78E-05	**-99.54%**	1.31E-02	1.30E-02	**-0.07%**	4.27E-02	4.27E-02	**-0.07%**
Fe-55	8.23E-03	8.22E-03	**-0.07%**	2.69E-02	2.68E-02	**-0.07%**	6.53E-03	6.57E-05	**-98.99%**	8.27E-03	8.27E-03	**-0.07%**	3.44E-02	3.44E-02	**-0.07%**
Fe-60	2.92E+00	2.92E+00	**-0.05%**	1.07E+01	1.06E+01	**-0.04%**	3.21E+00	3.14E-02	**-99.02%**	3.18E+00	3.18E+00	**-0.05%**	1.51E+01	1.51E+01	**-0.04%**
Co-58	1.15E-02	1.15E-02	**-0.07%**	4.23E-02	4.23E-02	**-0.07%**	9.15E-03	5.25E-05	**-99.43%**	1.17E-02	1.17E-02	**-0.07%**	3.85E-02	3.84E-02	**-0.07%**
Co-60	9.13E-02	9.12E-02	**-0.07%**	2.97E-01	2.97E-01	**-0.07%**	7.26E-02	3.99E-04	**-99.45%**	9.06E-02	9.05E-02	**-0.07%**	2.96E-01	2.96E-01	**-0.07%**
Ni-59	1.98E-03	1.98E-03	**-0.04%**	7.71E-03	7.71E-03	**-0.03%**	2.53E-03	4.62E-05	**-98.17%**	2.27E-03	2.27E-03	**-0.04%**	1.05E-02	1.05E-02	**-0.03%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ni-63	4.68E-03	4.68E-03	**-0.04%**	1.74E-02	1.74E-02	**-0.04%**	5.19E-03	9.55E-05	**-98.16%**	5.17E-03	5.17E-03	**-0.04%**	2.20E-02	2.20E-02	**-0.04%**
Cu-64	7.30E-08	7.30E-08	**-0.07%**	2.89E-05	2.89E-05	**-0.07%**	4.10E-08	4.10E-08	**-0.07%**	2.40E-08	2.40E-08	**-0.07%**	1.86E-07	1.86E-07	**-0.07%**
Zn-65	8.15E-02	8.15E-02	**-0.07%**	2.72E-01	2.72E-01	**-0.07%**	6.44E-02	6.47E-03	**-89.95%**	8.75E-02	8.74E-02	**-0.07%**	1.07E+00	1.07E+00	**-0.07%**
Ge-68	5.73E-02	5.73E-02	**-0.07%**	1.85E-01	1.85E-01	**-0.07%**	4.40E-02	2.55E-02	**-42.07%**	9.65E-02	9.65E-02	**-0.07%**	1.75E+00	1.74E+00	**-0.07%**
Se-75	4.55E-02	4.54E-02	**-0.07%**	1.58E-01	1.57E-01	**-0.07%**	3.60E-02	2.43E-03	**-93.24%**	4.96E-02	4.96E-02	**-0.07%**	2.36E-01	2.36E-01	**-0.07%**
Se-79	1.16E-01	1.16E-01	**-0.04%**	4.43E-01	4.42E-01	**-0.03%**	1.42E-01	8.58E-03	**-93.97%**	1.36E-01	1.36E-01	**-0.04%**	7.35E-01	7.34E-01	**-0.03%**
Rb-87	1.86E-01	1.86E-01	**-0.01%**	8.45E-01	8.44E-01	**-0.01%**	3.27E-01	4.63E-02	**-85.82%**	2.43E-01	2.43E-01	**-0.01%**	1.60E+00	1.60E+00	**-0.01%**
Sr-89	3.87E-02	3.87E-02	**-0.07%**	1.49E-01	1.49E-01	**-0.07%**	3.07E-02	7.94E-04	**-97.41%**	4.07E-02	4.07E-02	**-0.07%**	1.45E-01	1.45E-01	**-0.07%**
Sr-90	1.85E+00	1.85E+00	**-0.04%**	7.01E+00	7.01E+00	**-0.04%**	1.97E+00	4.16E-02	**-97.88%**	1.99E+00	1.99E+00	**-0.04%**	7.67E+00	7.67E+00	**-0.05%**
Y-90	2.32E-04	2.31E-04	**-0.07%**	2.16E-02	2.16E-02	**-0.07%**	1.83E-04	2.75E-06	**-98.50%**	1.13E-03	1.13E-03	**-0.07%**	3.77E-03	3.76E-03	**-0.07%**
Y-91	3.51E-02	3.51E-02	**-0.07%**	1.33E-01	1.32E-01	**-0.07%**	2.79E-02	1.27E-04	**-99.54%**	3.59E-02	3.59E-02	**-0.07%**	1.19E-01	1.18E-01	**-0.07%**
Mo-93	1.71E-01	1.71E-01	**-0.02%**	7.56E-01	7.56E-01	**-0.01%**	2.84E-01	5.20E-03	**-98.17%**	2.13E-01	2.13E-01	**-0.01%**	1.08E+00	1.08E+00	**-0.01%**
Mo-99	7.80E-05	7.80E-05	**-0.07%**	4.81E-03	4.81E-03	**-0.07%**	5.88E-05	1.56E-05	**-73.55%**	2.88E-04	2.88E-04	**-0.07%**	1.10E-03	1.10E-03	**-0.07%**
Nb-93m	2.68E-03	2.68E-03	**-0.07%**	8.71E-03	8.70E-03	**-0.07%**	2.14E-03	8.06E-06	**-99.62%**	2.69E-03	2.69E-03	**-0.07%**	8.68E-03	8.68E-03	**-0.07%**
Nb-94	3.48E-02	3.48E-02	**-0.06%**	1.16E-01	1.16E-01	**-0.06%**	3.03E-02	1.14E-04	**-99.62%**	3.57E-02	3.56E-02	**-0.06%**	1.21E-01	1.21E-01	**-0.06%**
Nb-95	6.58E-03	6.58E-03	**-0.07%**	2.75E-02	2.75E-02	**-0.07%**	5.23E-03	1.97E-05	**-99.62%**	6.88E-03	6.87E-03	**-0.07%**	2.22E-02	2.21E-02	**-0.07%**
Zr-93	1.50E-02	1.50E-02	**-0.07%**	4.90E-02	4.90E-02	**-0.06%**	1.23E-02	4.70E-05	**-99.62%**	1.51E-02	1.51E-02	**-0.06%**	4.98E-02	4.98E-02	**-0.06%**
Zr-95	1.39E-02	1.39E-02	**-0.07%**	5.17E-02	5.17E-02	**-0.07%**	1.10E-02	4.22E-05	**-99.62%**	1.42E-02	1.42E-02	**-0.07%**	4.56E-02	4.56E-02	**-0.07%**
Tc-96	1.15E-03	1.15E-03	**-0.07%**	2.62E-02	2.62E-02	**-0.07%**	8.99E-04	1.43E-04	**-84.10%**	2.74E-03	2.74E-03	**-0.07%**	1.10E-02	1.10E-02	**-0.07%**
Tc-97	7.92E-01	7.92E-01	**0.00%**	3.84E+00	3.84E+00	**0.00%**	1.57E+00	4.65E-02	**-97.04%**	1.05E+00	1.05E+00	**0.00%**	6.12E+00	6.12E+00	**0.00%**
Tc-98	2.03E+01	2.03E+01	**0.00%**	9.86E+01	9.86E+01	**0.00%**	4.03E+01	1.19E+00	**-97.04%**	2.69E+01	2.69E+01	**0.00%**	1.57E+02	1.57E+02	**0.00%**
Tc-99	7.53E+00	7.53E+00	**0.00%**	3.65E+01	3.65E+01	**0.00%**	1.49E+01	4.42E-01	**-97.04%**	9.96E+00	9.96E+00	**0.00%**	5.81E+01	5.82E+01	**0.00%**
Ru-97	1.78E-05	1.77E-05	**-0.07%**	1.26E-03	1.26E-03	**-0.07%**	1.41E-05	2.56E-07	**-98.18%**	7.49E-05	7.49E-05	**-0.07%**	2.66E-04	2.65E-04	**-0.07%**
Ru-103	8.74E-03	8.73E-03	**-0.07%**	3.56E-02	3.55E-02	**-0.07%**	6.94E-03	3.84E-05	**-99.45%**	9.08E-03	9.07E-03	**-0.07%**	3.15E-02	3.15E-02	**-0.07%**
Ru-106	1.35E-01	1.35E-01	**-0.07%**	4.46E-01	4.46E-01	**-0.07%**	1.07E-01	5.66E-04	**-99.47%**	1.35E-01	1.35E-01	**-0.07%**	4.67E-01	4.67E-01	**-0.07%**
Pd-107	1.24E-03	1.24E-03	**-0.05%**	4.57E-03	4.57E-03	**-0.04%**	1.40E-03	1.75E-04	**-87.51%**	1.52E-03	1.52E-03	**-0.05%**	7.97E-03	7.97E-03	**-0.04%**
Ag-108m	4.44E-02	4.43E-02	**-0.07%**	1.44E-01	1.44E-01	**-0.07%**	3.53E-02	9.59E-04	**-97.29%**	4.60E-02	4.60E-02	**-0.07%**	1.70E-01	1.69E-01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Ag-110m	4.95E-02	4.95E-02	**-0.07%**	1.66E-01	1.66E-01	**-0.07%**	3.92E-02	1.10E-03	**-97.21%**	5.14E-02	5.14E-02	**-0.07%**	1.90E-01	1.89E-01	**-0.07%**
Cd-113m	1.14E+00	1.14E+00	**-0.05%**	3.94E+00	3.94E+00	**-0.06%**	9.98E-01	8.53E-03	**-99.15%**	1.12E+00	1.12E+00	**-0.06%**	4.02E+00	4.02E+00	**-0.07%**
Cd-115m	4.38E-02	4.38E-02	**-0.07%**	1.73E-01	1.73E-01	**-0.07%**	3.48E-02	3.40E-04	**-99.02%**	4.54E-02	4.54E-02	**-0.07%**	1.67E-01	1.67E-01	**-0.07%**
In-115	5.26E-01	5.26E-01	**-0.07%**	1.71E+00	1.71E+00	**-0.07%**	4.22E-01	4.19E-03	**-99.01%**	5.33E-01	5.33E-01	**-0.07%**	2.03E+00	2.03E+00	**-0.07%**
Sb-122	1.60E-04	1.60E-04	**-0.07%**	1.38E-02	1.38E-02	**-0.07%**	1.26E-04	2.64E-06	**-97.91%**	7.49E-04	7.48E-04	**-0.07%**	2.52E-03	2.51E-03	**-0.07%**
Sb-124	3.65E-02	3.65E-02	**-0.07%**	1.37E-01	1.37E-01	**-0.07%**	2.90E-02	1.43E-04	**-99.51%**	3.73E-02	3.73E-02	**-0.07%**	1.24E-01	1.24E-01	**-0.07%**
Sb-125	2.11E-02	2.11E-02	**-0.07%**	6.90E-02	6.89E-02	**-0.07%**	1.68E-02	8.08E-05	**-99.52%**	2.13E-02	2.12E-02	**-0.07%**	7.04E-02	7.03E-02	**-0.07%**
Te-123	6.19E-02	6.19E-02	**-0.07%**	2.65E-01	2.65E-01	**-0.07%**	9.68E-02	1.05E-03	**-98.91%**	7.51E-02	7.51E-02	**-0.07%**	3.85E-01	3.85E-01	**-0.07%**
Te-125m	1.33E-02	1.33E-02	**-0.07%**	5.03E-02	5.02E-02	**-0.07%**	1.06E-02	1.33E-04	**-98.74%**	1.37E-02	1.37E-02	**-0.07%**	5.19E-02	5.19E-02	**-0.07%**
Sn-126	1.05E-01	1.05E-01	**-0.06%**	3.50E-01	3.50E-01	**-0.06%**	9.14E-02	4.44E-03	**-95.14%**	1.12E-01	1.11E-01	**-0.06%**	9.40E-01	9.39E-01	**-0.06%**
I-129	2.70E+00	2.70E+00	**-0.05%**	9.97E+00	9.96E+00	**-0.04%**	3.06E+00	2.28E-01	**-92.54%**	3.16E+00	3.15E+00	**-0.04%**	1.57E+01	1.57E+01	**-0.04%**
I-131	7.29E-02	7.29E-02	**-0.07%**	6.31E-01	6.31E-01	**-0.07%**	5.67E-02	1.08E-02	**-80.90%**	1.15E-01	1.15E-01	**-0.07%**	5.57E-01	5.57E-01	**-0.07%**
Cs-134	2.93E-01	2.93E-01	**-0.07%**	9.56E-01	9.55E-01	**-0.07%**	2.32E-01	1.72E-02	**-92.57%**	3.20E-01	3.20E-01	**-0.07%**	1.66E+00	1.66E+00	**-0.07%**
Cs-135	5.05E-02	5.04E-02	**-0.06%**	1.77E-01	1.77E-01	**-0.05%**	5.04E-02	3.60E-03	**-92.86%**	5.73E-02	5.73E-02	**-0.05%**	3.15E-01	3.15E-01	**-0.05%**
Cs-137	2.38E-01	2.38E-01	**-0.06%**	7.93E-01	7.93E-01	**-0.06%**	2.00E-01	1.45E-02	**-92.74%**	2.62E-01	2.61E-01	**-0.06%**	1.34E+00	1.34E+00	**-0.06%**
La-137	1.67E-03	1.67E-03	**-0.07%**	5.47E-03	5.47E-03	**-0.06%**	1.38E-03	5.66E-06	**-99.59%**	1.69E-03	1.69E-03	**-0.06%**	5.60E-03	5.60E-03	**-0.06%**
La-138	2.06E-02	2.06E-02	**-0.07%**	6.75E-02	6.75E-02	**-0.06%**	1.70E-02	6.99E-05	**-99.59%**	2.09E-02	2.09E-02	**-0.06%**	6.91E-02	6.91E-02	**-0.06%**
La-140	1.17E-05	1.17E-05	**-0.07%**	7.65E-03	7.65E-03	**-0.07%**	9.16E-06	4.41E-07	**-95.19%**	1.60E-04	1.60E-04	**-0.07%**	5.20E-04	5.20E-04	**-0.07%**
Ba-140	1.39E-02	1.39E-02	**-0.07%**	9.09E-02	9.08E-02	**-0.07%**	1.10E-02	9.17E-05	**-99.17%**	1.71E-02	1.71E-02	**-0.07%**	5.60E-02	5.60E-02	**-0.07%**
Ce-141	8.26E-03	8.26E-03	**-0.07%**	3.53E-02	3.52E-02	**-0.07%**	6.56E-03	2.72E-05	**-99.59%**	8.68E-03	8.68E-03	**-0.07%**	2.80E-02	2.80E-02	**-0.07%**
Ce-144	9.95E-02	9.95E-02	**-0.07%**	3.32E-01	3.32E-01	**-0.07%**	7.90E-02	3.22E-04	**-99.59%**	1.00E-01	1.00E-01	**-0.07%**	3.23E-01	3.23E-01	**-0.07%**
Sm-146	1.15E+00	1.15E+00	**-0.06%**	3.92E+00	3.92E+00	**-0.06%**	1.06E+00	4.58E-03	**-99.57%**	1.20E+00	1.19E+00	**-0.06%**	4.24E+00	4.23E+00	**-0.05%**
Sm-147	1.05E+00	1.05E+00	**-0.06%**	3.58E+00	3.58E+00	**-0.06%**	9.69E-01	4.18E-03	**-99.57%**	1.09E+00	1.09E+00	**-0.06%**	3.87E+00	3.86E+00	**-0.05%**
Sm-151	2.18E-03	2.18E-03	**-0.06%**	7.32E-03	7.31E-03	**-0.06%**	1.90E-03	8.19E-06	**-99.57%**	2.24E-03	2.24E-03	**-0.06%**	7.64E-03	7.63E-03	**-0.06%**
Pm-147	5.56E-03	5.56E-03	**-0.07%**	1.82E-02	1.82E-02	**-0.07%**	4.42E-03	1.86E-05	**-99.58%**	5.55E-03	5.55E-03	**-0.07%**	1.79E-02	1.79E-02	**-0.07%**
Eu-152	2.67E-02	2.66E-02	**-0.07%**	8.68E-02	8.67E-02	**-0.07%**	2.13E-02	8.95E-05	**-99.58%**	2.67E-02	2.67E-02	**-0.07%**	8.65E-02	8.65E-02	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Eu-154	3.93E-02	3.93E-02	**-0.07%**	1.28E-01	1.28E-01	**-0.07%**	3.13E-02	1.31E-04	**-99.58%**	3.94E-02	3.94E-02	**-0.07%**	1.27E-01	1.27E-01	**-0.07%**
Eu-155	6.67E-03	6.67E-03	**-0.07%**	2.17E-02	2.17E-02	**-0.07%**	5.30E-03	2.23E-05	**-99.58%**	6.69E-03	6.69E-03	**-0.07%**	2.16E-02	2.16E-02	**-0.07%**
Gd-152	8.72E-01	8.72E-01	**-0.06%**	2.97E+00	2.97E+00	**-0.05%**	8.05E-01	3.38E-03	**-99.58%**	9.07E-01	9.06E-01	**-0.06%**	3.20E+00	3.19E+00	**-0.05%**
Ho-166m	4.18E-02	4.17E-02	**-0.06%**	1.42E-01	1.42E-01	**-0.06%**	3.83E-02	1.65E-04	**-99.57%**	4.34E-02	4.33E-02	**-0.06%**	1.53E-01	1.53E-01	**-0.05%**
Lu-176	3.63E-02	3.63E-02	**-0.07%**	1.19E-01	1.19E-01	**-0.06%**	2.98E-02	1.77E-04	**-99.41%**	3.68E-02	3.68E-02	**-0.06%**	1.32E-01	1.32E-01	**-0.06%**
Ta-180	3.55E-13	3.55E-13	**-0.07%**	1.85E-06	1.85E-06	**-0.07%**	1.93E-13	1.92E-13	**-0.07%**	2.26E-12	2.26E-12	**-0.07%**	7.50E-12	7.50E-12	**-0.07%**
Hf-182	5.04E-02	5.04E-02	**-0.07%**	1.64E-01	1.64E-01	**-0.07%**	4.04E-02	1.53E-04	**-99.62%**	5.08E-02	5.07E-02	**-0.07%**	1.65E-01	1.64E-01	**-0.07%**
Re-186m	2.17E-01	2.17E-01	**-0.01%**	9.78E-01	9.78E-01	**-0.01%**	3.76E-01	9.74E-03	**-97.41%**	2.74E-01	2.74E-01	**-0.01%**	1.52E+00	1.52E+00	**-0.01%**
Re-187	4.70E-04	4.70E-04	**-0.01%**	2.12E-03	2.12E-03	**-0.01%**	8.15E-04	2.11E-05	**-97.41%**	5.93E-04	5.93E-04	**-0.01%**	3.29E-03	3.29E-03	**-0.01%**
Ir-192n	2.07E-02	2.07E-02	**-0.06%**	7.06E-02	7.06E-02	**-0.06%**	1.90E-02	8.38E-05	**-99.56%**	2.15E-02	2.15E-02	**-0.06%**	7.74E-02	7.73E-02	**-0.05%**
Pt-193	8.67E-04	8.67E-04	**-0.06%**	2.90E-03	2.89E-03	**-0.06%**	7.40E-04	5.40E-05	**-92.70%**	9.62E-04	9.62E-04	**-0.06%**	4.11E-03	4.11E-03	**-0.06%**
Hg-194	9.39E-02	9.38E-02	**-0.02%**	4.09E-01	4.09E-01	**-0.01%**	1.50E-01	1.45E-02	**-90.35%**	1.14E-01	1.14E-01	**-0.02%**	1.80E+00	1.80E+00	**-0.02%**
Hg-203	8.28E-03	8.27E-03	**-0.07%**	3.19E-02	3.19E-02	**-0.07%**	6.53E-03	7.58E-04	**-88.39%**	9.09E-03	9.09E-03	**-0.07%**	1.68E-01	1.68E-01	**-0.07%**
Pb-202	3.56E-01	3.55E-01	**-0.06%**	1.23E+00	1.23E+00	**-0.05%**	3.41E-01	2.28E-03	**-99.33%**	3.74E-01	3.74E-01	**-0.06%**	1.37E+00	1.37E+00	**-0.05%**
Pb-205	5.99E-03	5.99E-03	**-0.06%**	2.07E-02	2.07E-02	**-0.05%**	5.75E-03	3.84E-05	**-99.33%**	6.30E-03	6.30E-03	**-0.06%**	2.32E-02	2.31E-02	**-0.05%**
Pb-210	1.63E+01	1.63E+01	**-0.06%**	5.36E+01	5.36E+01	**-0.06%**	1.33E+01	8.98E-02	**-99.33%**	1.65E+01	1.65E+01	**-0.06%**	5.50E+01	5.50E+01	**-0.07%**
Bi-207	7.40E-02	7.40E-02	**-0.04%**	2.82E-01	2.81E-01	**-0.04%**	8.02E-02	8.43E-04	**-98.95%**	8.00E-02	8.00E-02	**-0.04%**	3.04E-01	3.03E-01	**-0.05%**
Bi-210	1.18E-03	1.18E-03	**-0.07%**	2.22E-02	2.22E-02	**-0.07%**	9.32E-04	3.93E-05	**-95.78%**	2.48E-03	2.48E-03	**-0.07%**	8.50E-03	8.49E-03	**-0.07%**
Bi-210m	1.19E+00	1.19E+00	**-0.02%**	5.31E+00	5.31E+00	**-0.01%**	2.02E+00	2.10E-02	**-98.96%**	1.49E+00	1.49E+00	**-0.01%**	7.47E+00	7.47E+00	**-0.01%**
Po-210	4.59E+00	4.58E+00	**-0.07%**	1.58E+01	1.58E+01	**-0.07%**	3.64E+00	3.32E-02	**-99.09%**	4.66E+00	4.65E+00	**-0.07%**	1.68E+01	1.68E+01	**-0.07%**
Ra-223	7.25E-01	7.25E-01	**-0.07%**	5.13E+00	5.12E+00	**-0.07%**	5.75E-01	9.39E-03	**-98.37%**	9.30E-01	9.29E-01	**-0.07%**	3.22E+00	3.22E+00	**-0.07%**
Ra-224	3.08E-02	3.08E-02	**-0.07%**	1.10E+00	1.10E+00	**-0.07%**	2.43E-02	1.46E-03	**-93.96%**	9.01E-02	9.00E-02	**-0.07%**	3.19E-01	3.18E-01	**-0.07%**
Ra-225	1.10E+00	1.10E+00	**-0.07%**	6.50E+00	6.49E+00	**-0.07%**	8.75E-01	1.26E-02	**-98.56%**	1.31E+00	1.31E+00	**-0.07%**	4.51E+00	4.51E+00	**-0.07%**
Ra-226	9.10E+00	9.10E+00	**-0.05%**	3.33E+01	3.33E+01	**-0.04%**	1.01E+01	9.67E-02	**-99.04%**	9.96E+00	9.96E+00	**-0.05%**	4.04E+01	4.04E+01	**-0.04%**
Ra-228	2.51E+01	2.51E+01	**-0.07%**	8.16E+01	8.15E+01	**-0.07%**	1.99E+01	1.97E-01	**-99.01%**	2.52E+01	2.52E+01	**-0.07%**	8.56E+01	8.56E+01	**-0.07%**
Ac-227	5.72E+00	5.72E+00	**-0.07%**	1.85E+01	1.85E+01	**-0.07%**	4.55E+00	1.92E-02	**-99.58%**	5.75E+00	5.75E+00	**-0.07%**	1.87E+01	1.87E+01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Th-227	8.42E-02	8.42E-02	**-0.07%**	4.41E-01	4.41E-01	**-0.07%**	6.69E-02	2.68E-04	**-99.60%**	9.44E-02	9.44E-02	**-0.07%**	3.06E-01	3.06E-01	**-0.07%**
Th-228	1.65E+00	1.65E+00	**-0.07%**	5.42E+00	5.41E+00	**-0.07%**	1.31E+00	5.16E-03	**-99.61%**	1.66E+00	1.66E+00	**-0.07%**	5.38E+00	5.38E+00	**-0.07%**
Th-229	8.99E+00	8.98E+00	**-0.07%**	2.92E+01	2.92E+01	**-0.07%**	7.24E+00	2.85E-02	**-99.61%**	9.06E+00	9.05E+00	**-0.07%**	2.96E+01	2.96E+01	**-0.07%**
Th-230	3.73E+00	3.73E+00	**-0.07%**	1.21E+01	1.21E+01	**-0.07%**	3.01E+00	1.18E-02	**-99.61%**	3.76E+00	3.76E+00	**-0.07%**	1.23E+01	1.23E+01	**-0.07%**
Th-231	4.52E-08	4.51E-08	**-0.07%**	5.40E-04	5.40E-04	**-0.07%**	3.39E-08	6.25E-09	**-81.55%**	2.69E-06	2.69E-06	**-0.07%**	8.77E-06	8.76E-06	**-0.07%**
Th-232	4.10E+00	4.10E+00	**-0.07%**	1.33E+01	1.33E+01	**-0.07%**	3.30E+00	1.30E-02	**-99.61%**	4.13E+00	4.13E+00	**-0.07%**	1.35E+01	1.35E+01	**-0.07%**
Th-234	3.29E-02	3.28E-02	**-0.07%**	1.55E-01	1.54E-01	**-0.07%**	2.61E-02	1.04E-04	**-99.60%**	3.55E-02	3.55E-02	**-0.07%**	1.15E-01	1.15E-01	**-0.07%**
Pa-230	6.49E-03	6.49E-03	**-0.07%**	3.53E-02	3.52E-02	**-0.07%**	5.16E-03	2.14E-05	**-99.59%**	7.38E-03	7.37E-03	**-0.07%**	2.41E-02	2.40E-02	**-0.07%**
Pa-231	8.19E+00	8.18E+00	**-0.07%**	2.65E+01	2.65E+01	**-0.07%**	6.52E+00	2.62E-02	**-99.60%**	8.23E+00	8.22E+00	**-0.07%**	2.68E+01	2.68E+01	**-0.07%**
Pa-233	1.00E-02	9.99E-03	**-0.07%**	4.52E-02	4.51E-02	**-0.07%**	7.94E-03	3.25E-05	**-99.59%**	1.07E-02	1.07E-02	**-0.07%**	3.48E-02	3.47E-02	**-0.07%**
U-232	7.10E+00	7.09E+00	**-0.06%**	2.42E+01	2.42E+01	**-0.06%**	6.38E+00	1.82E-01	**-97.15%**	7.56E+00	7.55E+00	**-0.06%**	2.82E+01	2.82E+01	**-0.06%**
U-233	1.09E+00	1.09E+00	**-0.06%**	3.83E+00	3.83E+00	**-0.05%**	1.09E+00	3.08E-02	**-97.17%**	1.19E+00	1.19E+00	**-0.05%**	4.72E+00	4.71E+00	**-0.05%**
U-234	1.05E+00	1.05E+00	**-0.06%**	3.70E+00	3.70E+00	**-0.05%**	1.05E+00	2.97E-02	**-97.17%**	1.15E+00	1.15E+00	**-0.05%**	4.55E+00	4.55E+00	**-0.05%**
U-235	9.95E-01	9.95E-01	**-0.06%**	3.49E+00	3.49E+00	**-0.05%**	9.93E-01	2.81E-02	**-97.17%**	1.08E+00	1.08E+00	**-0.05%**	4.30E+00	4.30E+00	**-0.05%**
U-236	9.92E-01	9.91E-01	**-0.06%**	3.48E+00	3.48E+00	**-0.05%**	9.90E-01	2.80E-02	**-97.17%**	1.08E+00	1.08E+00	**-0.05%**	4.29E+00	4.28E+00	**-0.05%**
U-237	1.53E-03	1.52E-03	**-0.07%**	1.75E-02	1.75E-02	**-0.07%**	1.20E-03	1.05E-04	**-91.21%**	2.56E-03	2.56E-03	**-0.07%**	9.62E-03	9.62E-03	**-0.07%**
U-238	9.50E-01	9.50E-01	**-0.06%**	3.34E+00	3.33E+00	**-0.05%**	9.48E-01	2.68E-02	**-97.17%**	1.03E+00	1.03E+00	**-0.05%**	4.11E+00	4.10E+00	**-0.05%**
Np-236	4.43E-01	4.42E-01	**-0.06%**	1.51E+00	1.51E+00	**-0.06%**	4.09E-01	1.73E-03	**-99.58%**	4.60E-01	4.60E-01	**-0.06%**	1.65E+00	1.65E+00	**-0.05%**
Np-237	2.05E+00	2.05E+00	**-0.06%**	6.99E+00	6.99E+00	**-0.06%**	1.89E+00	8.03E-03	**-99.58%**	2.13E+00	2.13E+00	**-0.06%**	7.64E+00	7.64E+00	**-0.05%**
Np-239	3.71E-05	3.70E-05	**-0.07%**	5.43E-03	5.43E-03	**-0.07%**	2.94E-05	3.63E-07	**-98.77%**	2.31E-04	2.31E-04	**-0.07%**	7.68E-04	7.67E-04	**-0.07%**
Am-237	6.27E-34	6.27E-34	**-0.07%**	7.05E-18	7.05E-18	**-0.07%**	3.18E-34	3.18E-34	**-0.07%**	5.39E-40	5.39E-40	**-0.07%**	4.37E-39	4.37E-39	**-0.07%**
Am-241	3.49E+00	3.48E+00	**-0.07%**	1.13E+01	1.13E+01	**-0.07%**	2.78E+00	1.10E-02	**-99.60%**	3.50E+00	3.50E+00	**-0.07%**	1.14E+01	1.14E+01	**-0.07%**
Am-242m	3.16E+00	3.16E+00	**-0.07%**	1.02E+01	1.02E+01	**-0.07%**	2.52E+00	1.00E-02	**-99.60%**	3.18E+00	3.18E+00	**-0.07%**	1.04E+01	1.04E+01	**-0.07%**
Am-243	3.46E+00	3.45E+00	**-0.07%**	1.12E+01	1.12E+01	**-0.07%**	2.75E+00	1.10E-02	**-99.60%**	3.48E+00	3.47E+00	**-0.07%**	1.13E+01	1.13E+01	**-0.07%**
Pu-237	1.48E-03	1.48E-03	**-0.07%**	5.86E-03	5.85E-03	**-0.07%**	1.18E-03	4.64E-06	**-99.61%**	1.53E-03	1.53E-03	**-0.07%**	4.93E-03	4.93E-03	**-0.07%**
Pu-238	3.84E+00	3.84E+00	**-0.07%**	1.24E+01	1.24E+01	**-0.07%**	3.05E+00	1.19E-02	**-99.61%**	3.86E+00	3.86E+00	**-0.07%**	1.25E+01	1.24E+01	**-0.07%**
Pu-239	4.21E+00	4.21E+00	**-0.07%**	1.36E+01	1.36E+01	**-0.07%**	3.35E+00	1.31E-02	**-99.61%**	4.23E+00	4.23E+00	**-0.07%**	1.37E+01	1.36E+01	**-0.07%**

Nuclide	Test Case 1			Test Case 2			Test Case 3			Test Case 4			Test Case 5		
	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change	V.2013	V.2017	% change
Pu-240	4.21E+00	4.21E+00	**-0.07%**	1.36E+01	1.36E+01	**-0.07%**	3.35E+00	1.31E-02	**-99.61%**	4.23E+00	4.23E+00	**-0.07%**	1.37E+01	1.36E+01	**-0.07%**
Pu-241	7.59E-02	7.58E-02	**-0.07%**	2.46E-01	2.46E-01	**-0.07%**	6.03E-02	2.36E-04	**-99.61%**	7.63E-02	7.62E-02	**-0.07%**	2.46E-01	2.46E-01	**-0.07%**
Pu-242	4.01E+00	4.00E+00	**-0.07%**	1.30E+01	1.30E+01	**-0.07%**	3.18E+00	1.24E-02	**-99.61%**	4.03E+00	4.02E+00	**-0.07%**	1.30E+01	1.30E+01	**-0.07%**
Pu-244	3.99E+00	3.99E+00	**-0.07%**	1.29E+01	1.29E+01	**-0.07%**	3.17E+00	1.24E-02	**-99.61%**	4.01E+00	4.01E+00	**-0.07%**	1.29E+01	1.29E+01	**-0.07%**
Cm-241	1.05E-02	1.05E-02	**-0.07%**	4.48E-02	4.48E-02	**-0.07%**	8.36E-03	3.47E-05	**-99.58%**	1.11E-02	1.10E-02	**-0.07%**	3.57E-02	3.57E-02	**-0.07%**
Cm-242	2.51E-01	2.51E-01	**-0.07%**	8.58E-01	8.57E-01	**-0.07%**	1.99E-01	8.14E-04	**-99.59%**	2.53E-01	2.53E-01	**-0.07%**	8.17E-01	8.17E-01	**-0.07%**
Cm-243	2.63E+00	2.63E+00	**-0.07%**	8.53E+00	8.53E+00	**-0.07%**	2.09E+00	8.52E-03	**-99.59%**	2.65E+00	2.65E+00	**-0.07%**	8.55E+00	8.55E+00	**-0.07%**
Cm-244	2.21E+00	2.20E+00	**-0.07%**	7.15E+00	7.14E+00	**-0.07%**	1.75E+00	7.13E-03	**-99.59%**	2.22E+00	2.22E+00	**-0.07%**	7.16E+00	7.15E+00	**-0.07%**
Cm-245	3.55E+00	3.55E+00	**-0.07%**	1.15E+01	1.15E+01	**-0.07%**	2.84E+00	1.15E-02	**-99.59%**	3.57E+00	3.57E+00	**-0.07%**	1.16E+01	1.16E+01	**-0.07%**
Cm-246	3.54E+00	3.53E+00	**-0.07%**	1.15E+01	1.15E+01	**-0.07%**	2.82E+00	1.15E-02	**-99.59%**	3.56E+00	3.56E+00	**-0.07%**	1.15E+01	1.15E+01	**-0.07%**
Cm-247	3.26E+00	3.26E+00	**-0.07%**	1.06E+01	1.06E+01	**-0.07%**	2.60E+00	1.06E-02	**-99.59%**	3.28E+00	3.28E+00	**-0.07%**	1.06E+01	1.06E+01	**-0.07%**
Cm-248	1.33E+01	1.32E+01	**-0.07%**	4.30E+01	4.29E+01	**-0.07%**	1.06E+01	4.31E-02	**-99.59%**	1.33E+01	1.33E+01	**-0.07%**	4.32E+01	4.32E+01	**-0.07%**
Cm-250	9.07E+01	9.06E+01	**-0.07%**	2.94E+02	2.94E+02	**-0.07%**	7.24E+01	2.95E-01	**-99.59%**	9.13E+01	9.12E+01	**-0.07%**	2.96E+02	2.95E+02	**-0.07%**
Bk-247	6.67E+00	6.67E+00	**-0.06%**	2.19E+01	2.19E+01	**-0.06%**	5.53E+00	2.10E-02	**-99.62%**	6.77E+00	6.76E+00	**-0.06%**	2.24E+01	2.24E+01	**-0.06%**
Bk-249	1.73E-02	1.73E-02	**-0.07%**	5.75E-02	5.75E-02	**-0.07%**	1.37E-02	5.23E-05	**-99.62%**	1.74E-02	1.74E-02	**-0.07%**	5.61E-02	5.61E-02	**-0.07%**
Cf-249	6.53E+00	6.52E+00	**-0.07%**	2.11E+01	2.11E+01	**-0.07%**	5.20E+00	1.98E-02	**-99.62%**	6.56E+00	6.56E+00	**-0.07%**	2.12E+01	2.12E+01	**-0.07%**
Cf-250	3.23E+00	3.23E+00	**-0.07%**	1.05E+01	1.05E+01	**-0.07%**	2.57E+00	9.77E-03	**-99.62%**	3.25E+00	3.25E+00	**-0.07%**	1.05E+01	1.05E+01	**-0.07%**
Cf-251	6.66E+00	6.66E+00	**-0.07%**	2.16E+01	2.16E+01	**-0.07%**	5.30E+00	2.02E-02	**-99.62%**	6.70E+00	6.69E+00	**-0.07%**	2.16E+01	2.16E+01	**-0.07%**
Cf-252	2.17E+00	2.16E+00	**-0.07%**	7.07E+00	7.07E+00	**-0.07%**	1.72E+00	6.54E-03	**-99.62%**	2.18E+00	2.17E+00	**-0.07%**	7.02E+00	7.01E+00	**-0.07%**
Es-253	5.71E-02	5.70E-02	**-0.07%**	2.87E-01	2.87E-01	**-0.07%**	4.53E-02	1.73E-04	**-99.62%**	6.30E-02	6.30E-02	**-0.07%**	2.03E-01	2.03E-01	**-0.07%**
UI alpha	4.21E+00	4.21E+00	**-0.07%**	1.36E+01	1.36E+01	**-0.07%**	3.35E+00	1.31E-02	**-99.61%**	4.23E+00	4.23E+00	**-0.07%**	1.37E+01	1.36E+01	**-0.07%**
UI beta	1.85E+00	1.85E+00	**-0.04%**	7.00E+00	7.00E+00	**-0.04%**	1.96E+00	4.15E-02	**-97.88%**	1.99E+00	1.99E+00	**-0.04%**	7.66E+00	7.65E+00	**-0.05%**

Appendix C. SRNL-L3200-2017-00044

SRNL-L3200-2017-00044

April 4, 2017

TO: Environmental Dosimetry Files

FROM: K. R. Moore, 999-W

Maximum Vegetable and Leafy Vegetable Production Value Update

LADTAP XL© Version 2017 (Moore 2017) is two EXCEL© spreadsheets (LADTAP and IRRIDOSE) used at the Savannah River Site (SRS) to estimate dose to offsite individuals and populations resulting from routine releases of radioactive materials to the Savannah River. The IRRIDOSE spreadsheet estimates annual doses based on agricultural irrigation using Savannah River water resulting in exposed milk, meat, and vegetation consumables.

Due to issues with obtaining information to approximate the annual total vegetable and leafy vegetable production within a 50-mile radius of SRS, these values will now be conservatively calculated using the irrigated land area (1000 acres) and an expected vegetable crop yield per area factor (currently 2.2 kg/m^2) (equation 1). It is assumed that 20% of the production is dedicated to leafy vegetables and 80% to all other harvestable vegetables (Jannik et. al. 2016). Table 1 presents a comparison of the maximum production values using equation 1 and previous value used in LADTAP XL© Version 2013 (Jannik et. al. 2013). The updated production value assumes a greater annual vegetable (7.13E+06 kg/yr) and leafy vegetable (1.78E+06 kg/yr) production and will therefore produce more conservative population dose estimates based on area calculations for the irrigation pathway.

$$P^{Max} = I \times Y \times F \tag{1}$$

P^{Max} maximum vegetable or leafy vegetable production within a 50-Mile radius of SRS (kg/yr)
I irrigated land area used for vegetable and leafy vegetable harvest
Y expected vegetable crop yield from irrigated land
F fraction of harvest assumed to be vegetable or leafy vegetable

Table 1. Maximum Total Vegetable Production Comparison (Vegetable + Leafy Vegetable)

	LADTAP XL V.2013	LADTAP XL V.2017	%Difference
Total Vegetable Production Maximum (kg/yr)	6.7E+06	8.9E+06	33%

References:

Jannik, G. T., Stone, D. K., and Dixon, K. L. LADTAP XL© Version 2013: A Spreadsheet for Estimating Dose Resulting from Aqueous Releases. SRNL-STI-2013-00697. Savannah River National Laboratory. Aiken, SC. 2013

Jannik, G. T., Stagich, B. H., Hartman, L. *Land and Water Use Characteristics and Human Health Input Parameters for Use in Environmental Dosimetry and Rish Assessments at the Savannah River Site – 2016 Update*. SRNL-STI-2016-00456. Savannah River National Laboratory. Aiken, SC. 2016.

Moore, K. R. LADTAP XL© Version 2017 Release. SRNL-L3200-2017-00030. Savannah River National Laboratory. Aiken, SC. 2017.

Distribution:

cc: G. T. Jannik, 999-W
J.J. Mayer, 999-W
B. H. Stagich, 999-W
K. L. Dixon, 773-42A

Appendix D. LADTAP XL© VERSION 2017 STANDARD INPUT AND OUTPUT

LADTAP XL ©

Version 2017

INSTRUCTIONS:

1.) LADTAP XL is to be used for chronic aqueous release scenarios.
2.) Enter the flow and exposure parameters. Only the numbers in RED are changeable.
A description of each is given in the user's documentation.
3.) Enter the source term (curies per year released to the Savannah River).
4.) Irrigation methods are contained in the 'IRRIDOSE' worksheet

LADTAP XL Version 2017 Protected

Kelsey Minter (803)-819-5049

FLOW & EXPOSURE PARAMETERS

Parameter	Value	Units	Comments
Effective River Flow Rate (Hwy 301):	7,500	cfs	
Flow Rate at Beaufort-Jasper-Chelsea:	10,000	cfs	
Flow Rate at Beaufort-Jasper-Purrysburg:	10,000	cfs	
Flow Rate at Port Wentworth:	10,000	cfs	
Flow Rate at the Estuary:	10,000	cfs	
Annual Max. Ind. Shoreline Usage:	20	hr	
Annual Max. Ind. Swimming Usage:	14	hr	
Annual Max. Ind. Boating Usage:	44	hr	
Ind. Fish Usage (Typ, Ref,value):	ref	24	kg/yr
Ind. Water Usage (Typ, Ref, value):	ref	800	L/yr
Recreation Transport Time (MEI):	1	d	
Water Transport Time (MEI):	1.5	d	
Fish/Invertebrate Transport Time (MEI):	2	d	
Beaufort-Jasper-Chelsea Population:	8.37E+04	persons	
Beaufort-Jasper-Purrysburg Population:	6.48E+04	persons	
Savannah I&D Population:	3.50E+04	persons	
50-Mile Population:	781060	persons	
Drinking Water Plant Travel Time:	4	d	
Pop. Water Usage (Typ, Ref, value):	typ	300	L/yr
Pop. Fish Usage (Typ, Ref, value):	typ	3.7	kg/yr
Pop. Invertebrate Usage (Typ, Ref, value):	typ	1.5	kg/yr
Annual Sport Fish Harvest (edible):	8.22E+03	kg/yr	
Annual Commercial Fish Harvest (edible):	5.70E+04	kg/yr	
Annual Invertebrate Harvest (edible):	3.80E+05	kg/yr	
Sport Fish Transport Time:	10	d	
Commercial/Invertebrate Transport Time:	13	d	
Estuary Dilution Factor:	3	unitless	
Population Shoreline Usage:	8.22E+05	person-hrs	
Population Swimming Usage:	2.95E+05	person-hrs	
Population Boating Usage:	3.11E+06	person-hrs	
Assessment Year:	2017		

Values Calculated by LADTAP based on User-Defined Input in Column D. These values should not be altered.

		Parameter	Value	Units	Comments	
		Total 50-Mile Fish Consumption:	2.89E+06	kg/yr		
		Total 50-Mile Invertebrate Consumption:	1.17E+06	kg/yr		

SOURCE TERM AND RIVER CONCENTRATIONS

	Released Amt.	AVERAGE UNDECAYED CONCENTRATIONS (uCi/ml)				
Nuclide	(Ci/yr)	301 Flow Rate	BJC Flow Rate	BJP Flow Rate	PW Flow Rate	Estuary Flow
H-3	1.00E+00	1.49E-10	1.12E-10	1.12E-10	1.12E-10	3.73E-11
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Be-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Si-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S-35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cl-36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K-43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ti-44	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V-49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ge-68	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	1.00E+00	1.49E-10	1.12E-10	1.12E-10	1.12E-10	3.73E-11
Y-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-93m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-96	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SOURCE TERM AND RIVER CONCENTRATIONS (Cont'd)

	Released Amt.	AVERAGE UNDECAYED CONCENTRATIONS (uCi/ml)				
Nuclide	(Ci/yr)	301 Flow Rate	BJC Flow Rate	BJP Flow Rate	PW Flow Rate	Estuary Flow
Ru-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pd-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag-108m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-113m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-115m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
In-115	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-123	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-125m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-129	1.00E+00	1.49E-10	1.12E-10	1.12E-10	1.12E-10	3.73E-11
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.00E+00	1.49E-10	1.12E-10	1.12E-10	1.12E-10	3.73E-11
La-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-146	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-152	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-154	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-155	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gd-152	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ho-166m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Lu-176	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ta-180	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hf-182	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re-186m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Re-187	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ir-192n	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pt-193	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-194	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb-202	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb-205	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pb-210	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi-207	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi-210	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi-210m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SOURCE TERM AND RIVER CONCENTRATIONS (Cont'd)						
	Released Amt.	AVERAGE UNDECAYED CONCENTRATIONS (uCi/ml)				
Nuclide	(Ci/yr)	301 Flow Rate	BJC Flow Rate	BJP Flow Rate	PW Flow Rate	Estuary Flow
Po-210	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-223	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-224	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-225	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-226	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ac-227	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-227	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-229	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-230	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-231	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Th-234	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pa-230	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pa-231	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pa-233	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-233	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-234	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-235	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-236	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-236	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-239	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-242m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-243	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-239	1.00E+00	1.49E-10	1.12E-10	1.12E-10	1.12E-10	3.73E-11
Pu-240	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-243	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-245	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-246	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-247	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-248	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-250	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bk-247	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bk-249	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SOURCE TERM AND RIVER CONCENTRATIONS (Cont'd)						
	Released Amt.	AVERAGE UNDECAYED CONCENTRATIONS (uCi/ml)				
Nuclide	(Ci/yr)	301 Flow Rate	BJC Flow Rate	BJP Flow Rate	PW Flow Rate	Estuary Flow
Cf-249	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cf-250	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cf-251	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cf-252	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Es-253	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Unidentified alpha	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Unidentified beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

DOSE SUMMARY REPORT

Version 2017

LADTAP XL Version 2017 Protected

Dose to a Hypothetical Individual Living on the Savannah River

50-year CEDE (mrem)

Fish Ingestion	Water Ingestion	Shoreline Exposure	Swimming and Boating	**TOTAL**
6.9E-01	2.0E-01	4.9E-03	4.3E-06	**9.0E-01**

Total Dose to the 50-Mile Population

50-year CEDE (person-rem)

Aquatic Foods Consumption	River Recreation	BJC Water Consumption	BJP Water Consumption	PW Water Consumption	**TOTAL**
6.8E+00	2.0E-01	4.8E+00	3.7E+00	2.0E+00	**1.7E+01**

CONVERSION FACTORS

Nuclide	Decay Constant (1/day)	Ingestion EDE Dose Factor (rem/uCi)	Grd Shine DF (mrem sq m) (yr uCi)	Water Im DF (mrem cu m) (yr uCi)	Freshwater Fish Accum. Factor (L/kg)	Saltwater Invert Accum Factor (L/kg)
H-3	1.54E-04	7.77E-05	0.00E+00	0.00E+00	1.00E+00	9.30E-01
Be-7	1.30E-02	1.29E-04	5.55E+00	5.61E-01	1.00E+02	1.00E+04
Be-10	1.26E-09	5.77E-03	4.01E-01	1.81E-02	1.00E+02	1.00E+04
C-14	3.33E-07	2.34E-03	1.49E-03	3.37E-04	3.00E+00	2.00E+04
Na-22	7.29E-04	1.44E-02	2.39E+02	2.57E+01	7.60E+01	1.00E+00
Na-24	1.11E+00	2.02E-03	4.19E+02	5.26E+01	7.60E+01	1.00E+00
Al-26	2.65E-09	1.70E-02	2.88E+02	3.24E+01	5.10E+01	6.00E+01
P-32	4.86E-02	1.25E-02	9.94E+00	7.53E-02	1.40E+05	3.80E+04
Si-32	1.44E-05	2.96E-03	3.35E-03	1.33E-03	2.00E+01	5.00E+04
S-35	7.92E-03	6.44E-04	1.55E-03	3.97E-04	8.00E+02	1.00E+00
Cl-36	6.30E-09	4.59E-03	1.30E+00	2.26E-02	4.70E+01	1.00E+00
K-40	1.52E-12	3.04E-02	2.38E+01	1.96E+00	3.20E+03	6.58E+00
K-43	7.46E-01	1.18E-03	1.09E+02	1.10E+01	3.20E+03	6.58E+00
Ca-41	1.86E-08	1.10E-03	0.00E+00	0.00E+00	1.20E+01	5.00E+00
Ca-45	4.26E-03	3.85E-03	4.41E-03	1.94E-03	1.20E+01	5.00E+00
Ca-47	1.53E-01	7.59E-03	1.16E+02	1.26E+01	1.20E+01	5.00E+00
Ti-44	3.16E-05	2.74E-02	1.44E+01	1.28E+00	1.90E+02	1.00E+03
V-49	2.10E-03	9.36E-05	0.00E+00	0.00E+00	9.70E+01	5.00E+01
Cr-51	2.50E-02	1.86E-04	3.49E+00	3.56E-01	4.00E+01	5.00E+02
Mn-53	5.13E-10	1.53E-04	0.00E+00	0.00E+00	2.40E+02	8.00E+02
Mn-54	2.22E-03	3.29E-03	9.21E+01	9.68E+00	2.40E+02	8.00E+02
Fe-55	6.93E-04	2.04E-03	1.69E-08	1.74E-09	1.70E+02	5.00E+03
Fe-60	1.26E-09	5.48E-01	2.67E-03	8.86E-04	1.70E+02	5.00E+03
Co-58	9.78E-03	3.74E-03	1.08E+02	1.12E+01	7.60E+01	2.00E+03
Co-60	3.60E-04	2.03E-02	2.68E+02	3.01E+01	7.60E+01	2.00E+03
Ni-59	1.88E-08	2.95E-04	1.73E-03	1.75E-04	2.10E+01	5.00E+02
Ni-63	1.90E-05	7.33E-04	0.00E+00	0.00E+00	2.10E+01	5.00E+02
Cu-64	1.31E+00	5.88E-04	2.08E+01	2.10E+00	2.30E+02	5.00E+03
Zn-65	2.84E-03	1.76E-02	6.27E+01	6.86E+00	3.40E+03	5.00E+04
Ge-68	2.56E-03	6.25E-03	4.21E-03	2.39E-05	4.00E+03	4.00E+03
Se-75	5.79E-03	1.24E-02	4.15E+01	4.25E+00	6.00E+03	5.00E+03
Se-79	6.43E-09	1.73E-02	1.69E-03	3.94E-04	6.00E+03	5.00E+03
Rb-87	3.85E-14	7.59E-03	9.21E-03	4.55E-03	4.90E+03	2.00E+02
Sr-89	1.37E-02	1.34E-02	8.03E+00	6.14E-02	2.90E+00	1.00E+00
Sr-90	6.59E-05	1.33E-01	1.30E+01	1.28E-01	2.90E+00	1.00E+00
Y-90	2.59E-01	1.37E-02	1.28E+01	1.15E-01	4.00E+01	1.00E+03
Y-91	1.18E-02	1.21E-02	8.67E+00	1.00E-01	4.00E+01	1.00E+03
Mo-93	4.74E-07	1.15E-02	4.47E-01	4.66E-03	1.90E+00	2.00E+01
Mo-99	2.52E-01	2.86E-03	2.07E+01	1.73E+00	1.90E+00	2.00E+01
Nb-93m	1.18E-04	6.59E-04	7.97E-02	8.32E-04	3.00E+02	5.00E+01
Nb-94	9.35E-08	8.25E-03	1.73E+02	1.81E+01	3.00E+02	5.00E+01
Nb-95	1.98E-02	2.78E-03	8.47E+01	8.82E+00	3.00E+02	5.00E+01
Zr-93	1.24E-09	3.70E-03	0.00E+00	7.88E-08	2.20E+01	5.00E+01
Zr-95	1.08E-02	4.66E-03	8.12E+01	8.44E+00	2.20E+01	5.00E+01
Tc-96	1.62E-01	5.11E-03	2.75E+02	2.89E+01	2.00E+01	1.00E+01
Tc-97	7.30E-10	3.50E-04	5.32E-01	6.07E-03	2.00E+01	1.00E+01
Tc-98	4.52E-10	8.99E-03	1.56E+02	1.62E+01	2.00E+01	1.00E+01
Tc-99	8.99E-09	3.33E-03	7.64E-03	3.66E-03	2.00E+01	1.00E+01
Ru-97	2.39E-01	7.18E-04	2.53E+01	2.54E+00	5.50E+01	1.00E+02

CONVERSION FACTORS (Cont'd)

Nuclide	Decay Constant (1/day)	Ingestion EDE Dose Factor (rem/uCi)	Grd Shine DF (mrem sq m) (yr uCi)	Water Im DF (mrem cu m) (yr uCi)	Freshwater Fish Accum. Factor (L/kg)	Saltwater Invert Accum Factor (L/kg)
Ru-103	1.77E-02	3.48E-03	5.53E+01	5.60E+00	5.50E+01	1.00E+02
Ru-106	1.85E-03	3.55E-02	0.00E+00	0.00E+00	5.50E+01	1.00E+02
Pd-107	2.92E-10	1.96E-04	0.00E+00	0.00E+00	1.00E+01	3.00E+02
Ag-108m	4.54E-06	1.09E-02	1.80E+02	1.83E+01	1.10E+02	3.50E+02
Ag-110m	2.77E-03	1.31E-02	3.02E+02	3.23E+01	1.10E+02	3.50E+02
Cd-113m	1.35E-04	9.51E-02	2.08E-01	1.24E-02	2.00E+02	5.00E+03
Cd-115m	1.55E-02	1.61E-02	1.19E+01	4.52E-01	2.00E+02	5.00E+03
In-115	4.30E-18	1.31E-01	4.36E-02	8.51E-03	1.00E+04	1.00E+04
Sb-122	2.54E-01	8.55E-03	5.69E+01	5.12E+00	3.70E+01	1.00E+02
Sb-124	1.15E-02	1.25E-02	2.02E+02	2.22E+01	3.70E+01	1.00E+02
Sb-125	6.88E-04	5.44E-03	4.83E+01	4.81E+00	3.70E+01	1.00E+02
Te-123	3.16E-18	5.51E-03	2.88E-03	7.22E-05	1.50E+02	1.00E+03
Te-125m	1.21E-02	4.51E-03	3.13E+00	9.08E-02	1.50E+02	1.00E+03
Sn-126	8.25E-09	2.36E-02	5.62E+00	4.77E-01	3.00E+03	5.00E+04
I-129	1.21E-10	4.48E-01	2.32E+00	7.79E-02	3.00E+01	5.00E+01
I-131	8.64E-02	1.16E-01	4.26E+01	4.31E+00	3.00E+01	5.00E+01
Cs-134	9.19E-04	6.92E-02	1.73E+02	1.79E+01	3.00E+03	3.00E+01
Cs-135	8.25E-10	9.77E-03	5.90E-03	2.77E-03	3.00E+03	3.00E+01
Cs-137	6.29E-05	4.92E-02	6.77E+01	6.81E+00	3.00E+03	3.00E+01
La-137	3.16E-08	4.11E-04	2.35E+00	8.40E-02	3.70E+01	1.00E+02
La-138	1.86E-14	5.07E-03	1.31E+02	1.47E+01	3.70E+01	1.00E+02
La-140	4.13E-01	9.88E-03	2.51E+02	2.79E+01	3.70E+01	1.00E+02
Ba-140	5.43E-02	1.34E-02	2.23E+01	2.03E+00	1.20E+00	1.00E+00
Ce-141	2.13E-02	3.62E-03	8.13E+00	8.02E-01	2.50E+01	5.00E+02
Ce-144	2.43E-03	2.68E-02	2.02E+00	1.88E-01	2.50E+01	5.00E+02
Sm-146	1.84E-11	2.59E-01	0.00E+00	0.00E+00	3.00E+01	1.00E+03
Sm-147	1.79E-14	2.37E-01	0.00E+00	0.00E+00	3.00E+01	1.00E+03
Sm-151	2.11E-05	5.00E-04	4.45E-04	7.23E-06	3.00E+01	1.00E+03
Pm-147	7.23E-04	1.34E-03	3.28E-03	1.12E-03	3.00E+01	1.00E+03
Eu-152	1.40E-04	6.44E-03	1.27E+02	1.37E+01	1.30E+02	1.00E+03
Eu-154	2.21E-04	9.66E-03	1.37E+02	1.46E+01	1.30E+02	1.00E+03
Eu-155	3.99E-04	1.67E-03	6.29E+00	5.68E-01	1.30E+02	1.00E+03
Gd-152	1.76E-17	1.97E-01	0.00E+00	0.00E+00	3.00E+01	2.00E+03
Ho-166m	1.58E-06	9.44E-03	1.79E+02	1.86E+01	3.00E+01	1.00E+03
Lu-176	4.93E-14	8.95E-03	5.22E+01	5.27E+00	2.50E+01	1.00E+03
Ta-180	2.04E+00	2.80E-04	4.88E+00	3.76E-01	3.00E+02	3.00E+03
Hf-182	2.11E-10	1.27E-02	2.60E+01	2.65E+00	1.10E+03	1.00E+03
Re-186m	9.49E-09	1.12E-02	1.53E+00	1.13E-01	1.20E+02	5.95E+01
Re-187	4.61E-14	2.44E-05	0.00E+00	0.00E+00	1.20E+02	5.95E+01
Ir-192n	7.87E-06	4.59E-03	9.91E-02	1.12E-02	1.00E+01	1.00E+02
Pt-193	3.79E-05	1.82E-04	1.25E-02	7.67E-05	3.50E+01	2.00E+03
Hg-194	4.31E-06	5.77E-03	1.89E-02	1.21E-04	6.10E+03	2.00E+04
Hg-203	1.49E-02	2.68E-03	2.59E+01	2.65E+00	6.10E+03	2.00E+04
Pb-202	3.61E-08	7.73E-02	2.19E-02	1.31E-04	2.50E+01	1.00E+03
Pb-205	1.24E-10	1.30E-03	2.22E-02	1.33E-04	2.50E+01	1.00E+03
Pb-210	8.55E-05	3.77E+00	2.53E-01	1.27E-02	2.50E+01	1.00E+03
Bi-207	5.77E-05	6.11E-03	1.69E+02	1.79E+01	1.50E+01	1.00E+03
Bi-210	1.38E-01	6.66E-03	4.10E+00	3.48E-02	1.50E+01	1.00E+03
Bi-210m	6.24E-10	7.44E-02	2.85E+01	2.91E+00	1.50E+01	1.00E+03

CONVERSION FACTORS (Cont'd)

Nuclide	Decay Constant (1/day)	Ingestion EDE Dose Factor (rem/uCi)	Grd Shine DF (mrem sq m) (yr uCi)	Water Im DF (mrem cu m) (yr uCi)	Freshwater Fish Accum. Factor (L/kg)	Saltwater Invert Accum Factor (L/kg)
Po-210	5.01E-03	1.32E+00	1.08E-03	1.13E-04	3.60E+01	5.00E+04
Ra-223	6.06E-02	8.03E-01	1.48E+01	1.48E+00	4.00E+00	1.00E+02
Ra-224	1.89E-01	4.66E-01	1.12E+00	1.15E-01	4.00E+00	1.00E+02
Ra-225	4.65E-02	8.81E-01	1.28E+00	6.34E-02	4.00E+00	1.00E+02
Ra-226	1.19E-06	1.68E+00	7.79E-01	7.98E-02	4.00E+00	1.00E+02
Ra-228	3.30E-04	5.92E+00	8.56E-02	7.91E-04	4.00E+00	1.00E+02
Ac-227	8.71E-05	1.45E+00	2.77E-02	9.63E-04	2.50E+01	1.00E+03
Th-227	3.71E-02	5.44E-02	1.34E+01	1.34E+00	6.00E+00	1.00E+03
Th-228	9.93E-04	4.29E-01	2.52E-01	2.15E-02	6.00E+00	1.00E+03
Th-229	2.58E-07	2.25E+00	9.04E+00	8.63E-01	6.00E+00	1.00E+03
Th-230	2.52E-08	9.36E-01	7.48E-02	3.99E-03	6.00E+00	1.00E+03
Th-231	6.52E-01	1.71E-03	1.77E+00	1.19E-01	6.00E+00	1.00E+03
Th-232	1.35E-13	1.03E+00	5.29E-02	2.10E-03	6.00E+00	1.00E+03
Th-234	2.88E-02	1.73E-02	9.56E-01	8.42E-02	6.00E+00	1.00E+03
Pa-230	3.98E-02	4.48E-03	7.26E+01	7.58E+00	1.00E+01	1.00E+01
Pa-231	5.79E-08	2.07E+00	4.05E+00	3.71E-01	1.00E+01	1.00E+01
Pa-233	2.57E-02	4.88E-03	2.36E+01	2.37E+00	1.00E+01	1.00E+01
U-232	2.75E-05	1.49E+00	8.52E-02	2.84E-03	9.60E-01	1.00E+01
U-233	1.19E-08	2.23E-01	5.55E-02	2.74E-03	9.60E-01	1.00E+01
U-234	7.73E-09	2.15E-01	6.77E-02	1.63E-03	9.60E-01	1.00E+01
U-235	2.70E-12	2.03E-01	1.74E+01	1.76E+00	9.60E-01	1.00E+01
U-236	8.10E-11	2.02E-01	5.62E-02	1.01E-03	9.60E-01	1.00E+01
U-237	1.03E-01	3.92E-03	1.44E+01	1.37E+00	9.60E-01	1.00E+01
U-238	4.25E-13	1.94E-01	4.56E-02	8.54E-04	9.60E-01	1.00E+01
Np-236	1.23E-08	9.99E-02	1.49E+01	1.44E+00	2.10E+01	1.00E+01
Np-237	8.85E-10	4.63E-01	2.85E+00	2.25E-01	2.10E+01	1.00E+01
Np-239	2.94E-01	4.11E-03	1.89E+01	1.89E+00	2.10E+01	1.00E+01
Am-237	1.37E+01	8.81E-05	3.94E+01	3.98E+00	2.40E+02	3.60E+02
Am-241	4.39E-06	8.81E-01	2.54E+00	1.80E-01	2.40E+02	3.60E+02
Am-242m	1.35E-05	7.99E-01	2.42E-01	5.29E-03	2.40E+02	3.60E+02
Am-243	2.57E-07	8.73E-01	5.79E+00	5.06E-01	2.40E+02	3.60E+02
Pu-237	1.53E-02	5.59E-04	4.98E+00	4.67E-01	3.00E+01	3.00E+02
Pu-238	2.16E-05	9.73E-01	6.99E-02	9.11E-04	3.00E+01	3.00E+02
Pu-239	7.87E-08	1.07E+00	3.57E-02	9.93E-04	3.00E+01	3.00E+02
Pu-240	2.89E-07	1.07E+00	6.63E-02	8.94E-04	3.00E+01	3.00E+02
Pu-241	1.32E-04	1.93E-02	1.67E-04	1.60E-05	3.00E+01	3.00E+02
Pu-242	5.06E-09	1.01E+00	6.49E-02	1.67E-03	3.00E+01	3.00E+02
Pu-244	2.37E-11	1.01E+00	2.24E+00	2.44E-01	3.00E+01	3.00E+02
Cm-241	2.11E-02	4.59E-03	5.41E+01	5.40E+00	3.00E+01	4.60E+02
Cm-242	4.26E-03	7.10E-02	7.79E-02	1.06E-03	3.00E+01	4.60E+02
Cm-243	6.52E-05	6.66E-01	1.38E+01	1.37E+00	3.00E+01	4.60E+02
Cm-244	1.05E-04	5.59E-01	6.83E-02	1.08E-03	3.00E+01	4.60E+02
Cm-245	2.23E-07	8.95E-01	1.06E+01	1.04E+00	3.00E+01	4.60E+02
Cm-246	3.99E-07	8.92E-01	4.52E-01	4.52E-02	3.00E+01	4.60E+02
Cm-247	1.22E-10	8.21E-01	3.48E+01	3.51E+00	3.00E+01	4.60E+02
Cm-248	5.45E-09	3.34E+00	1.46E+02	1.62E+01	3.00E+01	4.60E+02
Cm-250	2.29E-07	2.29E+01	1.48E+03	1.65E+02	3.00E+01	4.60E+02
Bk-247	1.37E-06	1.64E+00	1.54E+01	1.54E+00	2.50E+01	1.00E+03
Bk-249	2.10E-03	4.63E-03	6.62E-04	6.32E-05	2.50E+01	1.00E+03

	CONVERSION FACTORS (Cont'd)					
	Decay Constant	Ingestion EDE Dose Factor	Grd Shine DF (mrem sq m)	Water Im DF (mrem cu m)	Freshwater Fish Accum.	Saltwater Invert Accum
Nuclide	(1/day)	(rem/uCi)	(yr uCi)	(yr uCi)	Factor (L/kg)	Factor (L/kg)
Cf-249	5.41E-06	1.65E+00	3.59E+01	3.63E+00	2.50E+01	5.00E+02
Cf-250	1.45E-04	8.21E-01	1.14E+00	1.21E-01	2.50E+01	5.00E+02
Cf-251	2.11E-06	1.68E+00	1.25E+01	1.25E+00	2.50E+01	5.00E+02
Cf-252	7.17E-04	5.59E-01	5.04E+01	5.61E+00	2.50E+01	5.00E+02
Es-253	3.39E-02	3.41E-02	5.83E-02	3.85E-03	2.50E+01	7.00E+03
Unidentified alpha	7.87E-08	1.07E+00	3.57E-02	9.93E-04	3.00E+01	3.00E+02
Unidentified beta	6.59E-05	1.33E-01	1.30E+01	1.28E-01	2.90E+00	1.00E+00

	Maximally-Exposed-Individual Dose (50-Yr CEDE) (mrem)					
Nuclide	Fish Ingestion Dose	Water Ingestion Dose	Shoreline Dose	Swimming Dose	Boating Dose	Nuclide Dose All Pathways
H-3	2.8E-07	9.3E-06	0.0E+00	5.7E-09	0.0E+00	9.6E-06
Be-7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Be-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-24	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Al-26	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Si-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-43	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-47	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ti-44	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
V-49	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-53	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cu-64	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ge-68	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-79	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rb-87	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	1.4E-03	1.6E-02	7.3E-04	3.0E-08	4.8E-08	1.8E-02
Y-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-96	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Maximally-Exposed-Individual Dose (50-Yr CEDE) (mrem)					
Nuclide	Fish Ingestion Dose	Water Ingestion Dose	Shoreline Dose	Swimming Dose	Boating Dose	Nuclide Dose All Pathways
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pd-107	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-113m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-115m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
In-115	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-122	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Te-123	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Te-125m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sn-126	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	4.8E-02	5.3E-02	2.5E-04	1.9E-08	2.9E-08	1.0E-01
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	5.3E-01	5.9E-03	3.9E-03	1.6E-06	2.6E-06	5.4E-01
La-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
La-138	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
La-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-146	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-151	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Gd-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ho-166m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lu-176	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ta-180	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hf-182	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192n	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pt-193	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hg-194	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hg-203	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-202	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-205	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-207	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Maximally-Exposed-Individual Dose (50-Yr CEDE) (mrem)					
Nuclide	Fish Ingestion Dose	Water Ingestion Dose	Shoreline Dose	Swimming Dose	Boating Dose	Nuclide Dose All Pathways
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-242m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	1.1E-01	1.3E-01	3.9E-06	2.4E-10	3.7E-10	2.4E-01
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-245	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-246	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-248	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bk-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bk-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	Maximally-Exposed-Individual Dose (50-Yr CEDE) (mrem)					
	Fish	Water	Shoreline	Swimming	Boating	Nuclide Dose
Nuclide	Ingestion Dose	Ingestion Dose	Dose	Dose	Dose	All Pathways
Cf-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-251	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-252	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Es-253	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Unidentified alpha	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Unidentified beta	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
TOTAL Dose	**6.9E-01**	**2.0E-01**	**4.9E-03**	**1.7E-06**	**2.6E-06**	**9.0E-01**

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Maximum Doses

Nuclide	BJC Max Dose (mrem)	BJP Max Dose (mrem)	PW Max Dose (mrem)			
H-3	7.0E-06	7.0E-06	7.0E-06			
Be-7	0.0E+00	0.0E+00	0.0E+00			
Be-10	0.0E+00	0.0E+00	0.0E+00			
C-14	0.0E+00	0.0E+00	0.0E+00			
Na-22	0.0E+00	0.0E+00	0.0E+00			
Na-24	0.0E+00	0.0E+00	0.0E+00			
Al-26	0.0E+00	0.0E+00	0.0E+00			
P-32	0.0E+00	0.0E+00	0.0E+00			
Si-32	0.0E+00	0.0E+00	0.0E+00			
S-35	0.0E+00	0.0E+00	0.0E+00			
Cl-36	0.0E+00	0.0E+00	0.0E+00			
K-40	0.0E+00	0.0E+00	0.0E+00			
K-43	0.0E+00	0.0E+00	0.0E+00			
Ca-41	0.0E+00	0.0E+00	0.0E+00			
Ca-45	0.0E+00	0.0E+00	0.0E+00			
Ca-47	0.0E+00	0.0E+00	0.0E+00			
Ti-44	0.0E+00	0.0E+00	0.0E+00			
V-49	0.0E+00	0.0E+00	0.0E+00			
Cr-51	0.0E+00	0.0E+00	0.0E+00			
Mn-53	0.0E+00	0.0E+00	0.0E+00			
Mn-54	0.0E+00	0.0E+00	0.0E+00			
Fe-55	0.0E+00	0.0E+00	0.0E+00			
Fe-60	0.0E+00	0.0E+00	0.0E+00			
Co-58	0.0E+00	0.0E+00	0.0E+00			
Co-60	0.0E+00	0.0E+00	0.0E+00			
Ni-59	0.0E+00	0.0E+00	0.0E+00			
Ni-63	0.0E+00	0.0E+00	0.0E+00			
Cu-64	0.0E+00	0.0E+00	0.0E+00			
Zn-65	0.0E+00	0.0E+00	0.0E+00			
Ge-68	0.0E+00	0.0E+00	0.0E+00			
Se-75	0.0E+00	0.0E+00	0.0E+00			
Se-79	0.0E+00	0.0E+00	0.0E+00			
Rb-87	0.0E+00	0.0E+00	0.0E+00			
Sr-89	0.0E+00	0.0E+00	0.0E+00			
Sr-90	1.2E-02	1.2E-02	1.2E-02			
Y-90	0.0E+00	0.0E+00	0.0E+00			
Y-91	0.0E+00	0.0E+00	0.0E+00			
Mo-93	0.0E+00	0.0E+00	0.0E+00			
Mo-99	0.0E+00	0.0E+00	0.0E+00			
Nb-93m	0.0E+00	0.0E+00	0.0E+00			
Nb-94	0.0E+00	0.0E+00	0.0E+00			
Nb-95	0.0E+00	0.0E+00	0.0E+00			
Zr-93	0.0E+00	0.0E+00	0.0E+00			
Zr-95	0.0E+00	0.0E+00	0.0E+00			
Tc-96	0.0E+00	0.0E+00	0.0E+00			
Tc-97	0.0E+00	0.0E+00	0.0E+00			
Tc-98	0.0E+00	0.0E+00	0.0E+00			
Tc-99	0.0E+00	0.0E+00	0.0E+00			
Ru-97	0.0E+00	0.0E+00	0.0E+00			

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Maximum Doses						
Nuclide	BJC Max Dose (mrem)	BJP Max Dose (mrem)	PW Max Dose (mrem)			
Ru-103	0.0E+00	0.0E+00	0.0E+00			
Ru-106	0.0E+00	0.0E+00	0.0E+00			
Pd-107	0.0E+00	0.0E+00	0.0E+00			
Ag-108m	0.0E+00	0.0E+00	0.0E+00			
Ag-110m	0.0E+00	0.0E+00	0.0E+00			
Cd-113m	0.0E+00	0.0E+00	0.0E+00			
Cd-115m	0.0E+00	0.0E+00	0.0E+00			
In-115	0.0E+00	0.0E+00	0.0E+00			
Sb-122	0.0E+00	0.0E+00	0.0E+00			
Sb-124	0.0E+00	0.0E+00	0.0E+00			
Sb-125	0.0E+00	0.0E+00	0.0E+00			
Te-123	0.0E+00	0.0E+00	0.0E+00			
Te-125m	0.0E+00	0.0E+00	0.0E+00			
Sn-126	0.0E+00	0.0E+00	0.0E+00			
I-129	4.0E-02	4.0E-02	4.0E-02			
I-131	0.0E+00	0.0E+00	0.0E+00			
Cs-134	0.0E+00	0.0E+00	0.0E+00			
Cs-135	0.0E+00	0.0E+00	0.0E+00			
Cs-137	4.4E-03	4.4E-03	4.4E-03			
La-137	0.0E+00	0.0E+00	0.0E+00			
La-138	0.0E+00	0.0E+00	0.0E+00			
La-140	0.0E+00	0.0E+00	0.0E+00			
Ba-140	0.0E+00	0.0E+00	0.0E+00			
Ce-141	0.0E+00	0.0E+00	0.0E+00			
Ce-144	0.0E+00	0.0E+00	0.0E+00			
Sm-146	0.0E+00	0.0E+00	0.0E+00			
Sm-147	0.0E+00	0.0E+00	0.0E+00			
Sm-151	0.0E+00	0.0E+00	0.0E+00			
Pm-147	0.0E+00	0.0E+00	0.0E+00			
Eu-152	0.0E+00	0.0E+00	0.0E+00			
Eu-154	0.0E+00	0.0E+00	0.0E+00			
Eu-155	0.0E+00	0.0E+00	0.0E+00			
Gd-152	0.0E+00	0.0E+00	0.0E+00			
Ho-166m	0.0E+00	0.0E+00	0.0E+00			
Lu-176	0.0E+00	0.0E+00	0.0E+00			
Ta-180	0.0E+00	0.0E+00	0.0E+00			
Hf-182	0.0E+00	0.0E+00	0.0E+00			
Re-186m	0.0E+00	0.0E+00	0.0E+00			
Re-187	0.0E+00	0.0E+00	0.0E+00			
Ir-192n	0.0E+00	0.0E+00	0.0E+00			
Pt-193	0.0E+00	0.0E+00	0.0E+00			
Hg-194	0.0E+00	0.0E+00	0.0E+00			
Hg-203	0.0E+00	0.0E+00	0.0E+00			
Pb-202	0.0E+00	0.0E+00	0.0E+00			
Pb-205	0.0E+00	0.0E+00	0.0E+00			
Pb-210	0.0E+00	0.0E+00	0.0E+00			
Bi-207	0.0E+00	0.0E+00	0.0E+00			
Bi-210	0.0E+00	0.0E+00	0.0E+00			
Bi-210m	0.0E+00	0.0E+00	0.0E+00			

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Maximum Doses						
Nuclide	BJC Max Dose (mrem)	BJP Max Dose (mrem)	PW Max Dose (mrem)			
Po-210	0.0E+00	0.0E+00	0.0E+00			
Ra-223	0.0E+00	0.0E+00	0.0E+00			
Ra-224	0.0E+00	0.0E+00	0.0E+00			
Ra-225	0.0E+00	0.0E+00	0.0E+00			
Ra-226	0.0E+00	0.0E+00	0.0E+00			
Ra-228	0.0E+00	0.0E+00	0.0E+00			
Ac-227	0.0E+00	0.0E+00	0.0E+00			
Th-227	0.0E+00	0.0E+00	0.0E+00			
Th-228	0.0E+00	0.0E+00	0.0E+00			
Th-229	0.0E+00	0.0E+00	0.0E+00			
Th-230	0.0E+00	0.0E+00	0.0E+00			
Th-231	0.0E+00	0.0E+00	0.0E+00			
Th-232	0.0E+00	0.0E+00	0.0E+00			
Th-234	0.0E+00	0.0E+00	0.0E+00			
Pa-230	0.0E+00	0.0E+00	0.0E+00			
Pa-231	0.0E+00	0.0E+00	0.0E+00			
Pa-233	0.0E+00	0.0E+00	0.0E+00			
U-232	0.0E+00	0.0E+00	0.0E+00			
U-233	0.0E+00	0.0E+00	0.0E+00			
U-234	0.0E+00	0.0E+00	0.0E+00			
U-235	0.0E+00	0.0E+00	0.0E+00			
U-236	0.0E+00	0.0E+00	0.0E+00			
U-237	0.0E+00	0.0E+00	0.0E+00			
U-238	0.0E+00	0.0E+00	0.0E+00			
Np-236	0.0E+00	0.0E+00	0.0E+00			
Np-237	0.0E+00	0.0E+00	0.0E+00			
Np-239	0.0E+00	0.0E+00	0.0E+00			
Am-237	0.0E+00	0.0E+00	0.0E+00			
Am-241	0.0E+00	0.0E+00	0.0E+00			
Am-242m	0.0E+00	0.0E+00	0.0E+00			
Am-243	0.0E+00	0.0E+00	0.0E+00			
Pu-237	0.0E+00	0.0E+00	0.0E+00			
Pu-238	0.0E+00	0.0E+00	0.0E+00			
Pu-239	9.5E-02	9.5E-02	9.5E-02			
Pu-240	0.0E+00	0.0E+00	0.0E+00			
Pu-241	0.0E+00	0.0E+00	0.0E+00			
Pu-242	0.0E+00	0.0E+00	0.0E+00			
Pu-244	0.0E+00	0.0E+00	0.0E+00			
Cm-241	0.0E+00	0.0E+00	0.0E+00			
Cm-242	0.0E+00	0.0E+00	0.0E+00			
Cm-243	0.0E+00	0.0E+00	0.0E+00			
Cm-244	0.0E+00	0.0E+00	0.0E+00			
Cm-245	0.0E+00	0.0E+00	0.0E+00			
Cm-246	0.0E+00	0.0E+00	0.0E+00			
Cm-247	0.0E+00	0.0E+00	0.0E+00			
Cm-248	0.0E+00	0.0E+00	0.0E+00			
Cm-250	0.0E+00	0.0E+00	0.0E+00			
Bk-247	0.0E+00	0.0E+00	0.0E+00			
Bk-249	0.0E+00	0.0E+00	0.0E+00			
Cf-249	0.0E+00	0.0E+00	0.0E+00			
Cf-250	0.0E+00	0.0E+00	0.0E+00			

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Maximum Doses						
	BJC Max Dose	BJP Max Dose	PW Max Dose			
Nuclide	(mrem)	(mrem)	(mrem)			
Cf-251	0.0E+00	0.0E+00	0.0E+00			
Cf-252	0.0E+00	0.0E+00	0.0E+00			
Es-253	0.0E+00	0.0E+00	0.0E+00			
Unidentified alpha	0.0E+00	0.0E+00	0.0E+00			
Unidentified beta	0.0E+00	0.0E+00	0.0E+00			
TOTAL Dose	**1.5E-01**	**1.5E-01**	**1.5E-01**			

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Population Doses

Nuclide	BJC Pop Dose (person-rem)	BJP Pop Dose (person-rem)	PW Pop Dose (person-rem)	Total Water (person-rem)	All-Pathways (person-rem)	
H-3	2.2E-04	1.7E-04	9.1E-05	4.8E-04	**4.8E-04**	
Be-7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Be-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Na-24	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Al-26	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Si-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
K-43	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ca-47	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ti-44	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
V-49	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Mn-53	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Fe-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cu-64	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ge-68	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Se-79	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Rb-87	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sr-90	3.7E-01	2.9E-01	1.6E-01	8.2E-01	**8.6E-01**	
Y-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Mo-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Zr-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Tc-96	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Tc-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Tc-98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Population Doses						
Nuclide	BJC Pop Dose (person-rem)	BJP Pop Dose (person-rem)	PW Pop Dose (person-rem)	Total Water (person-rem)	All-Pathways (person-rem)	
Ru-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pd-107	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cd-113m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cd-115m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
In-115	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sb-122	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Te-123	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Te-125m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sn-126	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
I-129	1.3E+00	9.7E-01	5.3E-01	2.8E+00	**3.2E+00**	
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cs-135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cs-137	1.4E-01	1.1E-01	5.8E-02	3.0E-01	**1.9E+00**	
La-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
La-138	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
La-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ba-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sm-146	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Sm-151	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Gd-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ho-166m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Lu-176	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ta-180	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Hf-182	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Re-186m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Re-187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ir-192n	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pt-193	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Hg-194	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Hg-203	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pb-202	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pb-205	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Bi-207	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Population Doses						
Nuclide	BJC Pop Dose (person-rem)	BJP Pop Dose (person-rem)	PW Pop Dose (person-rem)	Total Water (person-rem)	All-Pathways (person-rem)	
Bi-210m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pa-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Np-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Np-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Am-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Am-242m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Am-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pu-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pu-239	3.0E+00	2.3E+00	1.3E+00	6.6E+00	**1.1E+01**	
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Pu-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-245	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-246	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-248	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cm-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Bk-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	

Beaufort-Jasper-Chelsea (BJC), Beaufort-Jasper-Purrysburg (BJP), and Port Wentworth (PW) Drinking Water Population Doses						
Nuclide	BJC Pop Dose (person-rem)	BJP Pop Dose (person-rem)	PW Pop Dose (person-rem)	Total Water (person-rem)	All-Pathways (person-rem)	
Bk-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cf-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cf-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cf-251	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Cf-252	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Es-253	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Unidentified alpha	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
Unidentified beta	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	
TOTAL Dose	**4.8E+00**	**3.7E+00**	**2.0E+00**	**1.0E+01**	**1.7E+01**	

	50-Mile Population Doses (50-Yr CEDE) (person-rem)					
Nuclide	Sport Fish Ingestion	Comm Fish Ingestion	Invertebrate Ingestion	Shoreline Exposure	Swimming	Boating
H-3	9.5E-08	6.6E-07	1.0E-06	0.0E+00	1.2E-07	0.0E+00
Be-7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Be-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Na-24	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Al-26	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Si-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
K-43	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ca-47	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ti-44	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
V-49	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-53	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fe-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cu-64	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ge-68	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Se-79	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Rb-87	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sr-90	4.7E-04	3.3E-03	1.9E-03	3.0E-02	6.4E-07	3.4E-06
Y-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Mo-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-96	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	50-Mile Population Doses (50-Yr CEDE) (person-rem)					
Nuclide	Sport Fish Ingestion	Comm Fish Ingestion	Invertebrate Ingestion	Shoreline Exposure	Swimming	Boating
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pd-107	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-113m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-115m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
In-115	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-122	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Te-123	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Te-125m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sn-126	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	1.6E-02	1.1E-01	3.2E-01	1.0E-02	3.9E-07	2.1E-06
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-135	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	1.8E-01	1.3E+00	2.1E-02	1.6E-01	3.4E-05	1.8E-04
La-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
La-138	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
La-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-146	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-151	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Gd-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ho-166m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lu-176	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ta-180	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hf-182	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-187	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192n	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pt-193	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hg-194	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hg-203	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-202	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-205	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-207	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	50-Mile Population Doses (50-Yr CEDE) (person-rem)					
Nuclide	Sport Fish Ingestion	Comm Fish Ingestion	Invertebrate Ingestion	Shoreline Exposure	Swimming	Boating
Bi-210m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Np-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-242m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Am-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-239	3.9E-02	2.7E-01	4.5E+00	1.6E-04	5.0E-09	2.6E-08
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pu-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-245	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-246	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-248	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cm-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bk-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

	50-Mile Population Doses (50-Yr CEDE) (person-rem)					
Nuclide	Sport Fish Ingestion	Comm Fish Ingestion	Invertebrate Ingestion	Shoreline Exposure	Swimming	Boating
Bk-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-251	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-252	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Es-253	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Unidentified alpha	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Unidentified beta	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
TOTAL Dose	**2.4E-01**	**1.6E+00**	**4.9E+00**	**2.0E-01**	**3.5E-05**	**1.9E-04**

IRRIDOSE

Version 2017

An electronic spreadsheet designed to calculate ingestion dose resulting from crop irrigation with Savannah River water.

LADTAP XL Version 2017 Protected

Irrigation Parameter Values:

Parameter	Value	Units	Comments
50Mile Total Vegetable Production:	7100000	kg/yr	**5.30E+06***
50Mile Total Leafy Veg Production:	1800000	kg/yr	**1.40E+06***
Irrigated land area:	1000	acres	
Pop dose determined by:	area		POP or AREA
River transit time:	2	d	
Irrigation rate:	3.6	L/sq.m/d	102 L/sq.m/mo
Weathering removal constant:	0.0495	1/d	14 d half-life
Crop exposure time:	70	d	
Grass exposure time:	30	d	
Vegetable crop yield:	2.2	kg/sq.m	
Pasture grass yield:	0.7	kg/sq.m	
Milk production yield:	0.34	L/sq.m	
Meat production yield:	0.01	kd/sq.m	
Surface density of soil:	240	kg/sq.m	
Pasture grass hold-up time:	0	d	
Veg transport time (individual):	1	d	
Veg transport time (population):	6	d	
Milk transport time:	3	d	
Meat transport time:	6	d	
Fraction of fodder from irrigated field:	1.00		
Cattle consumption rate of fodder:	36	kg/d	beef
	52	kg/d	milk
Fraction of water from Savannah River:	1.00		
Cattle consumption rate of water:	28	L/d	beef
	50	L/d	milk
Individual consumption rates:	289	kg/yr	veg
	31	kg/yr	leafy
	81	kg/yr	meat
	260	L/yr	milk
Population consumption rates:	89	kg/yr	veg
	11	kg/yr	leafy
	32	kg/yr	meat
	69	L/yr	milk
Fractional retention on leaves:	0.25		all nuclides

*Expected parameter value.

**** see LADTAP Worksheet for Source Term Entry**

Values Calculated by LADTAP based on User-Defined Input in Column D. These values should not be altered.

Parameter	Value	Units	Comments
Exposed population:	39,053	persons	
Savannah River flow rate:	7,500	cu.ft/sec	equals LT flow rate
Buildup time in soil:	23,011	d	Plant life
Production within irrigated area:	7.10E+06	kg/yr	veg
	1.78E+06	kg/yr	leafy
	4.05E+04	kg/yr	meat
	1.38E+06	kg/yr	milk

Version 2017

LADTAP XL Version 2017 Protected

DOSE SUMMARY

Pathway	Individual Dose (mrem/yr)	Population Dose by Irrigated Land Area (person rem/yr)
Veg Consumption:	8.9E-01	2.5E+01
Milk Consumption:	1.5E-01	8.0E-01
Meat Consumption:	4.7E-02	2.3E-02
TOTAL:	**1.1E+00**	**2.5E+01**

	NUCLIDE SPECIFIC PARAMETERS				
	Soil-to-plant	Milk Transfer	Meat Transfer		
Nuclide	transfer factor	(d/L)	(d/kg)		
H-3	4.80E+00	1.50E-02	0.00E+00		
Be-7	6.83E-04	8.30E-07	1.00E-03		
Be-10	6.83E-04	8.30E-07	1.00E-03		
C-14	1.37E-01	1.20E-02	3.10E-02		
Na-22	5.85E-03	1.30E-02	1.50E-02		
Na-24	5.85E-03	1.30E-02	1.50E-02		
Al-26	1.27E-04	2.06E-04	1.50E-03		
P-32	1.95E-01	2.00E-02	5.50E-02		
Si-32	2.65E-02	2.00E-05	4.00E-05		
S-35	2.93E-01	7.90E-03	2.00E-01		
Cl-36	3.49E+00	1.70E-02	1.70E-02		
K-40	2.54E-01	7.20E-03	2.00E-02		
K-43	2.54E-01	7.20E-03	2.00E-02		
Ca-41	3.90E+00	1.00E-02	1.30E-02		
Ca-45	3.90E+00	1.00E-02	1.30E-02		
Ca-47	3.90E+00	1.00E-02	1.30E-02		
Ti-44	5.85E-04	7.53E-05	1.73E-04		
V-49	5.85E-04	2.06E-05	2.50E-03		
Cr-51	1.95E-04	4.30E-04	9.00E-03		
Mn-53	6.39E-02	4.10E-05	6.00E-04		
Mn-54	6.39E-02	4.10E-05	6.00E-04		
Fe-55	1.10E-02	3.50E-05	1.40E-02		
Fe-60	1.10E-02	3.50E-05	1.40E-02		
Co-58	2.48E-02	1.10E-04	4.30E-04		
Co-60	2.48E-02	1.10E-04	4.30E-04		
Ni-59	2.18E-02	9.50E-04	5.00E-03		
Ni-63	2.18E-02	9.50E-04	5.00E-03		
Cu-64	1.56E-01	2.00E-03	9.00E-03		
Zn-65	1.71E-01	2.70E-03	1.60E-01		
Ge-68	1.56E-02	7.21E-02	7.00E-01		
Se-75	1.89E-02	4.00E-03	1.50E-02		
Se-79	1.89E-02	4.00E-03	1.50E-02		
Rb-87	1.39E-01	1.20E-02	1.00E-02		
Sr-89	1.23E-01	1.30E-03	1.30E-03		
Sr-90	1.23E-01	1.30E-03	1.30E-03		
Y-90	3.90E-04	2.00E-05	1.00E-03		
Y-91	3.90E-04	2.00E-05	1.00E-03		
Mo-93	8.71E-02	1.10E-03	1.00E-03		
Mo-99	8.71E-02	1.10E-03	1.00E-03		
Nb-93m	2.18E-03	4.10E-07	2.60E-07		
Nb-94	2.18E-03	4.10E-07	2.60E-07		
Nb-95	2.18E-03	4.10E-07	2.60E-07		
Zr-93	7.80E-04	3.60E-06	1.20E-06		
Zr-95	7.80E-04	3.60E-06	1.20E-06		
Tc-96	1.79E+01	1.87E-03	6.32E-03		
Tc-97	1.79E+01	1.87E-03	6.32E-03		
Tc-98	1.79E+01	1.87E-03	6.32E-03		
Tc-99	1.79E+01	1.87E-03	6.32E-03		
Ru-97	6.29E-03	9.40E-06	3.30E-03		

	NUCLIDE SPECIFIC PARAMETERS (CONT'D)				
Nuclide	Soil-to-plant transfer factor	Milk Transfer (d/L)	Meat Transfer (d/kg)		
Ru-103	6.29E-03	9.40E-06	3.30E-03		
Ru-106	6.29E-03	9.40E-06	3.30E-03		
Pd-107	1.28E-02	1.00E-02	4.00E-03		
Ag-108m	1.19E-04	1.58E-03	3.00E-03		
Ag-110m	1.19E-04	1.58E-03	3.00E-03		
Cd-113m	1.49E-01	1.90E-04	5.80E-03		
Cd-115m	1.49E-01	1.90E-04	5.80E-03		
In-115	2.43E-04	2.00E-04	8.00E-03		
Sb-122	2.61E-04	3.80E-05	1.20E-03		
Sb-124	2.61E-04	3.80E-05	1.20E-03		
Sb-125	2.61E-04	3.80E-05	1.20E-03		
Te-123	5.85E-02	3.40E-04	7.00E-03		
Te-125m	5.85E-02	3.40E-04	7.00E-03		
Sn-126	2.27E-03	1.00E-03	8.00E-02		
I-129	1.32E-02	5.40E-03	6.70E-03		
I-131	1.32E-02	5.40E-03	6.70E-03		
Cs-134	6.85E-03	4.60E-03	2.20E-02		
Cs-135	6.85E-03	4.60E-03	2.20E-02		
Cs-137	6.85E-03	4.60E-03	2.20E-02		
La-137	9.09E-04	2.00E-05	1.30E-04		
La-138	9.09E-04	2.00E-05	1.30E-04		
La-140	9.09E-04	2.00E-05	1.30E-04		
Ba-140	9.75E-04	1.60E-04	1.40E-04		
Ce-141	1.63E-03	2.00E-05	2.00E-05		
Ce-144	1.63E-03	2.00E-05	2.00E-05		
Sm-146	3.90E-03	3.00E-05	3.16E-04		
Sm-147	3.90E-03	3.00E-05	3.16E-04		
Sm-151	3.90E-03	3.00E-05	3.16E-04		
Pm-147	2.32E-02	3.00E-05	2.00E-05		
Eu-152	3.90E-03	3.00E-05	2.00E-05		
Eu-154	3.90E-03	3.00E-05	2.00E-05		
Eu-155	3.90E-03	3.00E-05	2.00E-05		
Gd-152	3.90E-03	3.00E-05	2.00E-05		
Ho-166m	3.90E-03	3.00E-05	3.00E-04		
Lu-176	7.80E-04	2.06E-05	4.50E-03		
Ta-180	4.88E-03	4.10E-07	1.34E-05		
Hf-182	1.95E-04	5.50E-07	3.16E-05		
Re-186m	1.21E-01	1.50E-03	8.00E-03		
Re-187	1.21E-01	1.50E-03	8.00E-03		
Ir-192n	4.76E-03	2.00E-06	1.50E-03		
Pt-193	4.88E-03	5.15E-03	4.00E-03		
Hg-194	9.03E-02	4.70E-04	2.50E-01		
Hg-203	9.03E-02	4.70E-04	2.50E-01		
Pb-202	5.18E-03	1.90E-04	7.00E-04		
Pb-205	5.18E-03	1.90E-04	7.00E-04		
Pb-210	5.18E-03	1.90E-04	7.00E-04		
Bi-207	9.75E-02	5.00E-04	4.00E-04		

	NUCLIDE SPECIFIC PARAMETERS (CONT'D)				
Nuclide	Soil-to-plant transfer factor	Milk Transfer (d/L)	Meat Transfer (d/kg)		
Bi-210	9.75E-02	5.00E-04	4.00E-04		
Bi-210m	9.75E-02	5.00E-04	4.00E-04		
Po-210	4.30E-04	2.10E-04	5.00E-03		
Ra-223	1.19E-02	3.80E-04	1.70E-03		
Ra-224	1.19E-02	3.80E-04	1.70E-03		
Ra-225	1.19E-02	3.80E-04	1.70E-03		
Ra-226	1.19E-02	3.80E-04	1.70E-03		
Ra-228	1.19E-02	3.80E-04	1.70E-03		
Ac-227	6.11E-05	2.00E-05	4.00E-04		
Th-227	3.14E-04	5.00E-06	2.30E-04		
Th-228	3.14E-04	5.00E-06	2.30E-04		
Th-229	3.14E-04	5.00E-06	2.30E-04		
Th-230	3.14E-04	5.00E-06	2.30E-04		
Th-231	3.14E-04	5.00E-06	2.30E-04		
Th-232	3.14E-04	5.00E-06	2.30E-04		
Th-234	3.14E-04	5.00E-06	2.30E-04		
Pa-230	6.11E-05	5.00E-06	4.47E-04		
Pa-231	6.11E-05	5.00E-06	4.47E-04		
Pa-233	6.11E-05	5.00E-06	4.47E-04		
U-232	6.69E-03	1.80E-03	3.90E-04		
U-233	6.69E-03	1.80E-03	3.90E-04		
U-234	6.69E-03	1.80E-03	3.90E-04		
U-235	6.69E-03	1.80E-03	3.90E-04		
U-236	6.69E-03	1.80E-03	3.90E-04		
U-237	6.69E-03	1.80E-03	3.90E-04		
U-238	6.69E-03	1.80E-03	3.90E-04		
Np-236	3.91E-03	5.00E-06	1.00E-03		
Np-237	3.91E-03	5.00E-06	1.00E-03		
Np-239	3.91E-03	5.00E-06	1.00E-03		
Am-237	7.33E-05	4.20E-07	5.00E-04		
Am-241	7.33E-05	4.20E-07	5.00E-04		
Am-242m	7.33E-05	4.20E-07	5.00E-04		
Am-243	7.33E-05	4.20E-07	5.00E-04		
Pu-237	1.97E-05	1.00E-05	1.10E-06		
Pu-238	1.97E-05	1.00E-05	1.10E-06		
Pu-239	1.97E-05	1.00E-05	1.10E-06		
Pu-240	1.97E-05	1.00E-05	1.10E-06		
Pu-241	1.97E-05	1.00E-05	1.10E-06		
Pu-242	1.97E-05	1.00E-05	1.10E-06		
Pu-244	1.97E-05	1.00E-05	1.10E-06		
Cm-241	1.27E-04	2.00E-05	4.00E-05		
Cm-242	1.27E-04	2.00E-05	4.00E-05		
Cm-243	1.27E-04	2.00E-05	4.00E-05		
Cm-244	1.27E-04	2.00E-05	4.00E-05		
Cm-245	1.27E-04	2.00E-05	4.00E-05		
Cm-246	1.27E-04	2.00E-05	4.00E-05		
Cm-247	1.27E-04	2.00E-05	4.00E-05		
Cm-248	1.27E-04	2.00E-05	4.00E-05		

	NUCLIDE SPECIFIC PARAMETERS (CONT'D)				
	Soil-to-plant	Milk Transfer	Meat Transfer		
Nuclide	transfer factor	(d/L)	(d/kg)		
Cm-250	1.27E-04	2.00E-05	4.00E-05		
Bk-247	1.00E-03	2.00E-06	2.50E-05		
Bk-249	1.00E-03	2.00E-06	2.50E-05		
Cf-249	6.11E-05	1.50E-06	4.00E-05		
Cf-250	6.11E-05	1.50E-06	4.00E-05		
Cf-251	6.11E-05	1.50E-06	4.00E-05		
Cf-252	6.11E-05	1.50E-06	4.00E-05		
Es-253	1.00E-03	2.00E-06	2.50E-05		
Unidentified alpha	1.97E-05	1.00E-05	1.10E-06		
Unidentified beta	1.23E-01	1.30E-03	1.30E-03		

	CALCULATION OF VEGETATION CONCENTRATIONS				
	Concentration in	Concentration in	Crop Concentration	Crop Concentration	
Nuclide	Water (pCi/L)	Fodder* (pCi/kg)	Ind (pCi/kg)	Pop (pCi/kg)	
H-3	1.5E-01	1.5E-01	1.5E-01	1.5E-01	
Be-7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Be-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
C-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Na-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Na-24	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Al-26	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
P-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Si-32	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
S-35	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cl-36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
K-40	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
K-43	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ca-41	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ca-45	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ca-47	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ti-44	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
V-49	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cr-51	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Mn-53	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Mn-54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Fe-55	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Fe-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Co-58	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Co-60	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ni-59	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ni-63	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cu-64	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Zn-65	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ge-68	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Se-75	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Se-79	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Rb-87	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sr-89	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Sr-90	1.5E-01	6.3E+00	4.5E+00	4.5E+00	
Y-90	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Y-91	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Mo-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Mo-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Nb-93m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Nb-94	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Nb-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Zr-93	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Zr-95	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Tc-96	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Tc-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Tc-98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Tc-99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ru-97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	

CALCULATION OF VEGETATION CONCENTRATIONS (CONT'D)

Nuclide	Concentration in Water (pCi/L)	Concentration in Fodder (pCi/kg)	Crop Concentration Ind Dose (pCi/kg)	Crop Concentration Pop Dose (pCi/kg)
Ru-103	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pd-107	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-113m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cd-115m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
In-115	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-122	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Te-123	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Te-125m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sn-126	0.0E+00	0.0E+00	0.0E+00	0.0E+00
I-129	1.5E-01	3.7E+00	1.9E+00	1.9E+00
I-131	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-134	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-135	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cs-137	1.5E-01	3.2E+00	1.4E+00	1.4E+00
La-137	0.0E+00	0.0E+00	0.0E+00	0.0E+00
La-138	0.0E+00	0.0E+00	0.0E+00	0.0E+00
La-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ba-140	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-141	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-146	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sm-151	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Gd-152	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ho-166m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lu-176	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ta-180	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hf-182	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-186m	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Re-187	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Ir-192n	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pt-193	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hg-194	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Hg-203	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-202	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-205	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-207	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00

CALCULATION OF VEGETATION CONCENTRATIONS (CONT'D)					
Nuclide	Concentration in Water (pCi/L)	Concentration in Fodder* (pCi/kg)	Crop Concentration Ind (pCi/kg)	Crop Concentration Pop (pCi/kg)	
Bi-210m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Po-210	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ra-223	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ra-224	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ra-225	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ra-226	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ra-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Ac-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-227	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-228	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-229	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Th-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pa-230	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pa-231	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pa-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-232	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-233	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-234	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-235	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
U-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Np-236	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Np-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Np-239	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Am-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Am-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Am-242m	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Am-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pu-237	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pu-238	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pu-239	1.5E-01	3.0E+00	1.2E+00	1.2E+00	
Pu-240	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pu-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pu-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Pu-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-241	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-242	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-243	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-244	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-245	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-246	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-248	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
Cm-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00	

CALCULATION OF VEGETATION CONCENTRATIONS (CONT'D)

Nuclide	Concentration in Water (pCi/L)	Concentration in Fodder* (pCi/kg)	Crop Concentration Ind (pCi/kg)	Crop Concentration Pop (pCi/kg)
Bk-247	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bk-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-249	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-250	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-251	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf-252	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Es-253	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Unidentified alpha	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Unidentified beta	0.0E+00	0.0E+00	0.0E+00	0.0E+00

CALCULATION OF MEAT & MILK CONCENTRATIONS

Nuclide	Concentration in Milk (pCi/L)	Concentration in Meat (pCi/kg)
H-3	1.5E-01	1.5E-01
Be-7	0.0E+00	0.0E+00
Be-10	0.0E+00	0.0E+00
C-14	0.0E+00	0.0E+00
Na-22	0.0E+00	0.0E+00
Na-24	0.0E+00	0.0E+00
Al-26	0.0E+00	0.0E+00
P-32	0.0E+00	0.0E+00
Si-32	0.0E+00	0.0E+00
S-35	0.0E+00	0.0E+00
Cl-36	0.0E+00	0.0E+00
K-40	0.0E+00	0.0E+00
K-43	0.0E+00	0.0E+00
Ca-41	0.0E+00	0.0E+00
Ca-45	0.0E+00	0.0E+00
Ca-47	0.0E+00	0.0E+00
Ti-44	0.0E+00	0.0E+00
V-49	0.0E+00	0.0E+00
Cr-51	0.0E+00	0.0E+00
Mn-53	0.0E+00	0.0E+00
Mn-54	0.0E+00	0.0E+00
Fe-55	0.0E+00	0.0E+00
Fe-60	0.0E+00	0.0E+00
Co-58	0.0E+00	0.0E+00
Co-60	0.0E+00	0.0E+00
Ni-59	0.0E+00	0.0E+00
Ni-63	0.0E+00	0.0E+00
Cu-64	0.0E+00	0.0E+00
Zn-65	0.0E+00	0.0E+00
Ge-68	0.0E+00	0.0E+00
Se-75	0.0E+00	0.0E+00
Se-79	0.0E+00	0.0E+00
Rb-87	0.0E+00	0.0E+00
Sr-89	0.0E+00	0.0E+00
Sr-90	4.3E-01	3.0E-01
Y-90	0.0E+00	0.0E+00
Y-91	0.0E+00	0.0E+00
Mo-93	0.0E+00	0.0E+00
Mo-99	0.0E+00	0.0E+00
Nb-93m	0.0E+00	0.0E+00
Nb-94	0.0E+00	0.0E+00
Nb-95	0.0E+00	0.0E+00
Zr-93	0.0E+00	0.0E+00
Zr-95	0.0E+00	0.0E+00
Tc-96	0.0E+00	0.0E+00
Tc-97	0.0E+00	0.0E+00
Tc-98	0.0E+00	0.0E+00
Tc-99	0.0E+00	0.0E+00
Ru-97	0.0E+00	0.0E+00

CALCULATION OF MEAT & MILK CONCENTRATIONS (CONT'D)

Nuclide	Concentration in Milk (pCi/L)	Concentration in Meat (pCi/kg)
Ru-103	0.0E+00	0.0E+00
Ru-106	0.0E+00	0.0E+00
Pd-107	0.0E+00	0.0E+00
Ag-108m	0.0E+00	0.0E+00
Ag-110m	0.0E+00	0.0E+00
Cd-113m	0.0E+00	0.0E+00
Cd-115m	0.0E+00	0.0E+00
In-115	0.0E+00	0.0E+00
Sb-122	0.0E+00	0.0E+00
Sb-124	0.0E+00	0.0E+00
Sb-125	0.0E+00	0.0E+00
Te-123	0.0E+00	0.0E+00
Te-125m	0.0E+00	0.0E+00
Sn-126	0.0E+00	0.0E+00
I-129	1.1E+00	9.1E-01
I-131	0.0E+00	0.0E+00
Cs-134	0.0E+00	0.0E+00
Cs-135	0.0E+00	0.0E+00
Cs-137	8.0E-01	2.6E+00
La-137	0.0E+00	0.0E+00
La-138	0.0E+00	0.0E+00
La-140	0.0E+00	0.0E+00
Ba-140	0.0E+00	0.0E+00
Ce-141	0.0E+00	0.0E+00
Ce-144	0.0E+00	0.0E+00
Sm-146	0.0E+00	0.0E+00
Sm-147	0.0E+00	0.0E+00
Sm-151	0.0E+00	0.0E+00
Pm-147	0.0E+00	0.0E+00
Eu-152	0.0E+00	0.0E+00
Eu-154	0.0E+00	0.0E+00
Eu-155	0.0E+00	0.0E+00
Gd-152	0.0E+00	0.0E+00
Ho-166m	0.0E+00	0.0E+00
Lu-176	0.0E+00	0.0E+00
Ta-180	0.0E+00	0.0E+00
Hf-182	0.0E+00	0.0E+00
Re-186m	0.0E+00	0.0E+00
Re-187	0.0E+00	0.0E+00
Ir-192n	0.0E+00	0.0E+00
Pt-193	0.0E+00	0.0E+00
Hg-194	0.0E+00	0.0E+00
Hg-203	0.0E+00	0.0E+00
Pb-202	0.0E+00	0.0E+00
Pb-205	0.0E+00	0.0E+00
Pb-210	0.0E+00	0.0E+00
Bi-207	0.0E+00	0.0E+00
Bi-210	0.0E+00	0.0E+00
Bi-210m	0.0E+00	0.0E+00

CALCULATION OF MEAT & MILK CONCENTRATIONS (CONT'D)

Nuclide	Concentration in Milk (pCi/L)	Concentration in Meat (pCi/kg)
Po-210	0.0E+00	0.0E+00
Ra-223	0.0E+00	0.0E+00
Ra-224	0.0E+00	0.0E+00
Ra-225	0.0E+00	0.0E+00
Ra-226	0.0E+00	0.0E+00
Ra-228	0.0E+00	0.0E+00
Ac-227	0.0E+00	0.0E+00
Th-227	0.0E+00	0.0E+00
Th-228	0.0E+00	0.0E+00
Th-229	0.0E+00	0.0E+00
Th-230	0.0E+00	0.0E+00
Th-231	0.0E+00	0.0E+00
Th-232	0.0E+00	0.0E+00
Th-234	0.0E+00	0.0E+00
Pa-230	0.0E+00	0.0E+00
Pa-231	0.0E+00	0.0E+00
Pa-233	0.0E+00	0.0E+00
U-232	0.0E+00	0.0E+00
U-233	0.0E+00	0.0E+00
U-234	0.0E+00	0.0E+00
U-235	0.0E+00	0.0E+00
U-236	0.0E+00	0.0E+00
U-237	0.0E+00	0.0E+00
U-238	0.0E+00	0.0E+00
Np-236	0.0E+00	0.0E+00
Np-237	0.0E+00	0.0E+00
Np-239	0.0E+00	0.0E+00
Am-237	0.0E+00	0.0E+00
Am-241	0.0E+00	0.0E+00
Am-242m	0.0E+00	0.0E+00
Am-243	0.0E+00	0.0E+00
Pu-237	0.0E+00	0.0E+00
Pu-238	0.0E+00	0.0E+00
Pu-239	1.6E-03	1.2E-04
Pu-240	0.0E+00	0.0E+00
Pu-241	0.0E+00	0.0E+00
Pu-242	0.0E+00	0.0E+00
Pu-244	0.0E+00	0.0E+00
Cm-241	0.0E+00	0.0E+00
Cm-242	0.0E+00	0.0E+00
Cm-243	0.0E+00	0.0E+00
Cm-244	0.0E+00	0.0E+00
Cm-245	0.0E+00	0.0E+00
Cm-246	0.0E+00	0.0E+00
Cm-247	0.0E+00	0.0E+00
Cm-248	0.0E+00	0.0E+00
Cm-250	0.0E+00	0.0E+00
Bk-247	0.0E+00	0.0E+00
Bk-249	0.0E+00	0.0E+00

CALCULATION OF MEAT & MILK CONCENTRATIONS (CONT'D)

Nuclide	Concentration in Milk (pCi/L)	Concentration in Meat (pCi/kg)
Cf-249	0.0E+00	0.0E+00
Cf-250	0.0E+00	0.0E+00
Cf-251	0.0E+00	0.0E+00
Cf-252	0.0E+00	0.0E+00
Es-253	0.0E+00	0.0E+00
Unidentified alpha	0.0E+00	0.0E+00
Unidentified beta	0.0E+00	0.0E+00

	CALCULATION OF INDIVIDUAL DOSE				
Nuclide	Veg Consumption Dose (mrem/yr)	Milk Consumption Dose (mrem/yr)	Meat Consumption Dose (mrem/yr)	Total Dose (mrem/yr)	
H-3	3.71E-06	3.01E-06	9.4E-07	7.7E-06	
Be-7	0.00E+00	0.00E+00	0.0E+00		
Be-10	0.00E+00	0.00E+00	0.0E+00		
C-14	0.00E+00	0.00E+00	0.0E+00		
Na-22	0.00E+00	0.00E+00	0.0E+00		
Na-24	0.00E+00	0.00E+00	0.0E+00		
Al-26	0.00E+00	0.00E+00	0.0E+00		
P-32	0.00E+00	0.00E+00	0.0E+00		
Si-32	0.00E+00	0.00E+00	0.0E+00		
S-35	0.00E+00	0.00E+00	0.0E+00		
Cl-36	0.00E+00	0.00E+00	0.0E+00		
K-40	0.00E+00	0.00E+00	0.0E+00		
K-43	0.00E+00	0.00E+00	0.0E+00		
Ca-41	0.00E+00	0.00E+00	0.0E+00		
Ca-45	0.00E+00	0.00E+00	0.0E+00		
Ca-47	0.00E+00	0.00E+00	0.0E+00		
Ti-44	0.00E+00	0.00E+00	0.0E+00		
V-49	0.00E+00	0.00E+00	0.0E+00		
Cr-51	0.00E+00	0.00E+00	0.0E+00		
Mn-53	0.00E+00	0.00E+00	0.0E+00		
Mn-54	0.00E+00	0.00E+00	0.0E+00		
Fe-55	0.00E+00	0.00E+00	0.0E+00		
Fe-60	0.00E+00	0.00E+00	0.0E+00		
Co-58	0.00E+00	0.00E+00	0.0E+00		
Co-60	0.00E+00	0.00E+00	0.0E+00		
Ni-59	0.00E+00	0.00E+00	0.0E+00		
Ni-63	0.00E+00	0.00E+00	0.0E+00		
Cu-64	0.00E+00	0.00E+00	0.0E+00		
Zn-65	0.00E+00	0.00E+00	0.0E+00		
Ge-68	0.00E+00	0.00E+00	0.0E+00		
Se-75	0.00E+00	0.00E+00	0.0E+00		
Se-79	0.00E+00	0.00E+00	0.0E+00		
Rb-87	0.00E+00	0.00E+00	0.0E+00		
Sr-89	0.00E+00	0.00E+00	0.0E+00		
Sr-90	1.90E-01	1.50E-02	3.2E-03	2.1E-01	
Y-90	0.00E+00	0.00E+00	0.0E+00		
Y-91	0.00E+00	0.00E+00	0.0E+00		
Mo-93	0.00E+00	0.00E+00	0.0E+00		
Mo-99	0.00E+00	0.00E+00	0.0E+00		
Nb-93m	0.00E+00	0.00E+00	0.0E+00		
Nb-94	0.00E+00	0.00E+00	0.0E+00		
Nb-95	0.00E+00	0.00E+00	0.0E+00		
Zr-93	0.00E+00	0.00E+00	0.0E+00		
Zr-95	0.00E+00	0.00E+00	0.0E+00		
Tc-96	0.00E+00	0.00E+00	0.0E+00		
Tc-97	0.00E+00	0.00E+00	0.0E+00		
Tc-98	0.00E+00	0.00E+00	0.0E+00		
Tc-99	0.00E+00	0.00E+00	0.0E+00		
Ru-97	0.00E+00	0.00E+00	0.0E+00		

	CALCULATION OF INDIVIDUAL DOSE (CONT'D)				
	Veg Consumption*	Milk Consumption	Meat Consumption	Total Dose	
Nuclide	Dose (mrem/yr)	Dose (mrem/yr)	Dose (mrem/yr)	(mrem/yr)	
Ru-103	0.00E+00	0.00E+00	0.0E+00		
Ru-106	0.00E+00	0.00E+00	0.0E+00		
Pd-107	0.00E+00	0.00E+00	0.0E+00		
Ag-108m	0.00E+00	0.00E+00	0.0E+00		
Ag-110m	0.00E+00	0.00E+00	0.0E+00		
Cd-113m	0.00E+00	0.00E+00	0.0E+00		
Cd-115m	0.00E+00	0.00E+00	0.0E+00		
In-115	0.00E+00	0.00E+00	0.0E+00		
Sb-122	0.00E+00	0.00E+00	0.0E+00		
Sb-124	0.00E+00	0.00E+00	0.0E+00		
Sb-125	0.00E+00	0.00E+00	0.0E+00		
Te-123	0.00E+00	0.00E+00	0.0E+00		
Te-125m	0.00E+00	0.00E+00	0.0E+00		
Sn-126	0.00E+00	0.00E+00	0.0E+00		
I-129	2.68E-01	1.25E-01	3.3E-02	4.3E-01	
I-131	0.00E+00	0.00E+00	0.0E+00		
Cs-134	0.00E+00	0.00E+00	0.0E+00		
Cs-135	0.00E+00	0.00E+00	0.0E+00		
Cs-137	2.17E-02	1.02E-02	1.0E-02	4.2E-02	
La-137	0.00E+00	0.00E+00	0.0E+00		
La-138	0.00E+00	0.00E+00	0.0E+00		
La-140	0.00E+00	0.00E+00	0.0E+00		
Ba-140	0.00E+00	0.00E+00	0.0E+00		
Ce-141	0.00E+00	0.00E+00	0.0E+00		
Ce-144	0.00E+00	0.00E+00	0.0E+00		
Sm-146	0.00E+00	0.00E+00	0.0E+00		
Sm-147	0.00E+00	0.00E+00	0.0E+00		
Sm-151	0.00E+00	0.00E+00	0.0E+00		
Pm-147	0.00E+00	0.00E+00	0.0E+00		
Eu-152	0.00E+00	0.00E+00	0.0E+00		
Eu-154	0.00E+00	0.00E+00	0.0E+00		
Eu-155	0.00E+00	0.00E+00	0.0E+00		
Gd-152	0.00E+00	0.00E+00	0.0E+00		
Ho-166m	0.00E+00	0.00E+00	0.0E+00		
Lu-176	0.00E+00	0.00E+00	0.0E+00		
Ta-180	0.00E+00	0.00E+00	0.0E+00		
Hf-182	0.00E+00	0.00E+00	0.0E+00		
Re-186m	0.00E+00	0.00E+00	0.0E+00		
Re-187	0.00E+00	0.00E+00	0.0E+00		
Ir-192n	0.00E+00	0.00E+00	0.0E+00		
Pt-193	0.00E+00	0.00E+00	0.0E+00		
Hg-194	0.00E+00	0.00E+00	0.0E+00		
Hg-203	0.00E+00	0.00E+00	0.0E+00		
Pb-202	0.00E+00	0.00E+00	0.0E+00		
Pb-205	0.00E+00	0.00E+00	0.0E+00		
Pb-210	0.00E+00	0.00E+00	0.0E+00		
Bi-207	0.00E+00	0.00E+00	0.0E+00		
Bi-210	0.00E+00	0.00E+00	0.0E+00		
Bi-210m	0.00E+00	0.00E+00	0.0E+00		

	CALCULATION OF INDIVIDUAL DOSE (CONT'D)				
	Veg Consumption*	Milk Consumption	Meat Consumption	Total Dose	
Nuclide	Dose (mrem/yr)	Dose (mrem/yr)	Dose (mrem/yr)	(mrem/yr)	
Po-210	0.00E+00	0.00E+00	0.0E+00		
Ra-223	0.00E+00	0.00E+00	0.0E+00		
Ra-224	0.00E+00	0.00E+00	0.0E+00		
Ra-225	0.00E+00	0.00E+00	0.0E+00		
Ra-226	0.00E+00	0.00E+00	0.0E+00		
Ra-228	0.00E+00	0.00E+00	0.0E+00		
Ac-227	0.00E+00	0.00E+00	0.0E+00		
Th-227	0.00E+00	0.00E+00	0.0E+00		
Th-228	0.00E+00	0.00E+00	0.0E+00		
Th-229	0.00E+00	0.00E+00	0.0E+00		
Th-230	0.00E+00	0.00E+00	0.0E+00		
Th-231	0.00E+00	0.00E+00	0.0E+00		
Th-232	0.00E+00	0.00E+00	0.0E+00		
Th-234	0.00E+00	0.00E+00	0.0E+00		
Pa-230	0.00E+00	0.00E+00	0.0E+00		
Pa-231	0.00E+00	0.00E+00	0.0E+00		
Pa-233	0.00E+00	0.00E+00	0.0E+00		
U-232	0.00E+00	0.00E+00	0.0E+00		
U-233	0.00E+00	0.00E+00	0.0E+00		
U-234	0.00E+00	0.00E+00	0.0E+00		
U-235	0.00E+00	0.00E+00	0.0E+00		
U-236	0.00E+00	0.00E+00	0.0E+00		
U-237	0.00E+00	0.00E+00	0.0E+00		
U-238	0.00E+00	0.00E+00	0.0E+00		
Np-236	0.00E+00	0.00E+00	0.0E+00		
Np-237	0.00E+00	0.00E+00	0.0E+00		
Np-239	0.00E+00	0.00E+00	0.0E+00		
Am-237	0.00E+00	0.00E+00	0.0E+00		
Am-241	0.00E+00	0.00E+00	0.0E+00		
Am-242m	0.00E+00	0.00E+00	0.0E+00		
Am-243	0.00E+00	0.00E+00	0.0E+00		
Pu-237	0.00E+00	0.00E+00	0.0E+00		
Pu-238	0.00E+00	0.00E+00	0.0E+00		
Pu-239	4.08E-01	4.53E-04	1.1E-05	4.1E-01	
Pu-240	0.00E+00	0.00E+00	0.0E+00		
Pu-241	0.00E+00	0.00E+00	0.0E+00		
Pu-242	0.00E+00	0.00E+00	0.0E+00		
Pu-244	0.00E+00	0.00E+00	0.0E+00		
Cm-241	0.00E+00	0.00E+00	0.0E+00		
Cm-242	0.00E+00	0.00E+00	0.0E+00		
Cm-243	0.00E+00	0.00E+00	0.0E+00		
Cm-244	0.00E+00	0.00E+00	0.0E+00		
Cm-245	0.00E+00	0.00E+00	0.0E+00		
Cm-246	0.00E+00	0.00E+00	0.0E+00		
Cm-247	0.00E+00	0.00E+00	0.0E+00		
Cm-248	0.00E+00	0.00E+00	0.0E+00		
Cm-250	0.00E+00	0.00E+00	0.0E+00		
Bk-247	0.00E+00	0.00E+00	0.0E+00		
Bk-249	0.00E+00	0.00E+00	0.0E+00		

	CALCULATION OF INDIVIDUAL DOSE (CONT'D)				
	Veg Consumption*	Milk Consumption	Meat Consumption	Total Dose	
Nuclide	Dose (mrem/yr)	Dose (mrem/yr)	Dose (mrem/yr)	(mrem/yr)	
Cf-249	0.00E+00	0.00E+00	0.0E+00		
Cf-250	0.00E+00	0.00E+00	0.0E+00		
Cf-251	0.00E+00	0.00E+00	0.0E+00		
Cf-252	0.00E+00	0.00E+00	0.0E+00		
Es-253	0.00E+00	0.00E+00	0.0E+00		
Unidentified alpha	0.00E+00	0.00E+00	0.0E+00		
Unidentified beta	0.00E+00	0.00E+00	0.0E+00		
Total	**8.9E-01**	**1.5E-01**	**4.7E-02**	**1.1E+00**	

	CALCULATION OF POPULATION DOSE				
	Veg Consumption*	Milk Consumption	Meat Consumption	Total Dose	
Nuclide	Dose (per rem/yr)	Dose (per rem/yr)	Dose (per rem/yr)	(per rem/yr)	
H-3	1.03E-04	1.6E-05	4.7E-07	1.2E-04	
Be-7	0.00E+00	0.0E+00	0.0E+00		
Be-10	0.00E+00	0.0E+00	0.0E+00		
C-14	0.00E+00	0.0E+00	0.0E+00		
Na-22	0.00E+00	0.0E+00	0.0E+00		
Na-24	0.00E+00	0.0E+00	0.0E+00		
Al-26	0.00E+00	0.0E+00	0.0E+00		
P-32	0.00E+00	0.0E+00	0.0E+00		
Si-32	0.00E+00	0.0E+00	0.0E+00		
S-35	0.00E+00	0.0E+00	0.0E+00		
Cl-36	0.00E+00	0.0E+00	0.0E+00		
K-40	0.00E+00	0.0E+00	0.0E+00		
K-43	0.00E+00	0.0E+00	0.0E+00		
Ca-41	0.00E+00	0.0E+00	0.0E+00		
Ca-45	0.00E+00	0.0E+00	0.0E+00		
Ca-47	0.00E+00	0.0E+00	0.0E+00		
Ti-44	0.00E+00	0.0E+00	0.0E+00		
V-49	0.00E+00	0.0E+00	0.0E+00		
Cr-51	0.00E+00	0.0E+00	0.0E+00		
Mn-53	0.00E+00	0.0E+00	0.0E+00		
Mn-54	0.00E+00	0.0E+00	0.0E+00		
Fe-55	0.00E+00	0.0E+00	0.0E+00		
Fe-60	0.00E+00	0.0E+00	0.0E+00		
Co-58	0.00E+00	0.0E+00	0.0E+00		
Co-60	0.00E+00	0.0E+00	0.0E+00		
Ni-59	0.00E+00	0.0E+00	0.0E+00		
Ni-63	0.00E+00	0.0E+00	0.0E+00		
Cu-64	0.00E+00	0.0E+00	0.0E+00		
Zn-65	0.00E+00	0.0E+00	0.0E+00		
Ge-68	0.00E+00	0.0E+00	0.0E+00		
Se-75	0.00E+00	0.0E+00	0.0E+00		
Se-79	0.00E+00	0.0E+00	0.0E+00		
Rb-87	0.00E+00	0.0E+00	0.0E+00		
Sr-89	0.00E+00	0.0E+00	0.0E+00		
Sr-90	5.27E+00	7.9E-02	1.6E-03	5.4E+00	
Y-90	0.00E+00	0.0E+00	0.0E+00		
Y-91	0.00E+00	0.0E+00	0.0E+00		
Mo-93	0.00E+00	0.0E+00	0.0E+00		
Mo-99	0.00E+00	0.0E+00	0.0E+00		
Nb-93m	0.00E+00	0.0E+00	0.0E+00		
Nb-94	0.00E+00	0.0E+00	0.0E+00		
Nb-95	0.00E+00	0.0E+00	0.0E+00		
Zr-93	0.00E+00	0.0E+00	0.0E+00		
Zr-95	0.00E+00	0.0E+00	0.0E+00		
Tc-96	0.00E+00	0.0E+00	0.0E+00		
Tc-97	0.00E+00	0.0E+00	0.0E+00		
Tc-98	0.00E+00	0.0E+00	0.0E+00		
Tc-99	0.00E+00	0.0E+00	0.0E+00		
Ru-97	0.00E+00	0.0E+00	0.0E+00		

	CALCULATION OF POPULATION DOSE (CONT'D)				
Nuclide	Veg Consumption Dose (per rem/yr)	Milk Consumption Dose (per rem/yr)	Meat Consumption Dose (per rem/yr)	Total Dose (per rem/yr)	
Ru-103	0.00E+00	0.0E+00	0.0E+00		
Ru-106	0.00E+00	0.0E+00	0.0E+00		
Pd-107	0.00E+00	0.0E+00	0.0E+00		
Ag-108m	0.00E+00	0.0E+00	0.0E+00		
Ag-110m	0.00E+00	0.0E+00	0.0E+00		
Cd-113m	0.00E+00	0.0E+00	0.0E+00		
Cd-115m	0.00E+00	0.0E+00	0.0E+00		
In-115	0.00E+00	0.0E+00	0.0E+00		
Sb-122	0.00E+00	0.0E+00	0.0E+00		
Sb-124	0.00E+00	0.0E+00	0.0E+00		
Sb-125	0.00E+00	0.0E+00	0.0E+00		
Te-123	0.00E+00	0.0E+00	0.0E+00		
Te-125m	0.00E+00	0.0E+00	0.0E+00		
Sn-126	0.00E+00	0.0E+00	0.0E+00		
I-129	7.45E+00	6.6E-01	1.7E-02	8.1E+00	
I-131	0.00E+00	0.0E+00	0.0E+00		
Cs-134	0.00E+00	0.0E+00	0.0E+00		
Cs-135	0.00E+00	0.0E+00	0.0E+00		
Cs-137	6.03E-01	5.4E-02	5.2E-03	6.6E-01	
La-137	0.00E+00	0.0E+00	0.0E+00		
La-138	0.00E+00	0.0E+00	0.0E+00		
La-140	0.00E+00	0.0E+00	0.0E+00		
Ba-140	0.00E+00	0.0E+00	0.0E+00		
Ce-141	0.00E+00	0.0E+00	0.0E+00		
Ce-144	0.00E+00	0.0E+00	0.0E+00		
Sm-146	0.00E+00	0.0E+00	0.0E+00		
Sm-147	0.00E+00	0.0E+00	0.0E+00		
Sm-151	0.00E+00	0.0E+00	0.0E+00		
Pm-147	0.00E+00	0.0E+00	0.0E+00		
Eu-152	0.00E+00	0.0E+00	0.0E+00		
Eu-154	0.00E+00	0.0E+00	0.0E+00		
Eu-155	0.00E+00	0.0E+00	0.0E+00		
Gd-152	0.00E+00	0.0E+00	0.0E+00		
Ho-166m	0.00E+00	0.0E+00	0.0E+00		
Lu-176	0.00E+00	0.0E+00	0.0E+00		
Ta-180	0.00E+00	0.0E+00	0.0E+00		
Hf-182	0.00E+00	0.0E+00	0.0E+00		
Re-186m	0.00E+00	0.0E+00	0.0E+00		
Re-187	0.00E+00	0.0E+00	0.0E+00		
Ir-192n	0.00E+00	0.0E+00	0.0E+00		
Pt-193	0.00E+00	0.0E+00	0.0E+00		
Hg-194	0.00E+00	0.0E+00	0.0E+00		
Hg-203	0.00E+00	0.0E+00	0.0E+00		
Pb-202	0.00E+00	0.0E+00	0.0E+00		
Pb-205	0.00E+00	0.0E+00	0.0E+00		
Pb-210	0.00E+00	0.0E+00	0.0E+00		
Bi-207	0.00E+00	0.0E+00	0.0E+00		
Bi-210	0.00E+00	0.0E+00	0.0E+00		
Bi-210m	0.00E+00	0.0E+00	0.0E+00		

CALCULATION OF POPULATION DOSE (CONT'D)

Nuclide	Veg Consumption Dose (per rem/yr)	Milk Consumption Dose (per rem/yr)	Meat Consumption Dose (per rem/yr)	Total Dose (per rem/yr)
Po-210	0.00E+00	0.0E+00	0.0E+00	
Ra-223	0.00E+00	0.0E+00	0.0E+00	
Ra-224	0.00E+00	0.0E+00	0.0E+00	
Ra-225	0.00E+00	0.0E+00	0.0E+00	
Ra-226	0.00E+00	0.0E+00	0.0E+00	
Ra-228	0.00E+00	0.0E+00	0.0E+00	
Ac-227	0.00E+00	0.0E+00	0.0E+00	
Th-227	0.00E+00	0.0E+00	0.0E+00	
Th-228	0.00E+00	0.0E+00	0.0E+00	
Th-229	0.00E+00	0.0E+00	0.0E+00	
Th-230	0.00E+00	0.0E+00	0.0E+00	
Th-231	0.00E+00	0.0E+00	0.0E+00	
Th-232	0.00E+00	0.0E+00	0.0E+00	
Th-234	0.00E+00	0.0E+00	0.0E+00	
Pa-230	0.00E+00	0.0E+00	0.0E+00	
Pa-231	0.00E+00	0.0E+00	0.0E+00	
Pa-233	0.00E+00	0.0E+00	0.0E+00	
U-232	0.00E+00	0.0E+00	0.0E+00	
U-233	0.00E+00	0.0E+00	0.0E+00	
U-234	0.00E+00	0.0E+00	0.0E+00	
U-235	0.00E+00	0.0E+00	0.0E+00	
U-236	0.00E+00	0.0E+00	0.0E+00	
U-237	0.00E+00	0.0E+00	0.0E+00	
U-238	0.00E+00	0.0E+00	0.0E+00	
Np-236	0.00E+00	0.0E+00	0.0E+00	
Np-237	0.00E+00	0.0E+00	0.0E+00	
Np-239	0.00E+00	0.0E+00	0.0E+00	
Am-237	0.00E+00	0.0E+00	0.0E+00	
Am-241	0.00E+00	0.0E+00	0.0E+00	
Am-242m	0.00E+00	0.0E+00	0.0E+00	
Am-243	0.00E+00	0.0E+00	0.0E+00	
Pu-237	0.00E+00	0.0E+00	0.0E+00	
Pu-238	0.00E+00	0.0E+00	0.0E+00	
Pu-239	1.13E+01	2.4E-03	5.3E-06	1.1E+01
Pu-240	0.00E+00	0.0E+00	0.0E+00	
Pu-241	0.00E+00	0.0E+00	0.0E+00	
Pu-242	0.00E+00	0.0E+00	0.0E+00	
Pu-244	0.00E+00	0.0E+00	0.0E+00	
Cm-241	0.00E+00	0.0E+00	0.0E+00	
Cm-242	0.00E+00	0.0E+00	0.0E+00	
Cm-243	0.00E+00	0.0E+00	0.0E+00	
Cm-244	0.00E+00	0.0E+00	0.0E+00	
Cm-245	0.00E+00	0.0E+00	0.0E+00	
Cm-246	0.00E+00	0.0E+00	0.0E+00	
Cm-247	0.00E+00	0.0E+00	0.0E+00	
Cm-248	0.00E+00	0.0E+00	0.0E+00	
Cm-250	0.00E+00	0.0E+00	0.0E+00	
Bk-247	0.00E+00	0.0E+00	0.0E+00	
Bk-249	0.00E+00	0.0E+00	0.0E+00	

	CALCULATION OF POPULATION DOSE (CONT'D)				
	Veg Consumption	Milk Consumption	Meat Consumption	Total Dose	
Nuclide	Dose (per rem/yr)	Dose (per rem/yr)	Dose (per rem/yr)	(per rem/yr)	
Cf-249	0.00E+00	0.0E+00	0.0E+00		
Cf-250	0.00E+00	0.0E+00	0.0E+00		
Cf-251	0.00E+00	0.0E+00	0.0E+00		
Cf-252	0.00E+00	0.0E+00	0.0E+00		
Es-253	0.00E+00	0.0E+00	0.0E+00		
Unidentified alpha	0.00E+00	0.0E+00	0.0E+00		
Unidentified beta	0.00E+00	0.0E+00	0.0E+00		
Total	**2.5E+01**	**8.0E-01**	**2.3E-02**	**2.5E+01**	