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Verification of RESRAD-OFFSITE Code Version 4

Environmental Science Division

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Verification of RESRAD-OFFSITE Code Version 4

by

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1 INTRODUCTION

1.1 OVERVIEW

This report documents the verification of RESRAD-OFFSITE Version 4.0 and describes, where necessary, the verification of the following:

- The data comprising the standard dose and risk coefficient libraries in the RESRAD database files Master_dcf_ICRP07.mdb and Master_dcf_2k.mdb.
- The extraction and transfer of the data from the selected database file to the computational code by the RESRAD-OFFSITE 4.0 interface, ResOWin.exe.
- The different processes that are modeled by the main computational code in RESRAD-OFFSITE 4.0, ResOMain.exe.
- The data displayed in the graphical and text reports.

Many verifications were performed as part of the quality assurance quality control program associated with the development and release of RESRAD-OFFSITE 4.0, namely,

- developer testing,
- internal independent testing, and
- release testing.

Some were also performed in response to questions from users regarding the performance of the code. The main text of the report focuses on summarizing a subset of those tests, both independent and developer tests that verified the computations performed by the code. The verifications included in this report served as the basis for the development of the release tests of the computational executables and provided the quantitative results to be compared with the code output.

The input and output interfaces and the data transfers between the various executables of the code were tested while performing the verification testing. They were tested intentionally during release testing.

This report also provides some basic information to help in understanding the activities that were verified. The report

- outlines the components of RESRAD-OFFSITE 4.0 and the interconnections between these components,
- outlines the processes modeled by the computational code,
- provides summary figures and tables to offer confirmation of the verification of the computational components of the code,

- reproduces the verifiers' reports, if available, in individual appendices,
- refers to the previous verification report (Yu et al. 2011) for more details about some of the verifications, and
- reproduces the test cases and the testers' reports from the release testing in individual appendices, when possible.

1.2 COMPONENTS OF RESRAD-OFFSITE 4.0

RESRAD-OFFSITE 4.0 consists of eight executables and one compiled html help file and accesses data from two database files and a number of ASCII and binary data files. While Appendix 1 describes the components and interconnections in greater detail, this section focuses on the aspects of the components from the perspective of verification.

Executables:

- ResOwin.exe is the main interface. It performs the following verifiable tasks:
 - Accepts inputs and writes them in a format that can be read by the computational code ResOCalc.exe.
 - Queries the appropriate database file to extract the relevant dose and risk coefficients.
 - Writes the dose and risk coefficients to a number of files.
- ResOCalc.exe is the main computational code. It performs the following verifiable computations and tasks:
 - Reads the input and data files and writes the inputs, dose factors, and risk factors to text reports.
 - Computes the following:
 - Temporal variation of the thickness and mixing of the primary contamination.
 - Temporal variation of radioactivity in the primary contamination
 - under a number of conceptualizations of the primary contamination and
 - ♦ under a number of transfer mechanisms.
 - Temporal variation of the releases from the primary contamination
 - o under a number of conceptualizations of the primary contamination and
 - ◊ under a number of transfer mechanisms.
 - Atmospheric transport of
 - ♦ all (respirable and non-respirable) particulates,
 - ♦ respirable particulates, and
 - \diamond ³H and ¹⁴C in vapor or gaseous form.
 - Atmospheric transport of radon and three of its progeny and the radiological transformations that occur during transport.
 - Groundwater transport of

- a temporal flux input at the upgradient face of the transport zone, to determine the
 - temporal flux out of the zone and
 - temporal concentration in pore water at the end of the zone,
- ◊ a temporal pulse input distributed over a length of the transport zone, to determine the
 - temporal flux out of the zone and
 - temporal concentration in pore water at the end of the zone,
- an instantaneous pulse input distributed over a length of the transport zone, to determine the
 - temporal flux out of the zone and
 - temporal concentration in pore water at the end of the zone.
- Groundwater transport from a submerged source.
- Transfer of material eroded from the primary contamination to the offsite locations (farmed lands and the surface water body).
- Accumulation in the farmed lands.
- Accumulation in the surface water body.
- Temporal variation of the concentration of radionuclides in plants.
- Temporal variation of the concentration of radionuclides in meat.
- Temporal variation of the concentration of radionuclides in milk.
- Temporal variation of the concentration of radionuclides in aquatic food.
- Dose and risk from external radiation from the primary contamination and from the accumulation in the farmed lands.
- Dose and risk from the inhalation of respirable particulates while on the primary contamination and on the farmed lands.
- Dose and risk from the ingestion of plant foods.
- Dose and risk from the ingestion of meat.
- Dose and risk from the ingestion of milk.
- Dose and risk from the ingestion of water.
- Dose and risk from the ingestion of aquatic food.
- Dose and risk from the incidental ingestion of soil.
- Dose and risk from the inhalation of radon isotopes and three of their progeny.
- Additional models for ³H and ¹⁴C.
- Writes the doses, risks, concentrations, and other intermediate output.
- GrphCnv5.exe
 - Reads the binary output of ResOCalc.exe and writes text outputs of doses, risks, and concentrations for use by the plotting program.
- WResPlot.exe
 - Reads the text files created by GrphCnv5.exe or by GrphCnvP.exe and displays temporal plots of dose, risk, and concentration.
 - Outputs the data used to generate the selected plot.

- LHSRO.exe
- CorRegRO.exe
- GrphCnvP.exe
 - Reads the binary output of ResOCalc.exe and writes text outputs of doses, risks, and concentrations for each probabilistic realization for use by the plotting program.
- ResDCF.exe

Database files:

- Master_dcf_2k.mdb
- Master_dcf_ICRP07.mdb

2 VERIFICATION OF THE PRIMARY CONTAMINATION FORMULATIONS

The primary contamination formulations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 2 of NUREG/CR-7038 (Yu et al. 2011). The leaching release formulation in Version 2.5 is retained in Version 4.0 as the "RESRAD-ONSITE exponential release" option. But the underlying coding was modified to allow the first-order leach rate to vary with time and model transport within the primary contamination. Thus, three representative cases from that verification, Cases 1, 3, and 4, were reverified using the output of the candidate version of RESRAD-OFFSITE 4.0 prior to its release. The inputs that were changed from the defaults/placeholders of the code are listed in Table 2.1.

Inputs ↓ Ca	ase \rightarrow	1	3	4
Transformation data		ICRP-38	ICRP-38	ICRP-38
Number of calculation time points		1024	1024	
Largest reporting time, y		994	994	
Thickness of cover, m		(0) ^a	0.3	
Thickness of primary contamination, m		(2)	1	
Nominal erosion rate of cover, m y ^{-1b}		n a ^c	0.001	
Nominal erosion rate of primary contamination, m y ^{-1b}		0.01	0	
Rainfall and runoff factor		(160)	7.58929	
Slope length steepness factor		3.49	2	
Cover and management factor		0.3	1	
Soil erodibility factor in cover, tons acre ⁻¹		n a	0.470588	
Soil erodibility factor in primary contamination, tons ac	re ⁻¹	(0.4)	0	
Dry bulk density of cover, g (cm) ⁻³ n a			1.6	
Dry bulk density of unsaturated zone, g (cm) ⁻³		1.7	1.7	
Thickness of ¹⁴ C evasion layer, m		n a	n a	0.5
¹⁴ C evasion flux rate s ⁻¹		n a	n a	6.338 10-8

Table 2.1 Inputs Used in Verification of RESRAD-ONSITE Exponential Release Model

^a Values in parenthesis are the default/placeholder values of RESRAD-OFFSITE.

^b The erosion rates computed using other inputs are used in the verification; the nominal erosion rate is for information only.

^c n a = not applicable.

2.1 FORMULATIONS FOR CLEAR COVER, CONTAMINATED MIXING LAYER, AND UNDISTURBED PRIMARY CONTAMINATION

The expressions used to calculate the erosion rate of the primary contamination and the temporal variation of the thickness of the unmixed portion of the primary contamination are verified in Figure 2.1 for Case 1, which involves an eroding primary contamination with no cover. The same equations are verified in Figure 2.2 for Cases 3 and 4, which involve an eroding cover that is initially thicker than the mixing layer. The expressions used to compute the volume fraction of material from the primary contamination that are in the mixing layer are verified in Figure 2.3 for Cases 3 and 4, which involve an eroding cover that is initially thicker than the mixing layer are verified in Figure 2.3 for Cases 3 and 4, which involve an eroding cover that is initially thicker than the mixing layer.



Figure 2.1 Temporal Variation of Thicknesses of Contaminated Mixing Layer and Unmixed Primary Contamination When There Is No Cover above an Eroding Primary Contamination

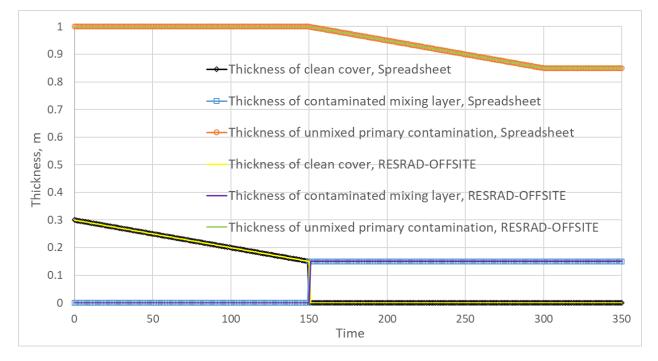


Figure 2.2 Temporal Variation of Thicknesses of Clean Cover, Contaminated Mixing Layer and Unmixed Primary Contamination When There Is an Eroding Cover above a Non-eroding Primary Contamination

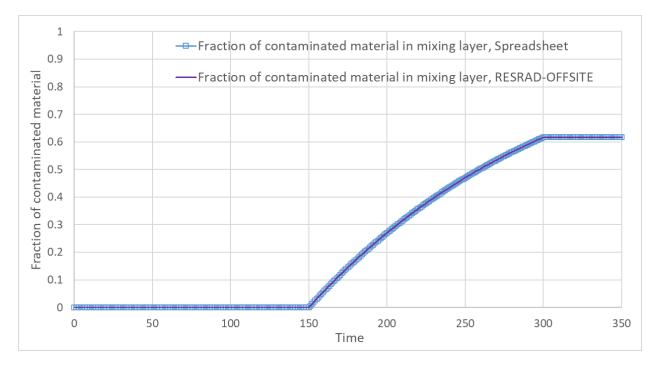


Figure 2.3 Temporal Variation of the Volume Fraction of Material from Primary Contamination in the Mixing Layer When There Is an Eroding Cover above a Non-eroding Primary Contamination

2.2 CONCENTRATION OF RADIONUCLIDES IN THE PRIMARY CONTAMINATION FOR THE "RESRAD-ONSITE EXPONENTIAL RELEASE" OPTION

The expressions used to compute the radionuclide concentration in the soil under the "RESRAD-ONSITE exponential release" option are verified in Figure 2.4 through Figure 2.11. Figure 2.10 and Figure 2.11 also verify the functionality to model time-varying removal rates, which was added post-Version 2.5, in this case for the evasion rate.

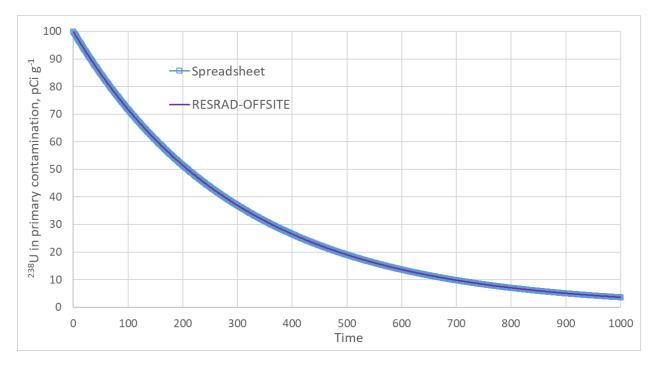


Figure 2.4 Temporal Variation of Concentration of ²³⁸U in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Decay

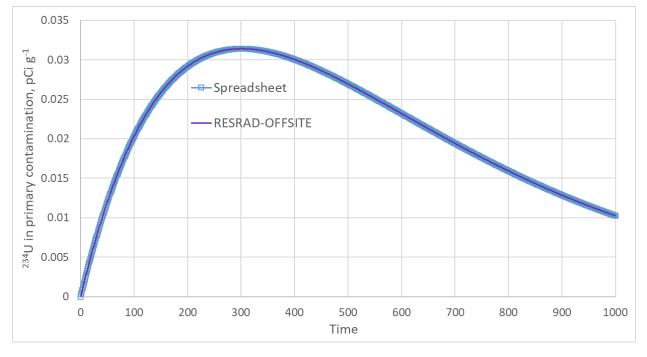


Figure 2.5 Temporal Variation of Concentration of ²³⁴U, Derived from ²³⁸U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

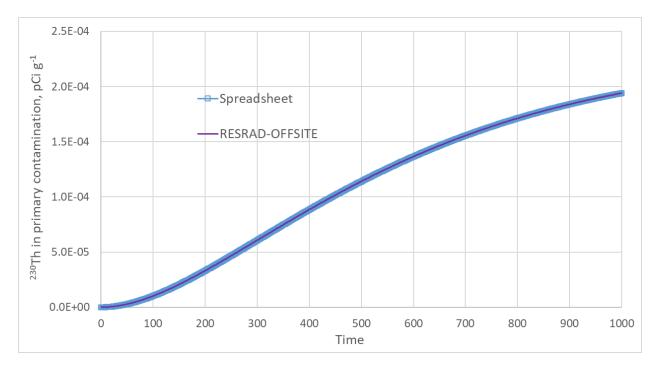


Figure 2.6 Temporal Variation of Concentration of ²³⁰Th, Derived from ²³⁸U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

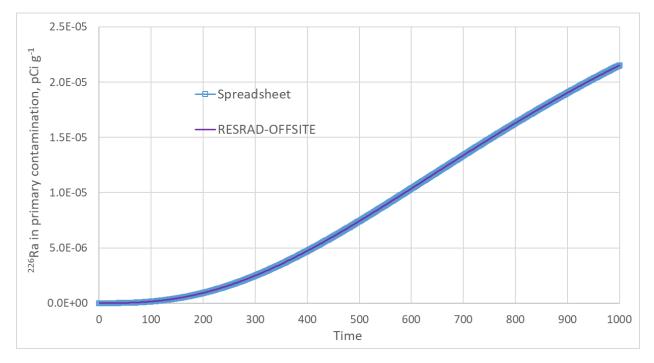


Figure 2.7 Temporal Variation of Concentration of ²²⁶Ra, Derived from ²³⁸U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

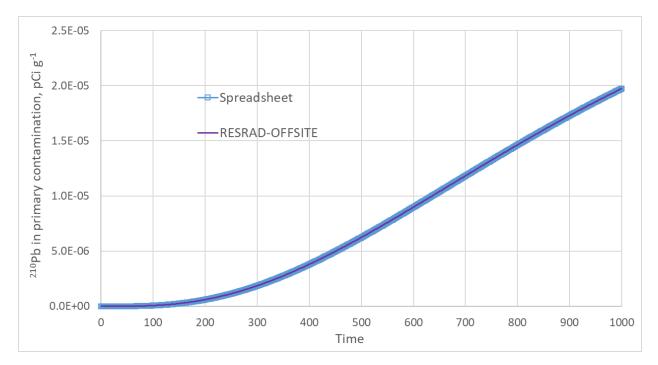


Figure 2.8 Temporal Variation of Concentration of ²¹⁰Pb, Derived from ²³⁸U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

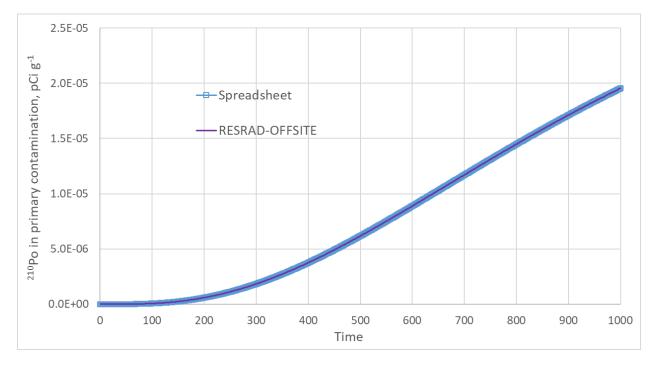


Figure 2.9 Temporal Variation of Concentration of ²¹⁰Po, Derived from ²³⁸U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

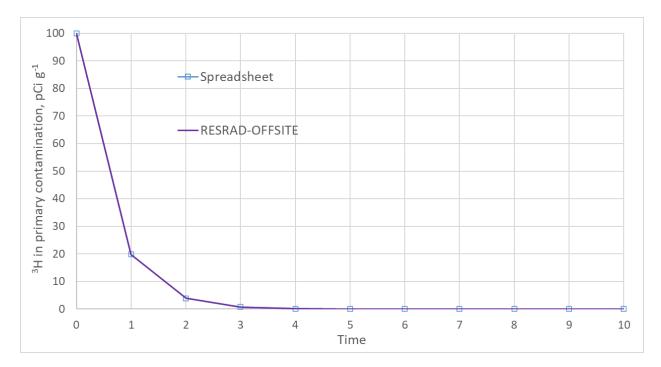


Figure 2.10 Temporal Variation of Concentration of ³H in the Primary Contamination Due to Evapotranspiration, Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

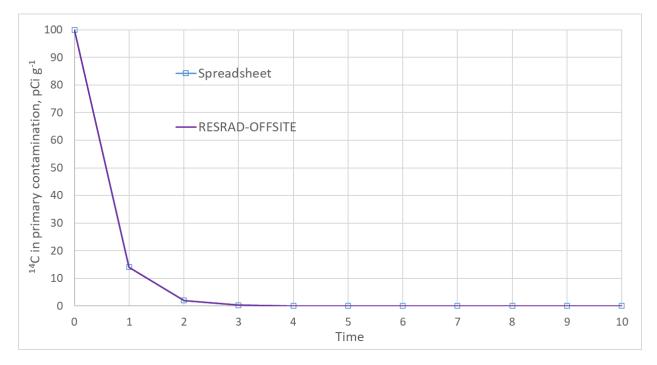


Figure 2.11 Temporal Variation of Concentration of ¹⁴C in the Primary Contamination Due to Evasion, Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

2.3 RELEASE OF RADIONUCLIDES TO INFILTRATION UNDER THE "RESRAD-ONSITE EXPONENTIAL RELEASE" OPTION

The expressions used to compute the release of radionuclides under the "RESRAD-ONSITE exponential release" option are verified in Figure 2.12 through Figure 2.17.

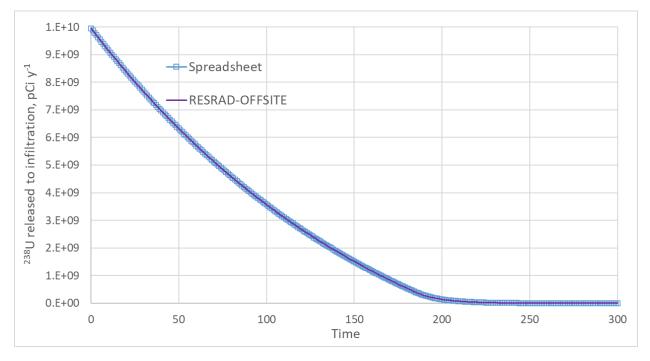


Figure 2.12 Temporal Variation of the Release of ²³⁸U to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

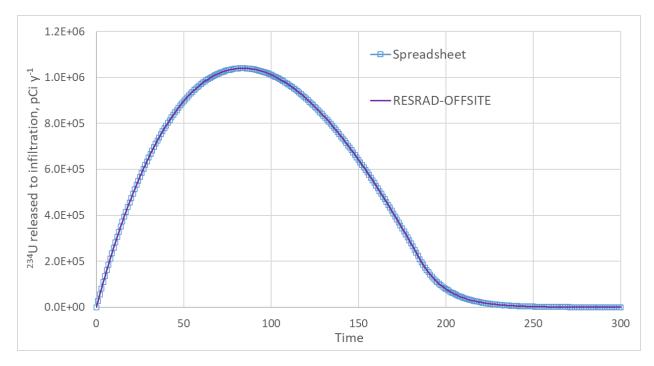


Figure 2.13 Temporal Variation of the Release of ²³⁴U to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

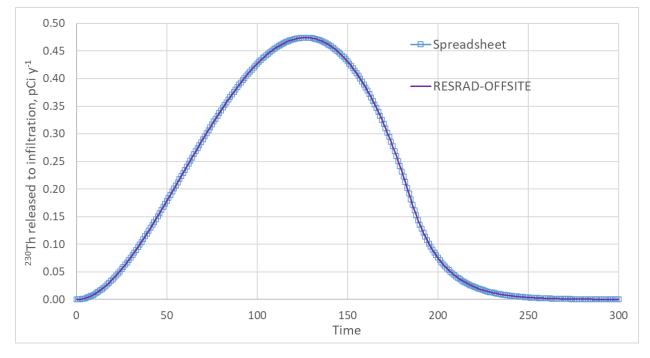


Figure 2.14 Temporal Variation of the Release of ²³⁰Th to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

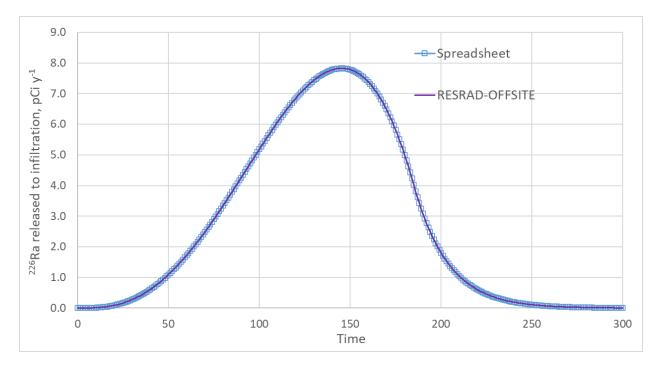


Figure 2.15 Temporal Variation of the Release of ²²⁶Ra to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

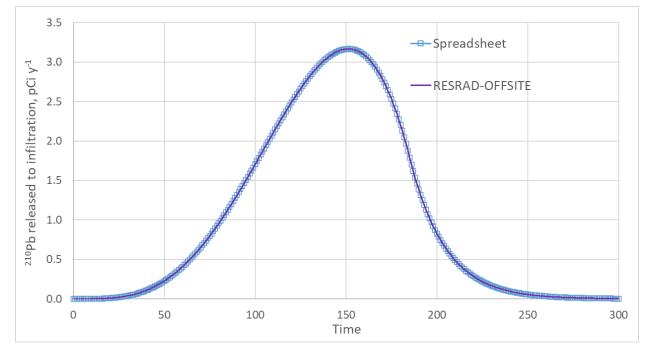


Figure 2.16 Temporal Variation of the Release of ²¹⁰Pb to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

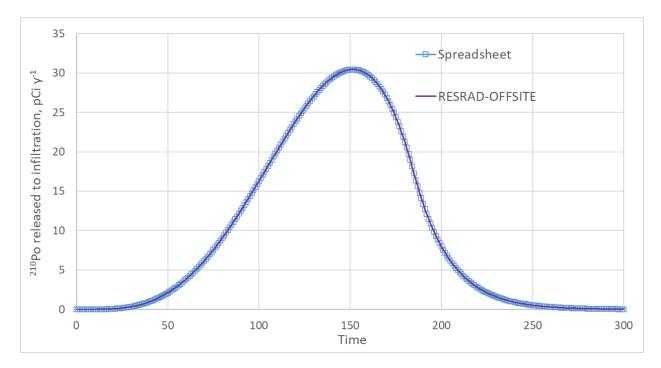


Figure 2.17 Temporal Variation of the Release of ²¹⁰Po to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

2.4 RELEASE OF RADIONUCLIDES IN PARTICULATES TO THE ATMOSPHERE UNDER THE "RESRAD-ONSITE EXPONENTIAL RELEASE" OPTION

The release of radionuclides associated with the release of particulates to the atmosphere was verified as described in Appendix 2. The expressions used to calculate the release of ⁹⁰Sr in particulates to the atmosphere are verified in Figure 2.18 for two cases:

- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 0.1 m, is equal to the thickness of the mixing layer, 0.15 m;
- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 1.2 m, is greater than the thickness of the mixing layer, 0.15 m.

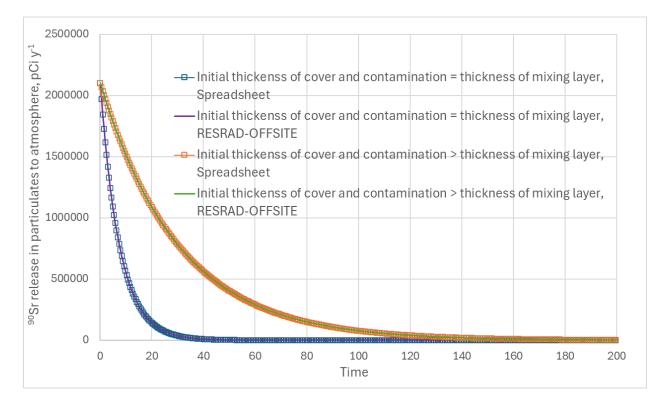


Figure 2.18 Temporal Variation of the Release of ⁹⁰Sr in Particulates to the Atmosphere

2.5 RELEASE OF RADIONUCLIDES IN PARTICULATES BY EROSION TO RUNOFF UNDER THE "RESRAD-ONSITE EXPONENTIAL RELEASE" OPTION

The release of radionuclides in particulates that are eroded and carried away by runoff was verified as described in Appendix 3. The expressions used to calculate the release of ⁹⁰Sr in particulates to runoff are verified in Figure 2.19 for two cases.

- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 0.1 m, is equal to the thickness of the mixing layer, 0.15 m;
- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 1.2 m, is greater than the thickness of the mixing layer, 0.15 m.

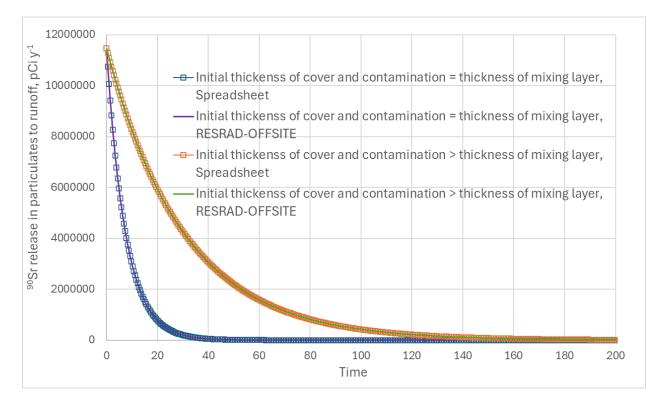


Figure 2.19 Temporal Variation of the Release of ⁹⁰Sr in Particulates Eroded and Carried Away by Runoff

The verification performed in this chapter provided the basis for the release testing of the primary contamination.

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3 VERIFICATION OF GROUNDWATER TRANSPORT FORMULATIONS

The longitudinal groundwater transport formulations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 3 of NUREG/CR-7038 (Yu et al. 2011). The basic longitudinal groundwater transport formulations in Version 2.5 are retained in Version 4.0 and applied to the contaminated layer in addition to the uncontaminated layers in the unsaturated and saturated groundwater transport layers. These groundwater transport formulations were reverified prior to release of Version 4.0 and are discussed in this section. The verification performed in this chapter provided the basis for the release testing of the groundwater transport.

3.1 GROUNDWATER TRANSPORT OF A TEMPORALLY DISTRIBUTED FLUX INPUT ACROSS THE UPGRADIENT SURFACE OF THE TRANSPORT ZONE

The formulations were verified for four different radionuclide transport velocities for eight radionuclides to cover a wide range of conditions. The inputs used to model the transport velocities in the transport zone are show in Table 3.1. The computed radionuclide transport velocities and dispersion coefficients are shown in Table 3.2. The half-life of the radionuclide is an argument of the formulation. The eight radionuclides in Table 3.3 were selected because they cover a wide range of half-lives. The formulations were verified using two triangular input fluxes as described in Chapter 3 of NUREG/CR-7038 (Yu et al. 2011) using the RESRAD-OFFSITE feature allowing overriding the internal release model and specifying the desired triangular fluxes instead.

	Case 1	Case 2	Case 3	Case 4	
Characteristic	Value				
Precipitation rate, m y ⁻¹		(1) ^{a,b}		
Runoff coefficient	(0.2)				
Irrigation applied per year, m	(0.2)				
Evapotranspiration coefficient	(0.5)				
Transport distance, m	(4)				
Saturated hydraulic conductivity, m y ⁻¹	(10)				
Parameter b of Clapp-Hornberger equation	(5.3)				
Field capacity	(0.3)				
Total porosity	(0.4)				
Effective porosity	(0.2)				
Dry bulk density, g (cm) ⁻³	(1.5)				
Distribution coefficient, $(cm)^3 g^{-1}$	0	1	10	100	
Time horizon, y	4	20	200	2000	
Longitudinal dispersivity, m		(0	.1)		
Number of calculation time points		(1)	28)		

Table 3.1 Inputs Used to Model the Radionuclide Transport Velocities and theAssociated Dispersion Coefficients in the Unsaturated Zone for the Verification ofTransport of Flux Inputs

^a Values in parenthesis are the default/placeholder values of RESRAD-OFFSITE.

^b Values in the central column apply to all four cases.

	Case 1	Case 2	Case 3	Case 4	
Computed Characteristic	Computed Value				
Darcy velocity, m y ⁻¹	0.5^{a}				
Saturation ratio	0.8023				
Total moisture content	0.3209				
Effective moisture content	0.1605				
Retardation factor	1	5.674	47.74	468.4	
Advective contaminant transport velocity, m y ⁻¹	3.116	0.5492	0.06527	0.006652	
Dispersion coefficient of contaminant, m ² y ⁻¹	0.3116	0.0549	0.00653	0.000665	
Advective travel time, y	1.28	7.28	61.3	601	

 Table 3.2 Radionuclide Transport Velocities and Dispersion Coefficients Used in

 Verification of Transport of Flux Inputs

^a Values in the central column apply to all four cases.

Radionuclide	⁶⁰ Co	³ H	⁹⁰ Sr	¹³⁷ Cs	⁶³ Ni	²²⁶ Ra	¹⁴ C	²³⁸ U
Half-life, y	5.271	12.35	29.12	30	96	1600	5730	4.468×10 ⁹

The verification of the longitudinal transport of the flux inputs of the eight radionuclides at the upgradient surface are illustrated in Figure 3.1 through Figure 3.4 for the four cases. The advective velocity and the dispersion coefficient for these cases are in Table 3.2. As seen in Figure 3.1, the loss due to radiological transformations is not sufficient to make a noticeable shift in the time of the peaks of the curves at the high transport velocity and dispersion of Case 1. But the effect of the loss is reflected in the progressive lowering of the peak in the eight plots in the figure. The forward shift of the time of the peak of the ⁶⁰Co curve in Figure 3.2, due to the increasing loss from radiological transformations over time, is noticeable at the transport velocity and dispersion of Case 2. The forward shifts of the times of the peaks in the ⁶⁰Co and ³H curves in Figure 3.3, due to the increasing loss from radiological transformations over time, are noticeable at the transport velocity and dispersion of Case 3.

There is very good agreement between the spreadsheet calculated transfer rates and the transfer rates output by RESRAD-OFFSITE for the four longer-lived radionuclides ²³⁸U, ¹⁴C, ²²⁶Ra, and ⁶³Ni at the transport velocity and dispersion of Case 4. There is very good agreement between the spreadsheet calculated transfer rates and the transfer rates output by RESRAD-OFFSITE for the two radionuclides with half-lives that are approximately one twenty-fifth of the width of the peak with no decay, ¹³⁷Cs and ⁹⁰Sr, over most of the time range. But the spreadsheet calculated curves in Figure 3.4 are smooth at and near the initial part, while the RESRAD-OFFSITE curves are sharp and lag the spreadsheet curves initially. The formulations implemented in RESRAD-OFFSITE are truncated at four "dispersion standard deviations,"

 $\sqrt{\frac{2\theta_a Dt}{\theta_c + K_d \rho_b}}$, on either side of the advective travel distance to ensure the accuracy of the final

results by using only the precise digits of intermediate quantities. This was not implemented in the spreadsheet calculations, leading to smoother curves initially, but also to some negative

results initially, too. Negative results can occur when the imprecise digits of the intermediate calculations influence the final results. Thus, the need to truncate in the coding.

There are significant differences between the spreadsheet calculated curves and the RESRAD-OFFSITE curves for ³H and for ⁶⁰Co, radionuclides with half-lives that are less than one-sixtieth of the width of the undecayed peak. This too is due to the truncation discussed in the previous paragraph. As seen from Figure 3.4, the rates at which these radionuclides exit the transport zone for these short-lived radionuclides diminished by nine and sixteen orders of magnitude over the large travel time in the transport zone. Thus, this truncation is not expected to have a practical impact on the conclusions derived from the output of RESRAD-OFFSITE.

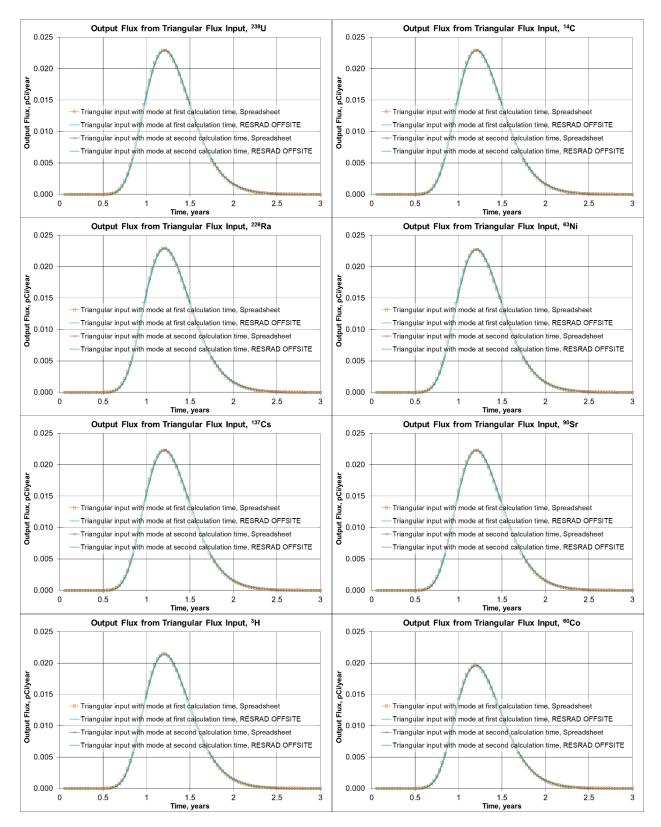


Figure 3.1 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 1

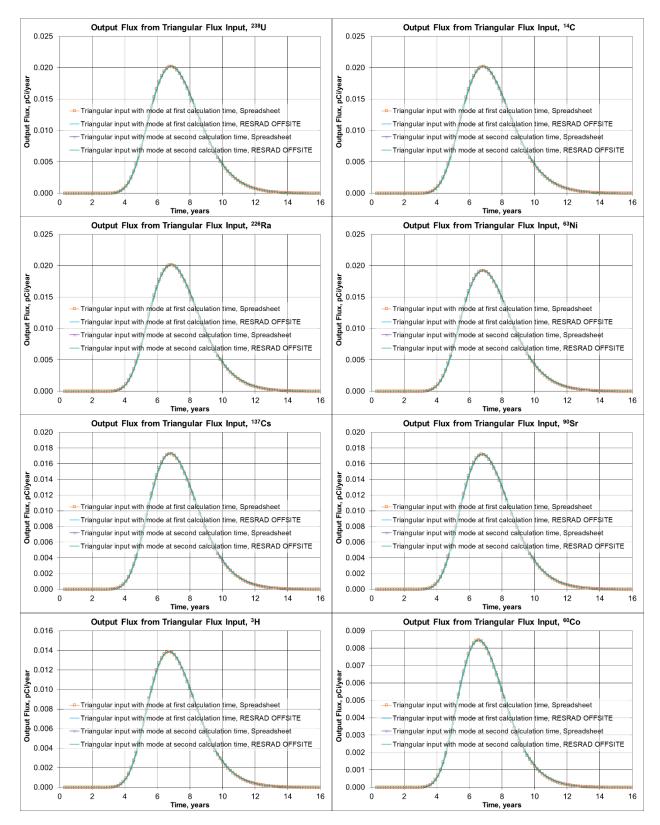


Figure 3.2 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 2

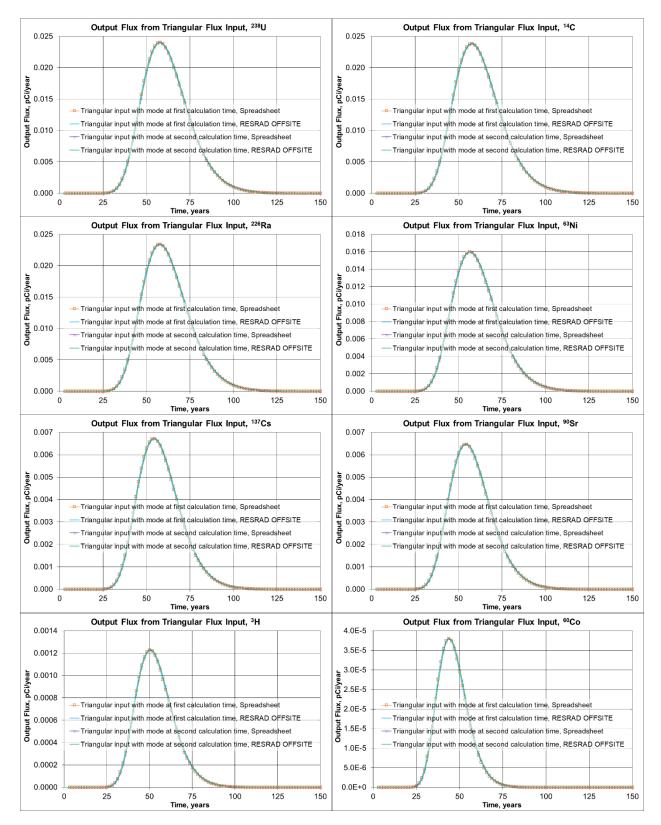


Figure 3.3 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 3

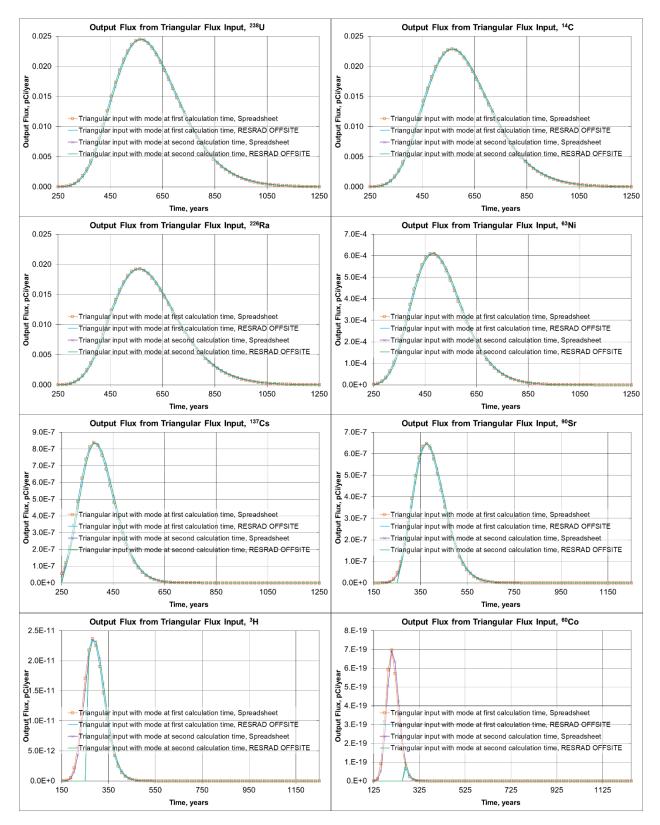


Figure 3.4 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 4

3.2 GROUNDWATER TRANSPORT OF A PULSE INPUT THAT IS DISTRIBUTED BOTH OVER TIME AND OVER A LENGTH OF THE TRANSPORT ZONE

The formulations were verified for three different radionuclide transport velocities for eight radionuclides to cover a wide range of conditions. The inputs used to model the transport velocities in the transport zone are shown in Table 3.4. The computed radionuclide transport velocities and dispersion coefficients are shown in Table 3.5. The eight radionuclides in Table 3.3 were used in this verification to cover a wide range of half-lives. The formulations were verified using two triangular input fluxes, as described in Chapter 3 of NUREG/CR-7038 (Yu et al. 2011), using the RESRAD-OFFSITE feature allowing overriding the internal release model and specifying the desired triangular pulses instead.

	Case 1	Case 2	Case 3
Characteristic		Value	
Length of primary contamination, m		(100) ^{a, b}	
Width of primary contamination, m		(100)	
Saturated hydraulic conductivity, m y ⁻¹		500	
Hydraulic gradient		(0.02)	
Precipitation rate, m y ⁻¹		(1)	
Runoff coefficient		(0.2)	
Irrigation applied per year, m		(0.2)	
Evapotranspiration coefficient		(0.5)	
Total porosity		(0.4)	
Effective porosity		(0.2)	
Dry bulk density, g (cm) ⁻³		(1.5)	
Longitudinal dispersivity, m		20	
Lateral horizontal dispersivity, m		3	
Lateral vertical dispersivity, m		0.15	
Distribution coefficient, $(cm)^3 g^{-1}$	0	1	10
Time horizon, y	32	128	1024
Number of calculation time points		128	
Inputs for surface water body, used to verify the flux output:			
Distance from downgradient edge of contamination, m		800	
Distance from plume centerline to right edge, m		-150	
Distance from plume centerline to left edge, m		150	
Depth of aquifer intercepted, m		(5)	
Inputs for well, used to verify the concentration output:			
Distance from downgradient edge of contamination, m		800	
Distance from plume centerline, m		(0)	
Well pumping rate, m ³ y ⁻¹		5100	
Depth of aquifer intercepted, m		5	

Table 3.4 Inputs Used to Model the Radionuclide Transport Velocities and the AssociatedDispersion Coefficients in the Saturated Zone for the Verification of Transport ofTemporally Distributed Pulse Inputs

^a Values in parenthesis are the default/placeholder values of RESRAD-OFFSITE.

^b Single values in the central column apply to all three cases.

	Case 1	Case 2	Case 3
Characteristic		Value	
Average transport distance, m		850ª	
Darcy Velocity, m y ⁻¹		10	
Infiltration rate, m y ⁻¹		0.5	
Depth of penetration of the pulse input into the saturated zone, m		5	
Retardation factor	1	4.75	38.5
Contaminant transport velocity, m y ⁻¹	50	10.53	1.299
Longitudinal dispersion coefficient of contaminant, m ² y ⁻¹	1000	210.6	25.97
Lateral horizontal dispersion coefficient of contaminant, m ² y ⁻¹	150	31.58	3.896
Lateral vertical dispersion coefficient of contaminant, m ² y ⁻¹	7.5	1.579	0.1948
Advective travel time, y	16-18	76-85.5	616-693
Time to peak output for 238 U, y	15.8	75.3	610
Time to peak output for ${}^{14}C$, y	15.8	75.2	608
Time to peak output for ²²⁶ Ra, y	15.8	75.1	603
Time to peak output for ⁶³ Ni, y	15.8	73.4	513
Time to peak output for 137 Cs, y	15.6	69.8	402
Time to peak output for ⁹⁰ Sr, y	15.6	69.6	399
Time to peak output for ³ H, y	15.2	63.7	300
Time to peak output for ⁶⁰ Co, y	14.5	54.3	212
Width of aquifer intercepted by well, m		51	

Table 3.5 Radionuclide Transport Velocities and Dispersion Coefficients Used in Verification of Transport of Pulse Inputs

^a Single values in the central column apply to all three cases.

The verifications of the longitudinal transport of a pulse input, distributed over a length of the transport zone, of the eight radionuclides are illustrated in Figure 3.5 through Figure 3.10 for the three cases. There are two figures for each case, one shows the verification of the rate at which the radionuclide exits the zone and the other shows the verification of the concentration in well water at the downgradient edge of the zone.

As can be seen in Figure 3.5 and Figure 3.6, these formulations for transport, capable of modeling the loss due to radiological transformations during advective-dispersive transport, show a noticeable shift in the times of the peaks of the curves for the two radionuclides with short half-lives, even at the high transport velocity and dispersion of Case 1. The loss is also reflected in the progressive lowering of the peak with decreasing half-life of the radionuclides in the eight plots in the figures. There is very good agreement between the spreadsheet calculations and the RESRAD-OFFSITE calculations for all 8 radionuclides in this case.

The forward shift of the time of the peak of the curves in Figure 3.7 and Figure 3.8, due to the increasing loss from radiological transformations over time, is noticeable for four of the eight radionuclides at the intermediate transport velocity and dispersion of Case 2. There is very good agreement between the spreadsheet calculations and the RESRAD-OFFSITE calculations for all eight radionuclides in this case, too.

There is very good agreement between the spreadsheet calculations and the RESRAD-OFFSITE calculations for four of the radionuclides, good agreement between the calculations for two of the radionuclides, and significant differences for two of the radionuclides at the low transport velocity and dispersion of Case 3, Figure 3.9 and Figure 3.10. This is similar to the observations at the low transport velocity and dispersion of Case 4 for the flux input in Section 3.1 and occurs for the same reason. As seen in Figure 3.9 and Figure 3.10, peaks for these short-lived radionuclides diminish by ten and seventeen orders of magnitude over the large travel time in the transport zone. Thus, this truncation is not expected to have a practical impact on the conclusions derived from the output of RESRAD-OFFSITE.

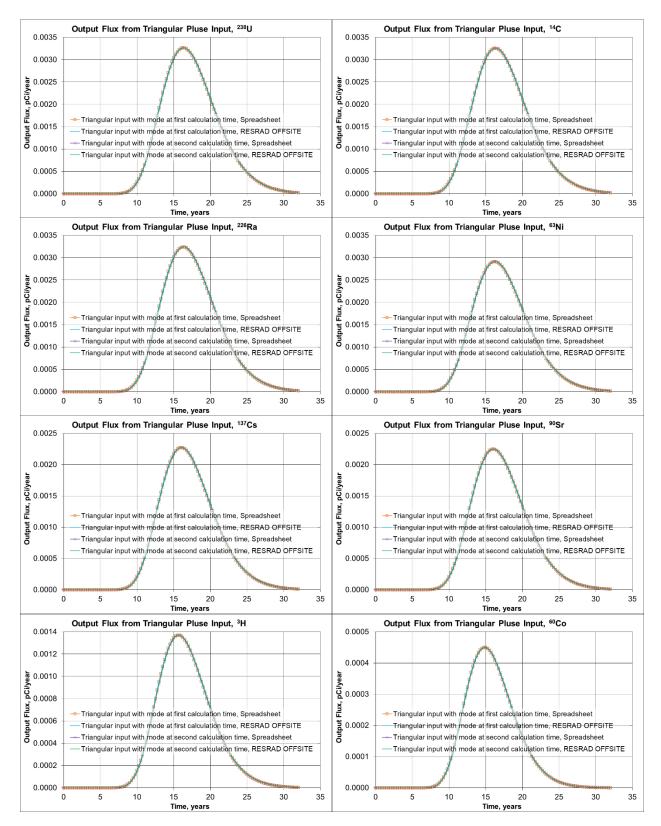


Figure 3.5 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 1

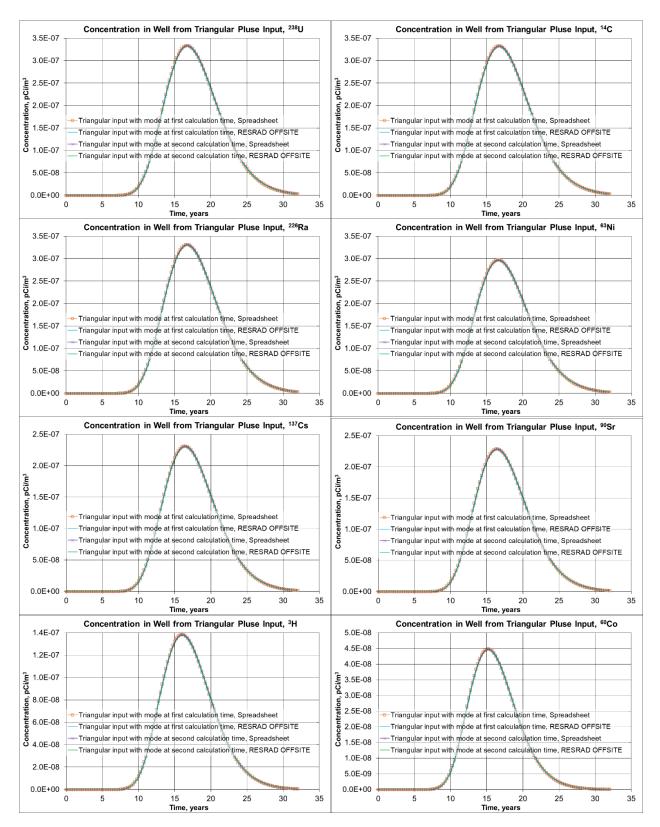


Figure 3.6 Temporal Variations of the Concentration of Radionuclides in Well Water Due to Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 1

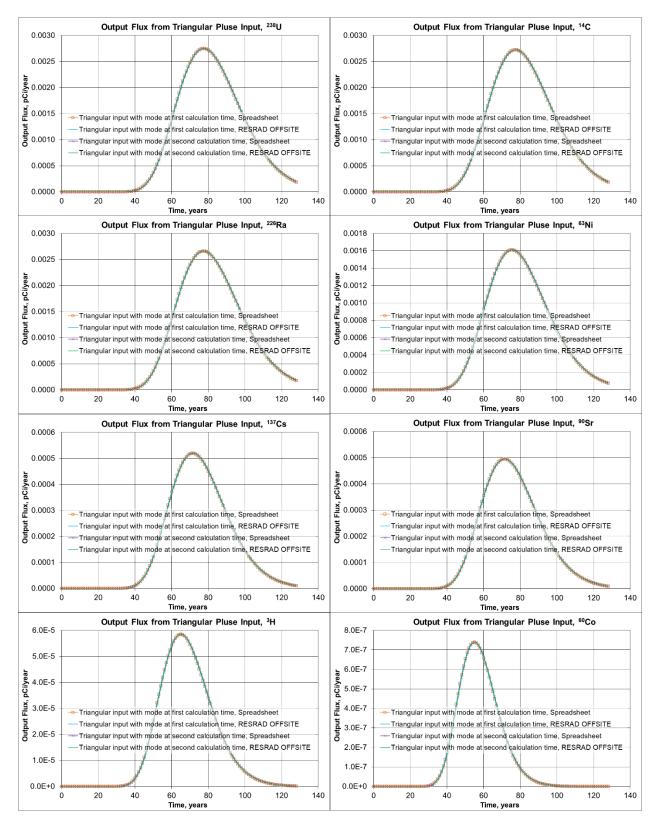


Figure 3.7 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 2

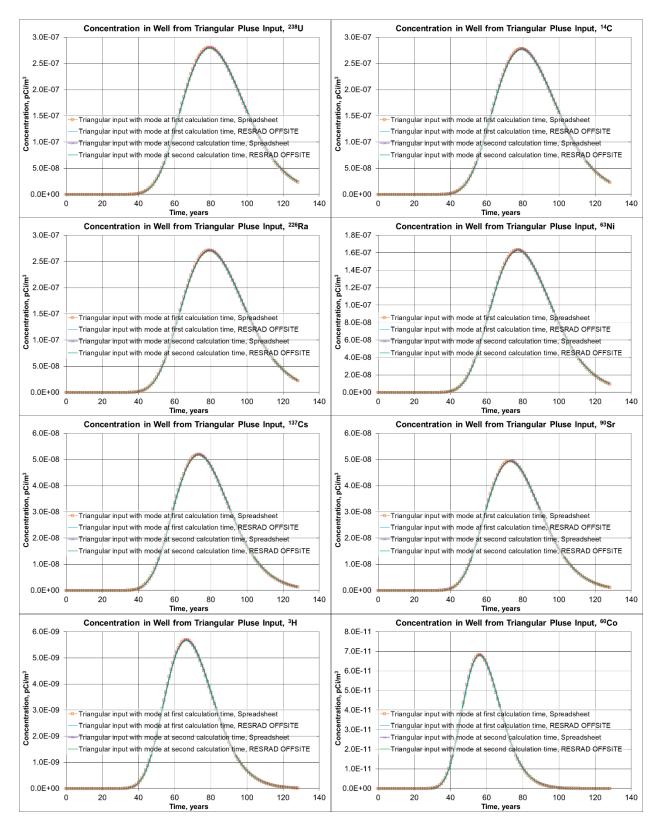


Figure 3.8 Temporal Variations of the Concentration of Radionuclides in Well Water Due to Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 2

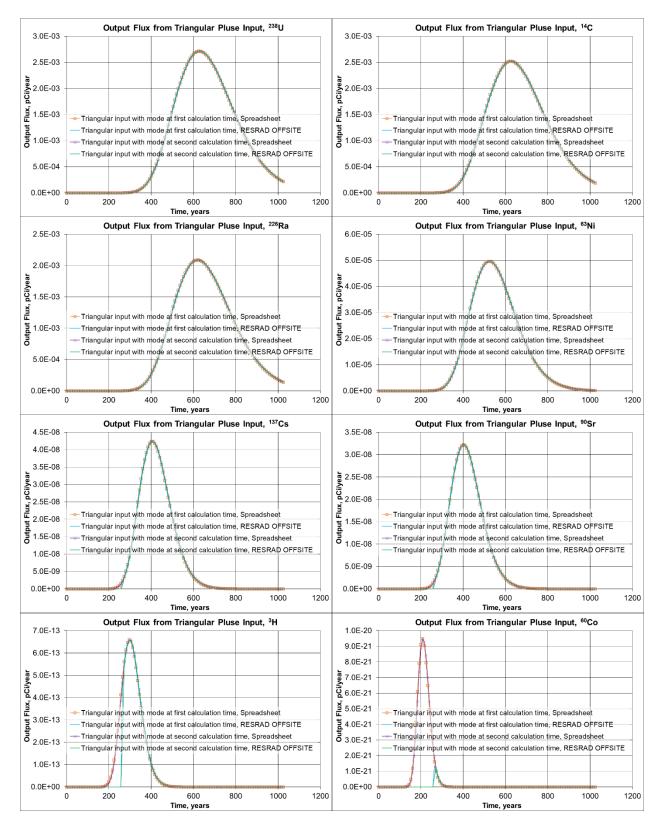


Figure 3.9 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 3

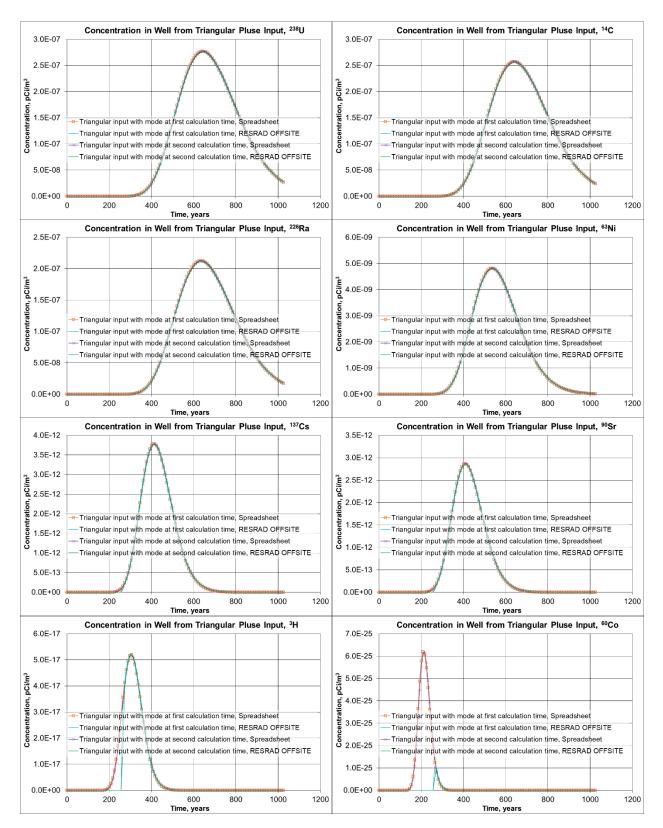


Figure 3.10 Temporal Variations of the Concentration of Radionuclides in Well Water Due to Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 3

4 VERIFICATION OF ATMOSPHERIC TRANSPORT FORMULATIONS

The atmospheric transport formulations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 4 of NUREG/CR-7038 (Yu et al. 2011). These formulations are used in RESRAD-OFFSITE Version 4.0 to compute atmospheric transport to all offsite locations other than the watershed of the surface water body. A formulation capable of modeling atmospheric transport to receptor locations that overlap the primary contamination was added to RESRAD-OFFSITE in Version 4.0. These formulations are verified for RESRAD-OFFSITE 4.0 in Appendix 4 and are summarized in the second subsection that follows.

4.1 χ/Q AT OFFSITE LOCATIONS THAT DO NOT OVERLAP THE PRIMARY CONTAMINATION

The verification of the ratio of the concentration in air at the offsite location to the rate of release to the atmosphere, χ/Q or chi over Q, at five different locations, each under different atmospheric condition, is summarized in Figure 4.1. None of these five offsite locations overlap the primary contamination from which the particles containing the radionuclides are released.

4.2 DEPLETED SOURCE STRENGTH WITH DISTANCE OF ATMOSPHERIC TRANSPORT

The verifications of the depleted source strength, the fraction of the released material remaining in the plume, at distances ranging from 0 to 3000 m of transport distance are summarized in Figure 4.2 for depletion by dry deposition and in Figure 4.3 for depletion by wet deposition. Some of the locations overlap the primary contamination while others are outside the primary contamination. Each figure shows five curves, showing the verification at five different atmospheric conditions.

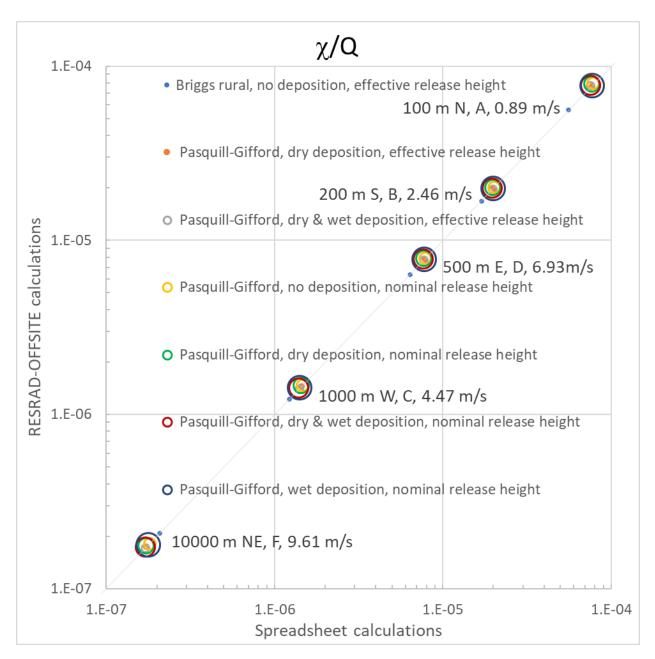


Figure 4.1 Summary of Chi over Q, (χ/Q) , the Concentration to Release Ratio, under Different Conditions at Different Locations

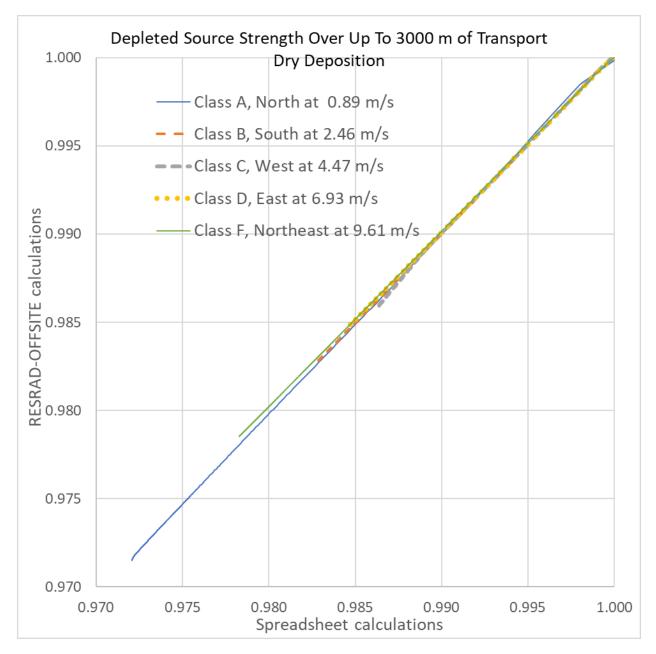


Figure 4.2 Depleted Source Strength over Distances of 0 to 3000 m under Different Conditions with Dry Deposition

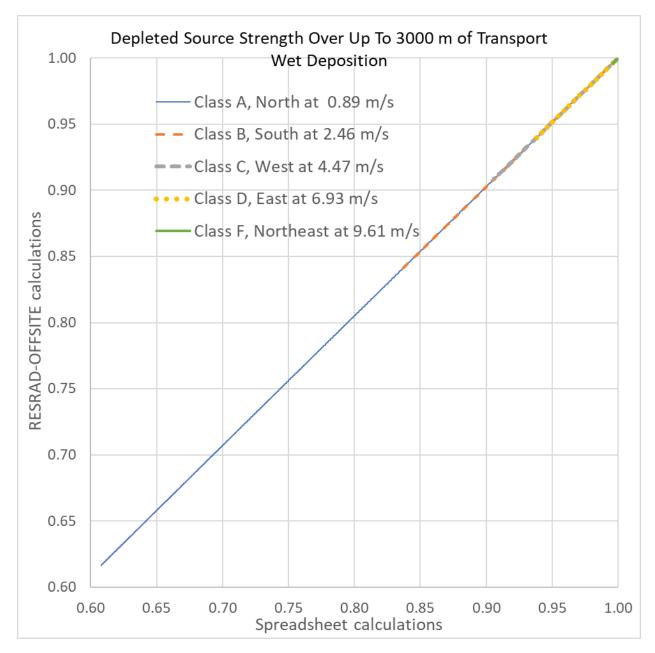


Figure 4.3 Depleted Source Strength Over Distances of 0 to 3000 m under Different Conditions with Wet Deposition

The verification performed in this chapter provided the basis for the release testing of the atmospheric transport.

5 VERIFICATION OF ACCUMULATION AT OFFSITE LOCATIONS

The formulations for the accumulation at offsite locations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 5 of NUREG/CR-7038 (Yu et al. 2011). The formulation in RESRAD-OFFSITE Version 4.0 for the accumulation in land-based offsite locations includes input of radionuclides that deposit from particles carried by runoff. The surface water body accumulation model was updated in RESRAD-OFFSITE 4.0. The verification performed in this chapter provided the basis for the release testing of the accumulation at offsite locations.

5.1 ACCUMULATION IN SURFACE WATER BODY

The pre-release verification of the new surface water body model in Version 4 of the code is described in Appendix 5 and is summarized in this sub-section. Figure 5.1 and Figure 5.2 illustrate the verification of the concentration of ⁹⁹Tc in surface water resulting from the influx of ⁹⁹Tc by all four transport pathways included in the new model:

- Deposition of material eroded from the primary contamination carried by runoff.
- Deposition of airborne material on the surface water body.
- Washout of airborne material that was deposited on the catchment/watershed.
- ⁹⁹Tc leached from the primary contamination by infiltration to groundwater that is intercepted by the surface water body.

The influx with groundwater dominates in Figure 5.1. Figure 5.2 shows the verification when the other three transport pathways make an appriciable contribution. Figure 5.3 illustrates the verification of the concentration of 234 U in surface water resulting from the influx of 234 U by the first three transport pathways. Figure 5.4 shows the verification of the concentration of 90 Sr in surface water that was carried out as part of the verification of dose from the ingestion pathways.

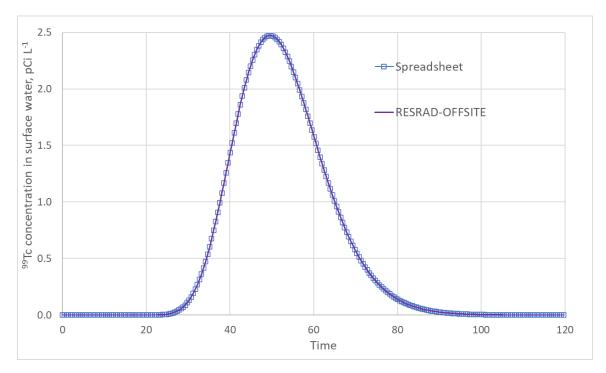


Figure 5.1 Temporal Variation of the Concentration of ⁹⁹Tc in Surface Water Primarily Due to Influx of ⁹⁹Tc Carried by Groundwater Infiltrating through Primary Contamination and Flowing into the Surface Water Body

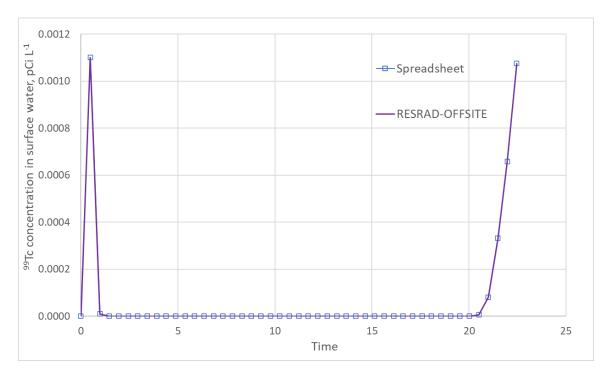


Figure 5.2 Temporal Variation of the Concentration of ⁹⁹Tc in Surface Water Due to Influx of ⁹⁹Tc Carried by Eroded Material into the Surface Water Body, Atmospheric Deposition on the Surface Water Body, and Washout of Atmospheric Deposition on the Catchment and by Groundwater, before the Groundwater Contribution Dominates

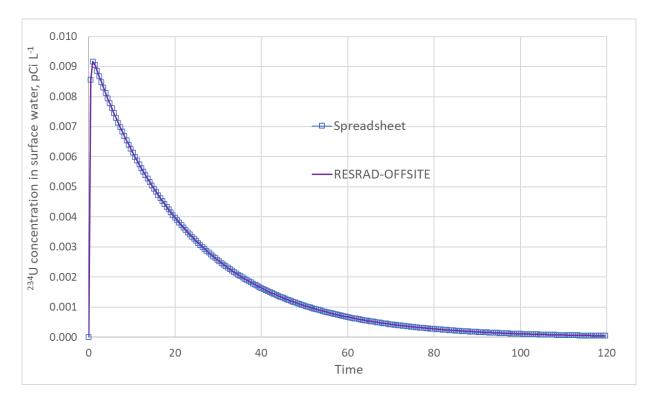


Figure 5.3 Temporal Variation of the Concentration of ²³⁴U in Surface Water Due to Influx of ²³⁴U Carried by Eroded Material into the Surface Water Body, Atmospheric Deposition on the Surface Water Body, and Washout of Atmospheric Deposition on the Catchment

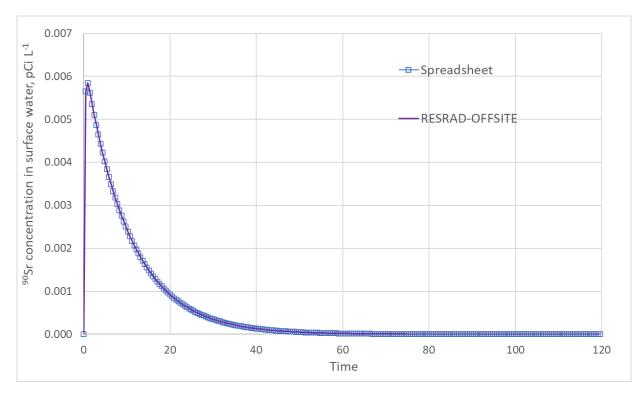


Figure 5.4 Temporal Variation of the Concentration of ⁹⁰Sr in Surface Water

5.2 ACCUMULATION IN OFFSITE SOILS

The pre-release verification of the accumulation model for offsite soils in Version 4 of the code is described in Appendix 6 and is summarized below.

- Figure 5.5 illustrates the verification of the concentration of four radionuclides in soil, each at different offsite locations, resulting from the influx of radionuclides by all three transport pathways:
 - Deposition of material eroded from the primary contamination carried by runoff.
 - Deposition of airborne material.
 - Irrigation with water from the well and or the surface water body.
- Figure 5.6 shows the verification of the concentration of ¹⁴C in soil at an offsite location due to each of the three radionuclide transport pathways listed above.
- Figure 5.7 shows the verification of the concentration of ⁹⁰Sr in soil at four offsite locations from the influx of ⁹⁰Sr by all three transport pathways listed above. This was part of the verification of the dose from the ingestion pathways.

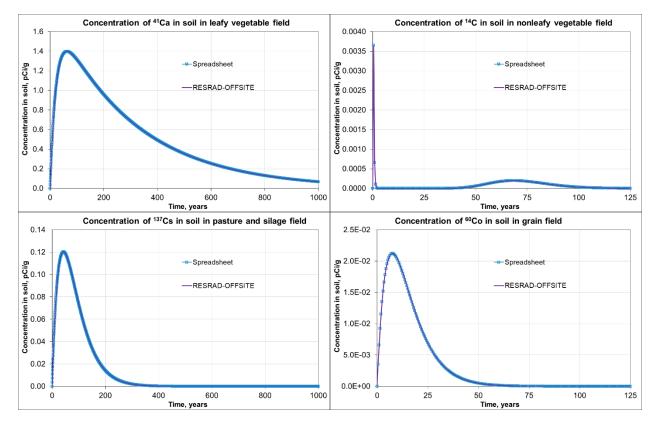


Figure 5.5 Temporal Variation of Concentration of Radionuclides in Offsite Soils

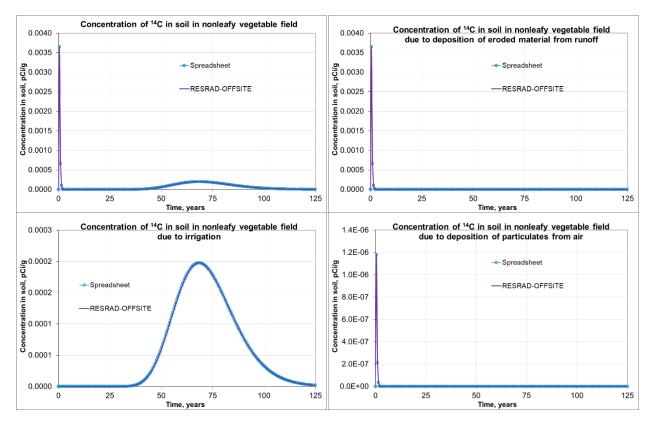


Figure 5.6 Temporal Variation of ¹⁴C Concentration in Offsite Soil Due to the Three Different Radionuclide Transport Pathways

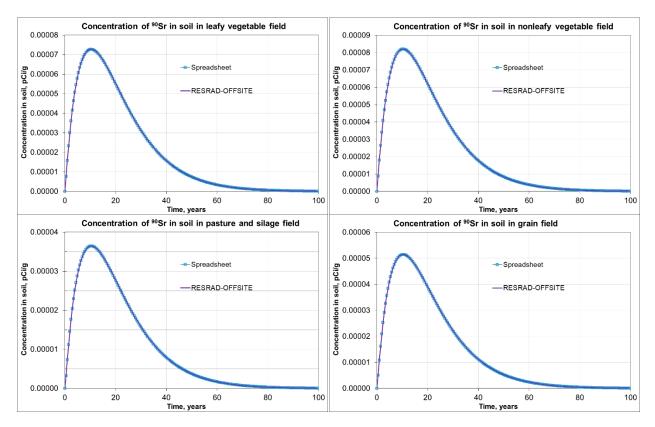


Figure 5.7 Temporal Variation of Concentration of ⁹⁰Sr in Soil at Four Different Offsite Locations

6 VERIFICATION OF TRANSFER AND ACCUMULATION IN PLANT FOOD, ANIMAL FEED, MEAT, MILK, AND AQUATIC FOOD

The concentration of ⁹⁰Sr in food ingested by the receptor and in animal feed was verified during the pre-release verification of the dose from the ingestion pathways. This was performed as outlined in Chapter 5 of NUREG/CR-7038 (Yu et al. 2011).

- The verification of concentration of ⁹⁰Sr in plant food and in animal feed at the time of harvest is shown in Figure 6.1.
- The radionuclides are transferred to different parts of the plant by three transport pathways:
 - Foliar interception of particulates followed, if necessary, by translocation to the part that is ingested.
 - Foliar interception of irrigation water followed, if necessary, by translocation to the part that is ingested.
 - Root uptake from accumulation in the agricultural land.
- In this case, the concentrations in the leaf are dominated by the sum of the two foliar interception transport pathways, while the concentrations in the other parts of the plant are dominated by root uptake from accumulation in soil. This leads to the two different temporal profiles seen in Figure 6.1.

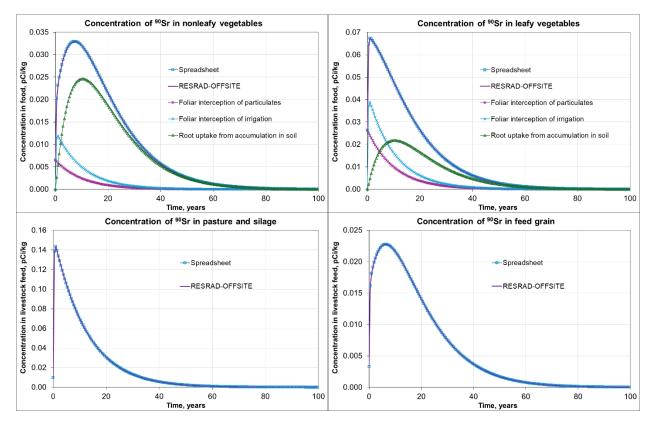


Figure 6.1 Temporal Concentration of ⁹⁰Sr in Plant Food and Animal Feed

The verification of concentration of ⁹⁰Sr in meat and milk at the time of harvest is shown in Figure 6.2.

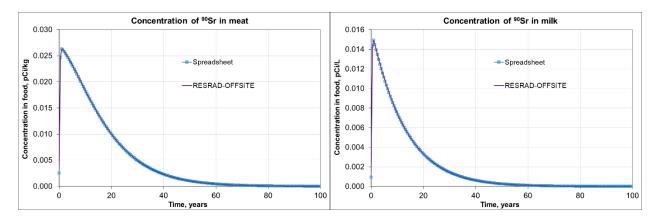


Figure 6.2 Temporal Concentration of ⁹⁰Sr in Meat and Milk

The verification of the concentration of ⁹⁰Sr in fish, crustacea, and mollusks at the time of harvest is shown in Figure 6.3.

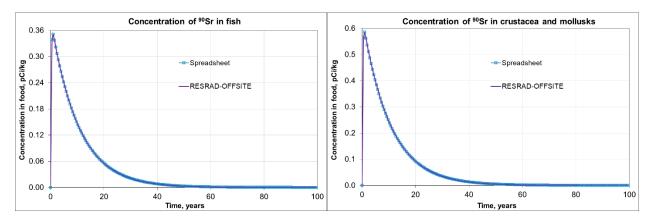


Figure 6.3 Temporal Concentration of ⁹⁰Sr in Fish, Crustacea, and Mollusks

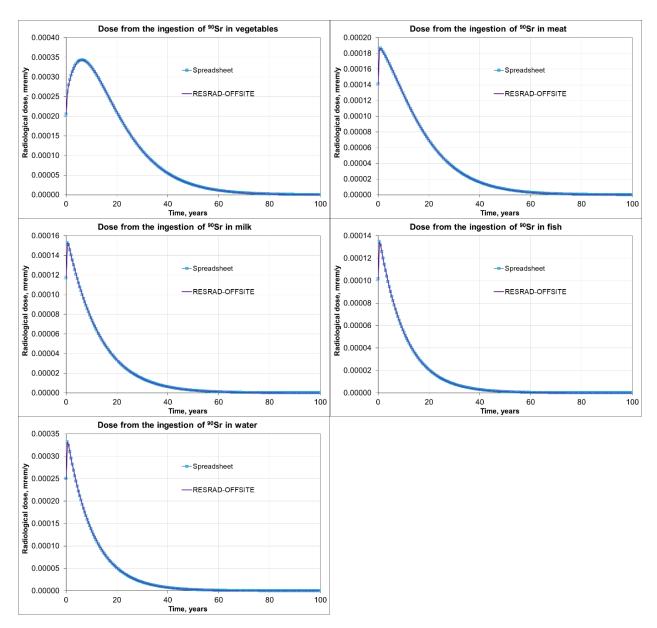
The verification performed in this chapter and the next provided the basis for the release testing of the concentrations in vegetables, livestock feed, meat, and milk.

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7 VERIFICATION OF RADIOLOGICAL DOSE FROM THE INGESTION PATHWAYS

The pre-release verification of the dose from the ingestion pathways and the incidental soil ingestion pathway of Version 4.0 of RESRAD-OFFSITE are described in Appendix 7 and Appendix 8 respectively. The verification of the ingestion pathways, summarized below, provided the basis for the release testing of the ingestion pathways.

• Figure 7.1 shows the verification of the 90 Sr dose from the five ingestion sub-pathways.



• Figure 7.2 shows the verification of the dose from the soil ingestion pathway.

Figure 7.1 Temporal Variation of Dose from the Ingestion of ⁹⁰Sr in Food and Water

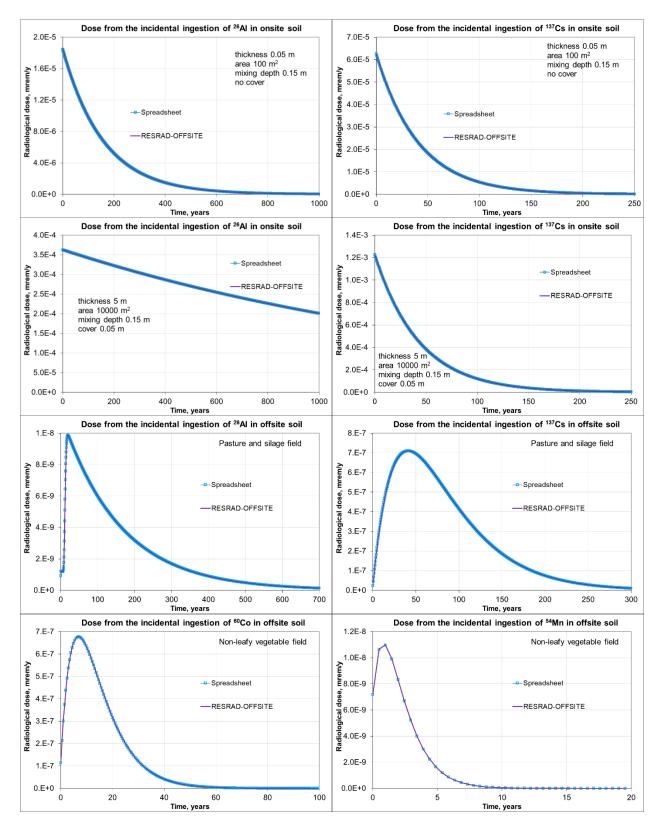


Figure 7.2 Temporal Variation of Dose from the Incidental Ingestion of Soil at Onsite and Offsite Locations

8 VERIFICATION OF RADIOLOGICAL DOSE FROM INHALATION OF RESPIRABLE PARTICULATES

The pre-release verification of the dose from the inhalation pathway of Version 4.0 of RESRAD-OFFSITE is described in Appendix 9 and is summarized below.

- Figure 8.1 shows the verification of the ²⁶Al inhalation dose at four receptor locations.
- Figure 8.2 shows the verification of the ¹³⁷Cs inhalation dose at four receptor locations.

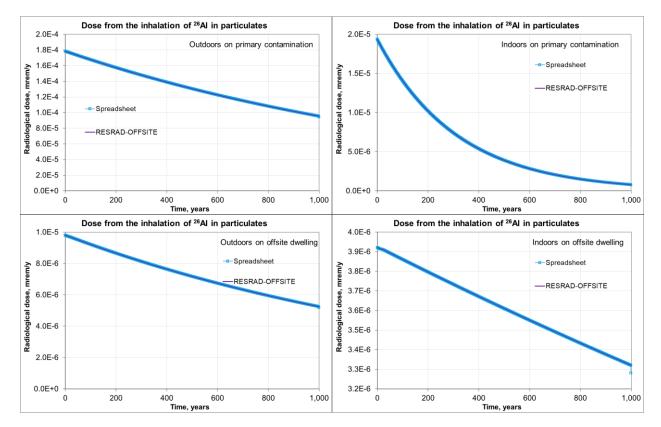


Figure 8.1 Temporal Variation of Dose from the Inhalation of ²⁶Al in Particulates

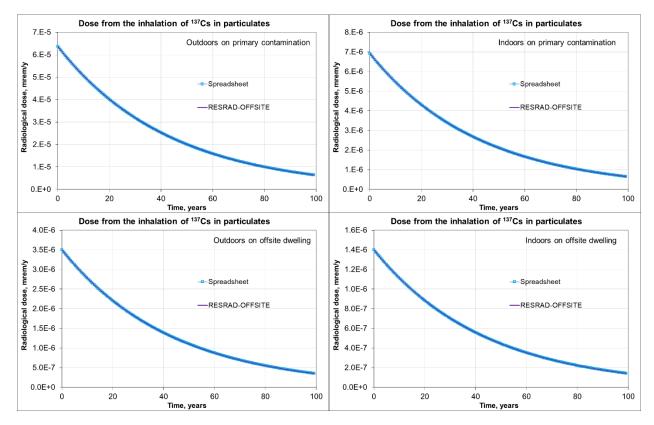


Figure 8.2 Temporal Variation of Dose from the Inhalation of ¹³⁷Cs in Particulates

The verification performed in this chapter provided the basis for the release testing of the inhalation pathway.

9 VERIFICATION OF RADIOLOGICAL DOSE FROM EXTERNAL RADIATION FROM OFFSITE SOILS

The pre-release verification of the dose from the external radiation pathway of Version 4.0 of RESRAD-OFFSITE is described in Appendix 10. The verification of the external radiation dose from ²⁶Al, ¹³⁷Cs, ⁶⁰Co, and ⁵⁴Mn in soil at offsite locations is illustrated in Figure 9.1. The verification of the external radiation dose from the primary contamination is shown in Table 9.1. The verification performed in this chapter provided the basis for the release testing of the external radiation pathway.

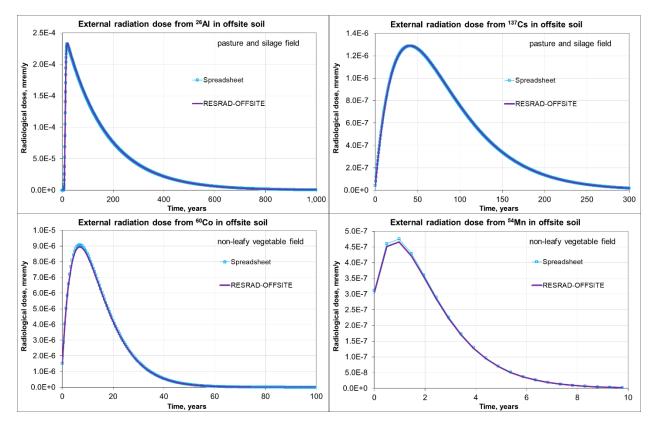


Figure 9.1 Temporal Variation of External Radiation Dose from the Accumulation of Radionuclides at the Offsite Locations

	Source area = Source thickne		Source radius Source thickne	
	Time integrated dose duri	ng the first year, mrem	Time integrated dose durir	ng the first year, mrem
Radionuclide	RESRAD-OFFSITE	Calculated	RESRAD-OFFSITE	Calculated
²⁶ Al	17.3	17.3	5.82	5.92
⁵⁷ Co	0.331	0.326	0.187	0.184
⁶⁰ Co	15.1	15.2	5.20	5.20
¹³⁷ Cs	3.37	3.37	1.32	1.31
⁵⁴ Mn	3.57	3.54	1.34	1.32
²³⁴ U	4.01E-04	4.02E-04	2.71E-04	2.86E-04
²³⁵ U	0.757	0.757	0.390	0.385

Table 9.1 Comparison of External Radiation Dose to Onsite Receptor

10 VERIFICATION OF ADDITIONAL MODELS FOR TRITIATED WATER

The pre-release verification of the formulations to model the movement and exposure from ³H in the form of tritiated water in addition to the movement and exposure from ³H in particulates is documented in this chapter. The verification performed in this chapter provided the basis for the release testing of the special models for tritium, ³H.

10.1 TEMPORAL CONCENTRATION IN PRIMARY CONTAMINATION

The calculation of the concentration of ³H in the primary contamination has an additional term to model the release of tritiated water vapor from the primary contamination due to evapotranspiration. The spreadsheet calculations of the initial loss/removal rate of ³H from the primary contamination and the erosion rate, in the tab "inputs," are outlined in Figure 10.1. The calculations of the three components of this loss rate, the radiological transformation rate, the leach rate under the RESRAD-ONSITE exponential release model, and the initial evasion rate are detailed in Figure 10.2, Figure 10.3, and Figure 10.4, respectively.

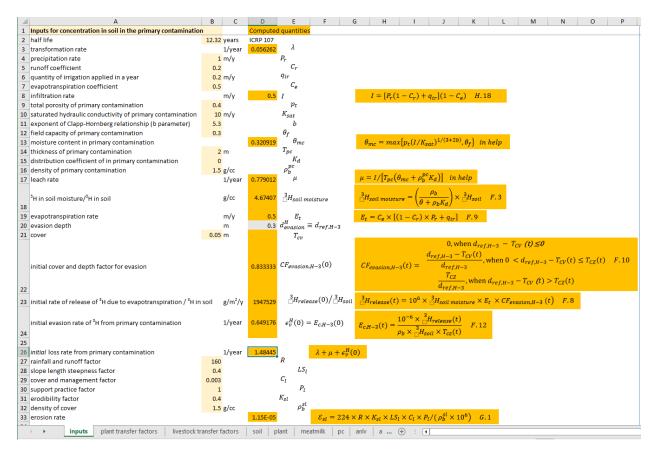


Figure 10.1 Screen Shot of Spreadsheet Calculations of the Initial Loss/Removal Rate of ³H and the Erosion Rate

D	3	: [×	$\sqrt{-f_x}$	=LN(2)/	B2
	A		в		D	E
1	Inputs for concentration in soil in the primary contaminatio	n	\frown		Computed	d quantities
2	half life		12.32	years	ICRP 107	¥
3	transformation rate		\smile	1/year	0.056262	λ

Figure 10.2 Screen Shot of Calculation of the Radiological Transformation Rate of ³H Using the ICRP-107 Half-life

D8	3 * :	×	$\checkmark = f_X$	=(B4*(1-	B5)+B6)*	(1-B7)			
	А	в	c		E	F)	G	н	1
1	Inputs for concentration in soil in the primary contamination			Computed	quantities				
4	precipitation rate	~	1 m/y		P_r				
5	runoff coefficient	🖌 о.	2		Cr	/			
6	quantity of irrigation applied in a year	0.	2 m/y		q_{ir}				
7	evapotranspiration coefficient	0.	5		C _e				
8	infiltration rate		m/y	0.5	I =	$[P_r(1-6)]$	$C_r) + q_{ir}$	$](1 - C_{e})$	H.18
D1	13 - :	\times	~ j	=MAX(B	12,B9*PO	VER(D8/B	10,1/(3	+2*B11)))	,
	А	В	С	D	E	F	G	н	<u>і</u> і
1	Inputs for concentration in soil in the primary contamination	n		Compute	d quantitie	es a la companya de l			
8	infiltration rate	\sim	m/y	0.5	I				
9	total porosity of primary contamination		0.4		p_t				
10	saturated hydraulic conductivity of primary contamination		10 m/y		K _{sat}				
11	exponent of Clapp-Hornberg relationship (b parameter)		5.3		b				
12	field capacity of primary contamination		0.3		θ_{f}				
13	moisture content in primary contamination			0.320919	$\theta_{mc} = n$	$nax\{p_t(I)\}$	$(K_{sat})^{1/2}$	$^{(3+2b)}, \theta_{f}$	in help
D1	17 🔹 :	×	√ f _x	=D8/B14	/(D13+B1	6*B15)			
	А	В	с	D	E	F	G	н	1
1	Inputs for concentration in soil in the primary contamination	1		Computed	quantities				
8	infiltration rate		m/y	0.5	Ι				
13	moisture content in primary contamination			0.320919	θ_{mc}		(
14	thickness of primary contamination		2 m		T_{pc}				
15	distribution coefficient of in primary contamination		0		K _{d3H}				
16	density of primary contamination	1	5 g/cc		ρ_b^{pc}				
17	leach rate		1/year	0.779012	· · ·	$= I / T_{pc}$	$(\theta_{max} + \theta_{max})$	$p_{K_{I}}^{pc}$	in help

Figure 10.3 Screen Shots of Estimation of the Leach Rate of ³H under the RESRAD-ONSITE Exponential Release Option

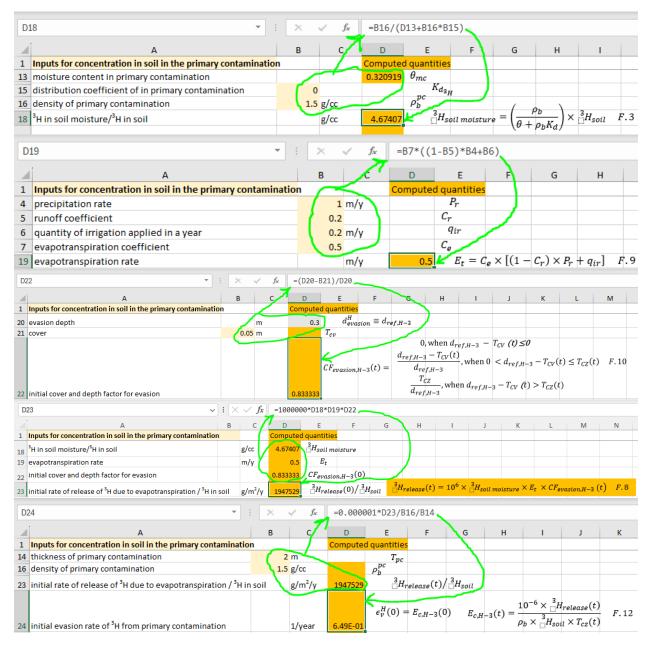


Figure 10.4 Screen Shot of Calculation of the Initial Evasion Rate of ³H from the Primary Contamination

The calculation of the rate at which the cover above the primary contamination erodes is shown in Figure 10.5. This erosion rate is used to compute the time-dependent thickness of the cover and the time dependence of the fraction of the evasion depth that is contaminated. The computation of the concentration of ³H remaining in the primary contamination at a specific time, 3/16 year, is shown in Figure 10.6; this figure also shows the verification of the concentrations at four different times. Figure 10.7 illustrates the verification of the temporal concentration of ³H remaining in the primary contamination.

D	33	~ :	$(\ f_x)$	=0.000224	*B27*B28*	B29*B30	*B31/B32						
	А		B C	D	E	F	G	н	1		J	К	
1	Inputs for concentration in soil in the primary contami	nation		Compute	d quantities								
27	rainfall and runoff factor		160		R								
28	slope length steepness factor		0.4		LSl								
29	cover and management factor	0.	.003		C_l								
30	support practice factor		1		P_l								
31	erodibility factor		0.4		K _{sl}								
32	density of cover		1.5 g/cc		ρ_b^{sl}								
33	erosion rate			1.15E-05	\leftarrow	$\mathcal{E}_{sl} = 1$	$224 \times R >$	$K_{sl} \times LS$	$S_l \times C_l \times$	$P_l/(\rho)$	$b^{sl} \times 1$	106) (G.1

Figure 10.5 Screen Shot of Calculation of the Erosion Rate of the Cover above the Primary Contamination

	А	В	С	D <u>E</u> F	F G	H I	J	K L
1		$s^{su}(t+t)$	t_{i} = s^{su} ($t_1)e^{-(\lambda_{\square}+\mu_{\square}+\varepsilon)}$	v^{t} G.56		E_t	$T_{pc}^{ev}(t)$
2			$L_1 = 3_{H}^{3}$		0.50		$\varepsilon_v = \frac{1}{d_{ev}T_{pc}(t)}$	$(\theta + \rho K_d)$
3		Code computed	spreadsheet	1/			ev-pc	
4	Year	RESRAD-OFFSITE	spreadsheet	RESRAD-OFFSITE	E/spreadsheet			
5	0	100	100)		
6	0.0625	91.13956	91.13956					
7	0.125	83.06419	83.06418	1				
8	0.1875	75.70432	=07*EXP(-(A8-A	7)*(inputs!D\$3+inputs	s!D\$17+inputs!D\$	\$19*(inputs!D\$20	D-inputs!B\$21+i	nputs!D\$33* <mark>A8</mark>)/
9	0.25	68.99655	inputs!D\$20/in	outs!B\$14/(inputs!D\$1	.3+inputs!B\$15*ii	nputs!B\$16)))		
10	0.3125	62.88312	62.88312	1				
11	0.375	57.31136	57.31137	1				

Figure 10.6 Screen Shot of Calculation of the Concentration of ³H Remaining in the Primary Contamination

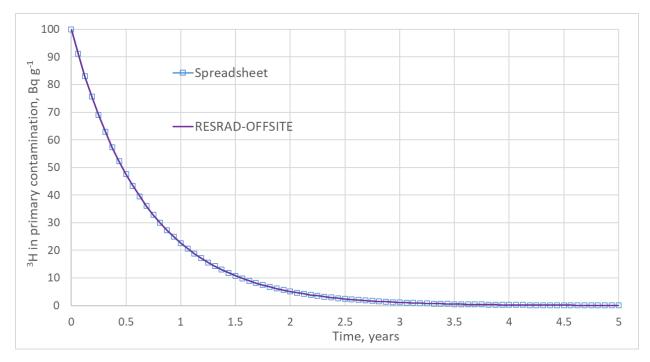


Figure 10.7 Temporal Variation of the Concentration of ³H Remaining in the Primary Contamination

10.2 CONCENTRATION IN PLANT

The movement of tritiated water from soil through the roots is modeled as being the same as the movement of water from soil. The calculation of the equivalent root transfer factor is illustrated in Figure 10.8.

B	7	\checkmark : $\times \checkmark f_x$ =B	5/(B4+B6*B5)*B	3			
	А	В	С	D	E	F	G
1	Inputs for concentration in plant			Computed quantitie	s		
2		nonleafy vegetables, fruit and grain	leafy vegetables	pasture and silage	livestock feed grain		
3	mass fraction of water in plants	0.8	0.8	0.8	0.8		H_2O_{plant}
4	moisture content of soil	0.3	0.3	0.3	0.3		θ_{mc}
5	dry bulk density of soil	1.5	1.5	1.5	1.5	g/cc	ρ_b
6	distribution coefficient	A 0	0	0	0	cc/g	K_d
7	root transfer factor		4	4	4	³ H from r	oot uptake
8	$rtf_{B_{H}}$	³ H _{soil n}	$_{noisture}(t)H_2O_{plan}$	$\frac{\rho}{\theta + \rho K_d} H_2 O_{plan}$		in a gram	of plant /
9		$rtf_{BH} = $	$^{3}H_{soil}(t)$	$-=\frac{1}{\theta+\rho K_d}H_2O_{plan}$	t	³ H in a gr	am of soil

Figure 10.8 Screen Shot of Calculation of Root Transfer Factor of ³H for Each Plant Type

The 3 H in plant from the foliar deposition of particles containing it are modeled in the same manner as for the other radionuclides. The computation of the air-to-plant concentration ratios that are used in this model are in shown in Figure 10.9.

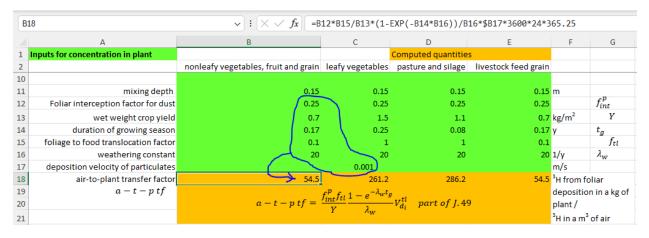


Figure 10.9 Screen Shot of Calculation of Air-to-Plant Concentration Ratios, which Are Used to Model Foliar Deposition

The calculation of the concentration of ³H in plant at a specific time, 0.25 years, and the verification of the code calculated value at that time and at six other times around it, are shown in Figure 10.10. The concentrations of ³H in the soil and in air used in these calculations were obtained for RESRAD-OFFSITE output. The calculation of concentration in offsite soils was verified in Section 5.2. The component calculations for the concentration in air were verified in Sections 2.4 and 4.1. The verification of the temporal concentration of ³H in plant is shown in Figure 10.11. The figure on the left shows the verification when the concentration is high, while

the figure on the right shows the verification during early times when the concentration is orders of magnitude lower and is mainly due to foliar deposition.

	А	В	С	D	E	F	G	Н	I	J K	L	М	N	0	Р	Q	R	S	Т	U	V	W
1								fa	= 0 when	entirely of	fsite											
2							$p_{on_i}^{ru}(t)$	$= 10^{3} f_{a} f_{a}$	$r_{cd}^{root}(t)rtf_i$	s _i (t) J.45			_									
3							1			$s_{i}^{o}(t)$ J.47				rtf _i	4	4	4	4				
5								Pagi				_					a –	$t - p t f_i$	54.47218	261.2081	286.2072	54.47218
6									$n^{fp}(t)$	$=\frac{f_{int}^p f_{tl}}{Y} \frac{1-1}{Y}$	$e^{-\lambda_w t_g}$	$ti(\chi)^{tl}$	$R_i^{tl}(t)$	1 49								
7									Pofice	Y	λ _w '	$d_i \left(Q \right)_{o_i} d_i$,,								
8						(1)	TH (1)	· TH ()	fp (1)		3	·				root	uptake				n of partic	
9						$p_H(t) =$	$p_{on_H}(t)$	$+ p_{ag_H}(t)$	$) + p_{of_{H}}(t)$	J.44 for	H					si	(t)		a	$P(t) \equiv \left(\frac{\chi}{2}\right)$	$\int_{a_i}^{tl} AR_i^{tl}(t)$	t)
10	2						Spread	Sheet		\sim	RESRAD	OFFSITE	\geq									
11	1	Concentra	tion in								\sim					concentra	tion in soil			ation in ai	r in particu	late form
12	7					fruit			livestock	fruit			livestock		fruit			livestock	fruit			livestock
13		leafy				grain	leafy	and	feed	grain		pasture	feed		grain		pasture	feed	grain		pasture	feed
14	1	vegetable		RESRAD-OF		nonleafy	vegetable	silage	grain	nonleafy	leafy	silage	grain		nonleafy	leafy	silage	grain	nonleafy	leafy	silage	grain
15		Bq/kg		spreadshee	et 🦯	, ,																
16 Ye			Spreadsheet	ע)						nlv	lv	ps	lfg		snlv	slv	sps	slfg	anlv	alv	aps	alfg
17			0.02633855	1			0.026339		3.31E-03	0.006495	0.026339				0	0	0	•	0.000119			6.08E-0
18	0.0625		0.0263941	0.999999		0.008745			4.46E-03	0.008745	0.026394		0.004461		7.07E-07		2.03E-07	3.6E-07		9.19E-05		
19	0.125		0.02524438	0.999999			0.025244		4.78E-03	0.009377	0.025244		0.004784		9.95E-07				9.9E-05			5.05E-0
20							0.023599			0.009246						9.15E-07				7.63E-05		4.60E-0
21	0.25		0.02180265				=0 +1000*			0.008775	0.021803					9.07E-07				6.96E-05		4.20E-0
22	0.3125						0.020017			0.008171	0.020017	01007000				8.64E-07			7.5E-05		21202 00	
23	0.375		0.01831665				0.018317		3.84E-03	0.007533		0.006708			9.53E-07							3.49E-0
24	0.4375	0.01673	0.01673001	0.999999		0.006908	0.01673	6.13E-03	3.52E-03	0.006908	0.01673	0.006126	0.003524	L	8.79E-07	7.43E-07	2.53E-07	4.48E-07	6.23E-05	5.27E-05	1.79E-05	3.18E-0

Figure 10.10 Screen Shot of Calculation and Verification of Concentration of ³H in Plants

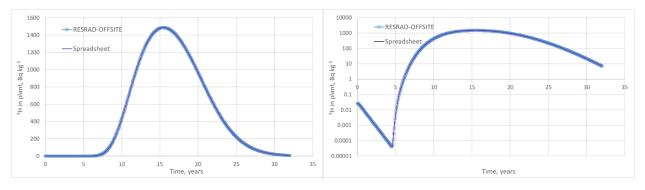


Figure 10.11 Verification of Temporal Concentration of ³H in Plant

10.3 CONCENTRATION IN MEAT AND MILK

The transfer of ³H ingested by the livestock to milk and meat is modeled as being the same as the transfer of H₂O to meat and milk, both as water and in the feed that is ingested by the livestock. The calculation of the intake to the concentration in meat factor and intake to the concentration in milk factor for ³H are shown in Figure 10.12. The use of these factors to compute the concentrations of ³H in meat and milk from livestock water, pasture and silage, feed grain, and the soils associated with the livestock feeds is illustrated in Figure 10.13. The verification of the temporal concentrations of ³H in milk and meat are shown in Figure 10.14 and Figure 10.15, respectively. The plots on the left of both figures show the verification during early times when the concentration is orders of magnitude lower and is mainly due to foliar deposition.

B2	24					\checkmark : $\times \checkmark f_x$	=B10/(B	4*B12+B	5*B13+B6'	*B14+B7*((B17/B16-	-B18)+B8	*(B21/B2	0+B22))				
	А		в		с	D	E	F	G	н	1	J	к	L	м	N	0	Р
1	Inputs for concentration in meat an	nd in m	nilk															
2		beef	cattle	dair	y cow													
3	rate of Intake		\sim		~													
4	water	-	50		160	L/d	Iwater											
5	pasture and silage		14		44	<mark>1</mark> kg/d	Ip&s											
6	livestock feed grain	1	54		/ 1	L kg/d	$I_{p\&s}^{\square}$ I_{fg}^{\square}											
7	soil in pasture and silage		0.1	1	0.4	kg/d	Ip&s soil											
8	soil in livestock feed grain		0.4	1	0.:	L <mark>kg/d</mark>	I _{fg soil}											
9	water content																	
10	meat		0.6	Y		g/g	H_2O_{meat}											
11	milk			1	0.88	<mark>8</mark> g/g	H_2O_{milk}											
12	water		1	. 1		g/g												
13	pasture and silage		0.	8	١.	g/g	$H_2O_{p\&s}$											
14	livestock feed grain		0.	8		g/g	H_2O_{fg}											
15	pasture and silage growing area																	
16	dry bulk density of soil		1.	5		g/cc	$(\rho)_{p\&s}$											
17	moisture content		0.	3	17	volume fraction	$(\theta)_{p\&s}$											
18	distribution coefficient		0			cc/g	$(K_d)_{p\&s}$											
19	livestock feed grain		Y															
20	dry bulk density of soil		1.	5	X	g/cc	$(\rho)_{fg}$											
21	moisture content		0.	3		volume fraction	$(\theta)_{fg}$											
22	distribution coefficient		0	1		cc/g	$(K_d)_{fg}$											
23	Computed quantities			4														
24	Intake to meat factor	5.7	4E-03			$imf = \frac{1}{3}$	$\frac{H_{meat}}{H_{cattle}^{intak}} = -\frac{1}{1}$	l ^{cattle} +	I ^{cattle} H ₂ ($D_{p\&s} + I_{fg}^{ca}$	H ₂ ^{ttle} H ₂ O _{fg}	O _{meat} + I ^{cattle} \$ soil	$\left(\frac{\theta}{\rho}+K_d\right)$	+ I ^{catt} n&s	$\frac{\partial e}{\partial \partial l} \left(\frac{\theta}{\rho} + K_d \right)$	$\left(\right)_{f_{n}}$ expo	unded for	rm of F.17
25	Intake to milk factor) 31E-03	imf 3 d/L	$= \frac{{}^{3}H_{milk}}{{}^{3}H_{cow}^{intak}}$	= I ^{cow} I ^{water}	$+ I_{p\&s}^{cow} H_{s}$	$_2O_{p\&s} + I_f^c$	H g ^{ow} H ₂ O _{fg} -	20 _{milk} + I ^{cow} p&s soil	$\left(\frac{\theta}{\rho} + K_d\right)_{pl}$	+ I ^{cow} ss	$\left(\frac{\theta}{\rho} + K_d\right)_j$	— expan fg	ded form	of F.17

Figure 10.12 Screen Shot of Calculation of Intake to Concentration in Meat and Intake to Concentration in Milk Factors for ³H

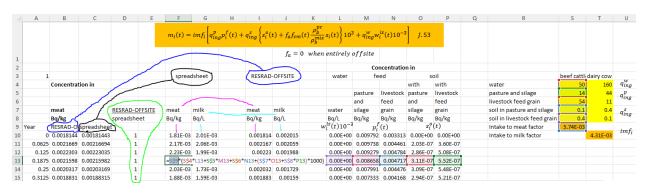


Figure 10.13 Screen Shot of Calculation and Verification of Concentration of ³H in Milk and Meat

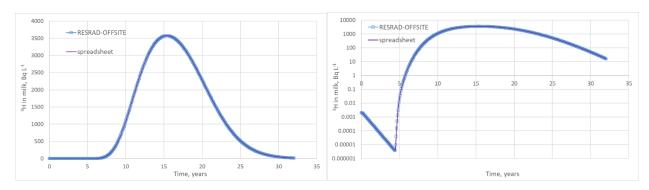


Figure 10.14 Verification of Temporal Concentration of ³H in Milk

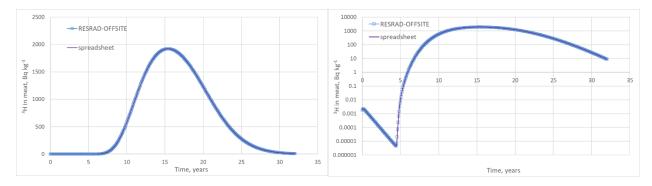


Figure 10.15 Verification of Temporal Concentration of ³H in Meat

10.4 INHALATION

The ³H inhalation dose in RESRAD-OFFSITE 4.0 is modeled as being from the inhalation of tritiated water. The evapotranspiration of tritiated water is modeled as paralleling that of regular water. The spreadsheet computations of the infiltration rate, the evapotranspiration rate, and the moisture content in soil are illustrated in Figure 10.16. These computed values are used in the spreadsheet computation of the rate of evasion of water from the evasion depth, as shown in Figure 10.17. The spreadsheet calculation of the cover and depth factor for the evasion of ³H is in Figure 10.18. The calculation of the concentration of ³H in the air above the primary contamination per unit concentration of ³H in the primary contamination is illustrated in Figure 10.19. This was found to be within the bounds computed by the spreadsheet in Figure 10.20.

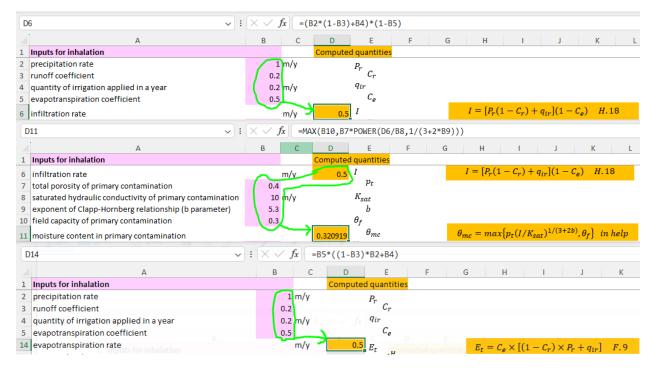


Figure 10.16 Screen Shots of Spreadsheet Computations of Infiltration Rate and Moisture Content in Soil and Evapotranspiration Rate

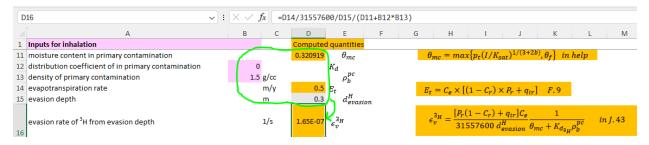


Figure 10.17 Screen Shot of Spreadsheet Calculation of Evasion Rate of ³H from the Entire Evasion Depth

D19	\sim]: $\times \checkmark f_x$] =(D15-B17)/D15
A	B C D E F G H I J K L M N O P
1 Inputs for inhalation	Computed quantities
15 evasion depth evasion rate of ³ H from evasion depth 16 17 cover 18 thickness of primary contamination	m 0.3 $d_{evasion}^{H}$ 1/5 1.65E-07 ϵ_{v}^{3H} $\epsilon_{v}^{2H} = \frac{[P_{r}(1-C_{r}) + q_{ir}]C_{e}}{31557600 d_{evasion}^{H} \theta_{mc} + K_{d_{3H}} \rho_{b}^{pc}}$ in J. 43 0 m T_{cv} 2 m T_{pc}
initial cover and depth factor for evasion	$f_{cd}^{ec_{in}^{H}}(0) \qquad f_{cd}^{ec_{in}^{H}}(0) = \frac{\frac{0, \text{when } T_{cv}(t) \ge d_{evasion}^{H}}{0}}{\frac{d_{evasion}^{H} - T_{cv}(t)}{d_{evasion}^{H}}, \text{when } T_{pc}(t) + T_{cv}(t) > d_{evasion}^{H} \ge T_{cv}(t) J.38$

Figure 10.18 Screen Shot of the Calculation of the Cover and Depth Factor for the Evasion of Water

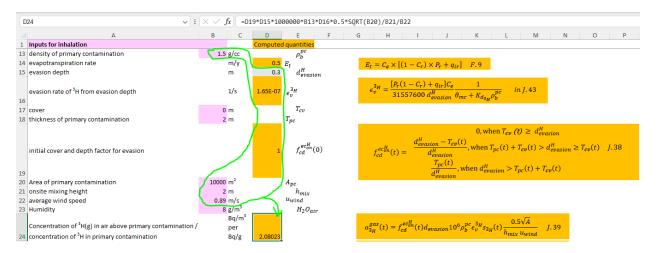


Figure 10.19 Screen Shot of the Calculation of the Ratio of the Concentration of ³H in the Air above and in the Soil in the Primary Contamination

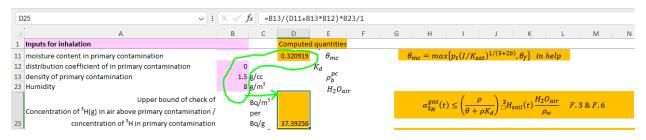


Figure 10.20 Screen Shot of the Calculation of the Upper Bound for the Ratio of the Concentration of ³H in the Air above and in the Soil in the Primary Contamination

Figure 10.21 shows the spreadsheet computation of the rate of release of ³H by evapotranspiration from the primary contamination per unit concentration in the primary contamination. The computation of the annual time-integrated concentration of ³H in the primary contamination using the trapezoidal approximation is illustrated in Figure 10.22. The instantaneous concentration in the primary contamination was verified in Section 2.2. As illustrated in Figure 10.23, the annual time-integrated concentration of ³H in the air above the primary contamination was computed by multiplying the annual time-integrated concentration in soil by the ratio calculated in Figure 10.19. Figure 10.24 shows the computation of the annual time-integrated concentration of the annual time-integrated concentration in soil, the rate of release per unit concentration in the primary contamination calculated in Figure 10.21, and the chi over Q, $\left(\frac{\chi}{Q}\right)_{offsite}^{gas}$, for transport of a gas from the primary contamination to the offsite location. The chi over Qs were verified in Section 4.1.

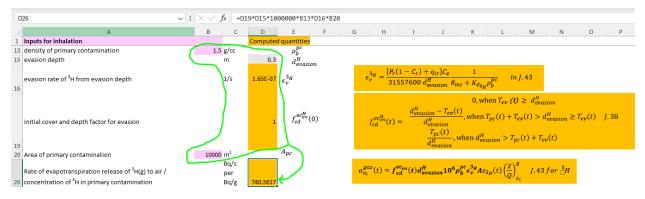


Figure 10.21 Screen Shot of the Calculation of the Release Rate of ³H per Unit Concentration in the Primary Contamination

1		B RATION: H-	C •3, Primar	D Y Contami	E nation	F										
2	INHALATIO	ON OF Hyd	rogen-3.R	ROF 01/07/	2020 22:50	Graphics.As										
3	Year	Value														
4	0	100	\checkmark													
5	0.0625	90.403														
6	0.125	81.72701					1									
7	0.1875	73.88366					V:	12	∨ : ×	$\sqrt{f_x}$	=(H3cz!E	4+2*SUM	(H3cz!B5:	B19)+H	3cz!B20)/32	• · ·
8	0.25							Α	Р	Q	R	S	т	U	V	w
9	0.3125						8		-							
0		54.58794					9		. (t+1		+1 - Ø (4)		- /	(^{t+1}	
1		49.34912					10		t J	$a_{ps}^{g}(t) dt$	J_t	$a_{lfg}^{g}(t) d$			$\int_{t}^{t} s_{3_{H}}(t) dt$	
2		44.61308					11	Year	foc foc		f_{oc}^{lfg}		DC_{inh}^{g}			
3	0.5625						12	0		2.09E+01		3.64E+01	2.89E-07		49.65951	
4	0.625						13	0.0625		1.89E+01		3.29E+01			44.89367	
5	0.6875						14	0.125		1.71E+01		2.97E+01			40.58522	
6	0.75						15	0.1875		1.54E+01		2.69E+01			36.69025	
7	0.8125							< >	gas	inputs	H3 inha	••• +	- E - M - I			•
8 9	0.875															
0	0.55/5	19.90324														
1	1.0625	17.99312														
	1.0025	17.35512														

Figure 10.22 Screen Shot of Time Integration of the Concentration in the Primary Contamination over a Year Using the Trapezoidal Approximation

G1	2	• : X	√ <i>f</i> x	= <u>V12</u> *inp	uts!D\$24	ļ.																
	А	В	С	D	Е	F	G	н	1	J.	К	L	м	N	0	Р	Q	R	s	т	U	v
8				L																		
9						-	t+1				$\int_{a_{od}}^{t+1} a_{od}^g(t) dt$		$a_{nlv}^{g}(t) d$		$\int_{a_{1v}^g}^{t+1} a_{1v}^g(t) dt$		$a_{ps}^{g}(t) d$		$a_{lfg}^{g}(t)$	it		· t+1
10						J	$a_{pc}^{g}(t) dt$, "od (i) i	,	t aniv (c) a		t alp(c) a	,	e apg(e) a	J	in lifg (c) i		J	$s_{3_H}(t) dt$
11	Year		FI _{inh}	foc	foc			food	foc			foc		foc		foc		f_{oc}^{lfg}		DC ^g _{inh}		
12	(0 3.23E-01	8400	0.1	0.1	1	1.03E+02	0.1	0.3		1.23E+02	0.1	7.00E+01	0.1	5.96E+01	0.1	2.09E+01	0.1	3.64E+01	2.89E-07		49.65951

Figure 10.23 Screen Shot of Computation of the Time-Integrated Concentration in the Air above the Primary Contamination over the First Year

012		• : ×	$\checkmark f_x$	-V12*0\$2	*inputs!	D\$26																
	Δ.	В	С	D	Е	F	G	н	1	J.	К	L	М	N	0	Р	Q	R	S	т	U	v
L											$\left(\frac{\chi}{Q}\right)_{od}^{g}$		$\left(\frac{\chi}{Q}\right)_{nlv}^g$	($\left(\frac{\chi}{Q}\right)_{lv}^{g}$		$\left(\frac{\chi}{Q}\right)_{ps}^{g}$		$\left(\frac{\chi}{Q}\right)_{lfg}^{g}$			
											3.35E-03		1.90E-03		1.62E-03		5.68E-04		9.89E-04			
)						Ĵ,	$a_{pc}^{g}(t) dt$			J	$\int_{t}^{t+1} a_{od}^g(t) d$		$a_{nlv}^{g}(t) a$		$\int_{t}^{t+1} a_{lv}^{g}(t) dt$	- J	$a_{ps}^{g}(t) d$		$a_{lfg}^{g}(t) d$	t	ſ	$s_{3_{H}}(t) d$
Year			Flinh	foc	foc			foc	foc			foc		foc		foc		f_{ac}^{lfg}		DC_{inh}^{g}		
2	0	3.23E-01	8400	0.1	0.1	1	1.03E+02	0.1	0.3	1	1.23E+02	0.1	7.00E+01	0.1	5.96E+01	0.1	2.09E+01		3.64E+01	2.89E-07		49.6595

Figure 10.24 Screen Shot of Computation of the Time-Integrated Concentration in the Air at an Offsite Location over the First Year

The aggregation of the inputs to compute the dose from inhalation, the dose conversion factor, the inhalation rate, and the indoor and outdoor occupancies in the onsite and offsite dwellings is shown in Figure 10.25. The calculation of the annual time-integrated ³H inhalation dose while the receptor is at the various locations is shown in Figure 10.26 for a specific time interval of 1 year beginning at 0.25 years. Figure 10.27 verifies the RESRAD-OFFSITE 4.0 ³H inhalation dose over the time horizon where that dose is significant.

D	50	~ :	$\times \checkmark j$	fx				
	А		В	С	D	E	F	G
1	Inputs for inhalation				Compute	d quantitie	s	
28	Dose conversion factor for inhalation for ³ H	(2.89E-07	mSv/Bq		DC_{in}^{g}	'n	
29	Inhalation rate	<u> </u>	8400	m³/y		FI _{inh}		
30	occupancy fraction, outdoors in onsite dwelling site		0.1	$\widetilde{}$		f _{oc} ^{opc}		
31	occupancy fraction, indoors in onsite dwelling site		0.1			f_{oc}^{ipc}		
32	occupancy fraction, outdoors in offsite dwelling site		0.1	\sum		f_{oc}^{ood}		
33	occupancy fraction, indoors in offsite dwelling site		0.3	J١		foc		
34	occupancy fraction, non-leafy vegetable field		0.1	1	/	f_oc^{nlv}		
35	occupancy fraction, leafy vegetable field		0.1			foc		
36	occupancy fraction, pasture & silage field		0.1			f_{oc}^{ps}		
37	occupancy fraction, livestock feed grain field		0.1					
38				1 (3.64E-03	1	.5 FI _{inh} Do	C ^g inh
				14		($f_{oc}^{opc} + f_{oc}^{ij}$	pc)
39				l,	0.2			
40				\sim	0.4	(f ^{ood} + foo)
41					Compute	d quantitie	s	

Figure 10.25 Screen Shot of the Aggregation of Inhalation Dose Pathway Inputs

		~ : ×	✓ <i>f</i> x	=C\$13*(F	\$13*G16-	+J\$13*K1	6+L\$12*M1	.6+N\$12*(016+P\$12'	*Q16+R \$ 1	2*516)											
	Α	В	С	D	E	F	G	н	1	J	к	L	м	N	0	Р	Q	R	S	т	U	v
5				1		*+1			**	1	4	*+1		1								
6		D^{g}	(t) = 1.5	Flins (f	$opc + f^{ip}$		g(t) dt +	(food +	fiod)	$a^{g}(t) \dot{a}$	$t + \sum_{i=1}^{4} f_{oc}^{a_i}$	gi	$g_{(t)}dt$	DC^{g} .	extendin	a C. 6 to	inhalatio	n of aas	· · ·			
7		~ inn	(*) 10		00 100	J _t "	pc(e) are	() 00	\int_{t}	and (r) a	<i>i</i> =1	Jt	agi(c) ac	2 Cinh		,						
8				L										,								
9							(^{t+1} g (1))				(^{t+1} - (t) -	. ($a^{g}(t)$	i+	$a^{\ell+1}$		$e^{\theta}(t)d$	• (t+1	*	ſ	$\frac{t+1}{s_{3H}(t)} dt$
10						J	$a_{pc}^{g}(t) d$				t a _{od} (t) a	۲ J	univ (c) c		t alv(c) a	·)	t aps(t) a	۲ J	alfg(e)e		J,	$s_{3_H}(t) dt$
11 Y	'ear		FIinh	foc opc	f _{oc} ^{ipc}			focd	f_{oc}^{iod}		$\int_{t}^{t+1} a_{od}^{g}(t) d$	foc		foc		foc		f_{oc}^{lfg}		DC_{inh}^{g}		
12	0	3.23E-01	8400	0.1	0.1	1	1.03E+02	0.1	0.3	1	1.23E+02	0.1	7.00E+01	0.1	5.96E+01	0.1	2.09E+01	0.1	3.64E+01	2.89E-07		49.65951
13	0.0625	2.92E-01	3.64E-03			0.2	9.34E+01			0.4	1.11E+02		6.33E+01		5.39E+01		1.89E+01		3.29E+01			44.89367
14	0.125	2.64E-01	$1.5 FI_{in}$	h DC ^g inh	(f ^{opc}	$+ f^{ipc}$	8.44E+01		(food	$+ f_{oc}^{iod}$	1.01E+02		5.72E+01		4.87E+01		1.71E+01		2.97E+01			40.58522
15	0.1875	2.38E-01		n inn	()00	100)	7.63E+01		()00	, ,00)	9.11E+01		5.17E+01		4.40E+01		1.54E+01		2.69E+01			36.69025
16	0.25	S16)					6.90E+01				8.24E+01		4.67E+01		3.98E+01		1.40E+01		2.43E+01			33.16907
17	0.3125	1.95E-01					6.24E+01				7.45E+01		4.23E+01		3.60E+01		1.26E+01		2.20E+01			29.98583
18	0.375	1.76E-01					5.64E+01				6.73E+01		3.82E+01		3.25E+01		1.14E+01		1.99E+01			27.10808
19	0.4375	1.59E-01					5.10E+01				6.09E+01		3.45E+01		2.94E+01		1.03E+01		1.79E+01			24.50651
20	0.5	1.44E-01					4.61E+01				5.50E+01		3.12E+01		2.66E+01		9.32E+00		1.62E+01			22.15461
21	0 5625	1 30F-01					4 17F+01				4 97F+01		2 82F+01		2 40F+01		8 43E+00		1 47F+01			20 02843

Figure 10.26 Screen Shot of Spreadsheet Calculation of the Annual Time-Integrated ³H Inhalation Dose Beginning at 0.25 years

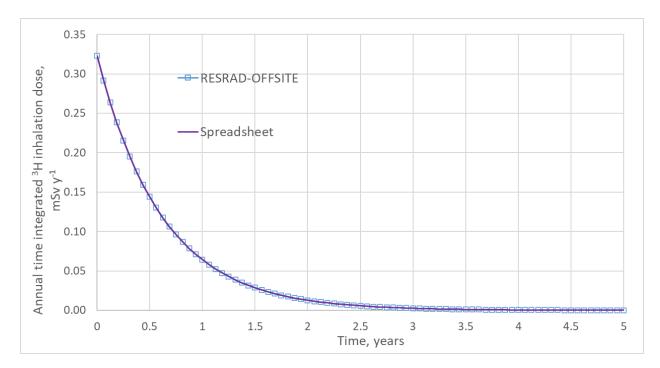


Figure 10.27 Verification of the Annual Time-Integrated ³H Inhalation Dose

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11 VERIFICATION OF ADDITIONAL MODELS FOR ¹⁴C

The pre-release verification of the formulations to model the movement and exposure from ${}^{14}C$ in the form of carbon dioxide (${}^{14}CO_2$) in addition to the movement and exposure from ${}^{14}C$ in particulates is documented in this chapter. The verification performed in this chapter provided the basis for the release testing of the special models for ${}^{14}C$.

11.1 TEMPORAL CONCENTRATION IN PRIMARY CONTAMINATION

The calculation of the concentration of ¹⁴C in the primary contamination has an additional term to model the evasion of ¹⁴CO₂ out of the primary contamination. The spreadsheet calculations of the initial loss/removal rate of ¹⁴C from the primary contamination and the erosion rate, in the tab "inputs," are outlined in Figure 11.1. The calculations of the three components of this loss rate, the radiological transformation rate, the leach rate under the RESRAD-ONSITE exponential release model, and the initial evasion rate are detailed in Figure 11.2, Figure 11.3, and Figure 11.4, respectively.

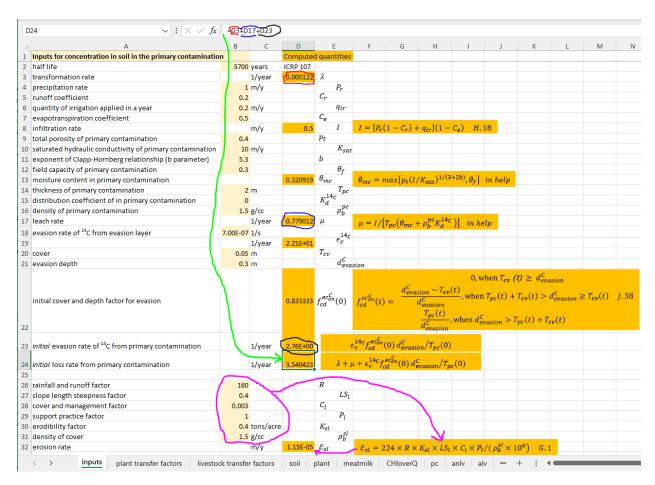


Figure 11.1 Screen Shot of Spreadsheet Calculations of the Initial Loss/Removal Rate of ¹⁴C from the Primary Contamination and the Erosion Rate of the Primary Contamination

D	3	√ <i>f</i> x	=LN(2)/	32 —	~	
	А	В	C	D		E
1	Inputs for concentration in soil in the primary contaminatio	n ' /		Compute	d quar	ntities
2	half life	570) years	ICRP 107	Ľ	
3	transformation rate		1/year	0.000122	λ	

Figure 11.2 Screen Shot of Calculation of the Radiological Transformation Rate of ¹⁴C Using the ICRP-107 Half-life

	А	В	С	D	E	F	G	н	1.1	J
4	precipitation rate	1	1 m/y		Pr					
5	runoff coefficient	(().2		C_r					
6	quantity of irrigation applied in a year	0).2 m/y		q_{ir}					
7	evapotranspiration coefficient	- C).5	50	Ce	_				
8	infiltration rate		m/y	0	0.5 I	I	$= [P_r(1 -$	$(C_r) + q_{ir}$	$](1 - C_e)$) H.18
D	13 \checkmark : \times f_x =MAX(B12, B9*POWER(D8/6	310,1/(3	+2*B11)))							
	А	В	С	D	E	F	G	н	1	J
8	infiltration rate		m/y	0.5	I	I =	$[P_r(1-C_r)$	$(1 + q_{ir}](1)$	— С _е) Н	<mark>(.18</mark>
9	total porosity of primary contamination	0.4			p_t					
10	saturated hydraulic conductivity of primary contamination	/ 10	m/y		K _{sat}					
11	exponent of Clapp-Hornberg relationship (b parameter)	5.3			b					
12	field capacity of primary contamination	0.3	I A		θ_{f}		(1 /	(2.25)	
L3	moisture content in primary contamination		(0.320919	θ_{mc}	θ_{mc}	$= max\{p_t($	$(I/K_{sat})^{1/2}$	$(3+20), \theta_{f}$	in hel
D	17 → : × / f_x =D8/B14/(D13+B16*B15)									
	A	В	С	D	E	F	G	н		J
8	infiltration rate	- F	m/y	0.5	Ι	I = [$P_r(1-C_r)$	$+ q_{ir}](1 -$	– С _е) Н	.18
13	moisture content in primary contamination		c	.320919	θ_{mc}	θ_{mc} =	$= max\{p_t($	$(I/K_{sat})^{1/6}$	$^{(3+2b)}, \theta_f$	in hel
L4	thickness of primary contamination	2	m		T_{pc}					
15	distribution coefficient of in primary contamination	0			$K_d^{14_C}$					
16	density of primary contamination	1.5	g/cc		ρ_b^{pc}					
17	leach rate		1/year C	0.779012	μ		$I/[T_{pc}(\theta_{mc}$	pc v14	(C) in I	alm

Figure 11.3 Screen Shots of Estimation of the Leach Rate of ¹⁴C under the RESRAD-ONSITE Exponential Release Option

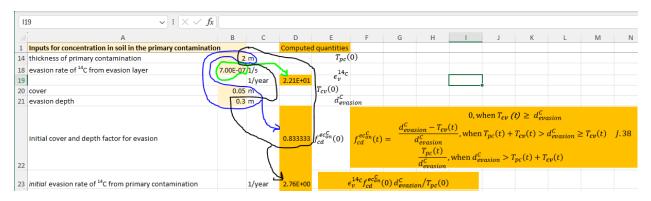


Figure 11.4 Screen Shot of Calculation of the Initial Evasion Rate of ¹⁴C from the Primary Contamination

Figure 11.5 illustrates the calculation of the initial rate of loss of ¹⁴C from the primary contamination. The calculation of the rate at which the cover above the primary contamination erodes is shown in Figure 11.6. This erosion rate is used to compute the time-dependent thickness of the cover and the time dependence of the fraction of the evasion depth that is contaminated. The computation of the concentration of ¹⁴C remaining in the primary contamination at a specific time, 3/16 year, is shown in Figure 11.7; this figure also shows the verification of the concentration of ¹⁴C remaining in the verification of the temporal concentration of ¹⁴C remaining in the primary contamination.

D	24 \mathbf{v} : $\mathbf{x} \neq \mathbf{f} \mathbf{x}$	=D3+D	17+D23						
	А	в	С	D	Е	F	G	н	1
1	Inputs for concentration in soil in the primary contamination			Computed	quantities				
3	transformation rate		1/year 🖌	0.000122	λ			14	
17	leach rate		1/year	0.779012	$\mu = \mu$	$I/[T_{pc}(\theta)]$	$\theta_{mc} + \rho_b^{pc}$	K_d^{14c}]	in help
23	initial evasion rate of ¹⁴ C from primary contamination	Ĺ	1/year	2.76E+00		$f_v^{14C} f_{cd}^{ec_{on}^C}$			
24	initial loss rate from primary contamination		1/year	3.540423	λ + μ	$u + \epsilon_v^{14c} f_c$	$d_{ed}^{ec_{on}^{C}}(0) d_{e}^{O}$	vasion/Tp	_c (0)

Figure 11.5 Screen Shot of Calculation of the Initial Rate of Removal of ¹⁴C from the Primary Contamination Due to Evasion, Radiological Transformations, and Leaching under the RESRAD-ONSITE Exponential Release Option

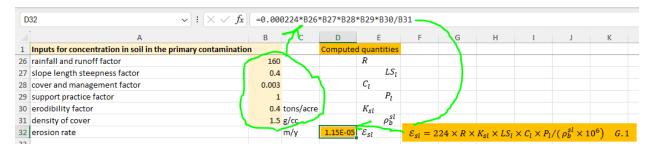


Figure 11.6 Screen Shot of Calculation of the Erosion Rate of the Cover above the Primary Contamination

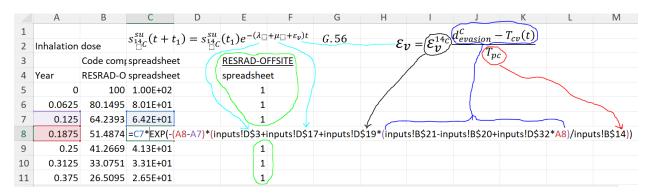


Figure 11.7 Screen Shot of Calculation of the Concentration of ¹⁴C Remaining in the Primary Contamination at a Specific Time

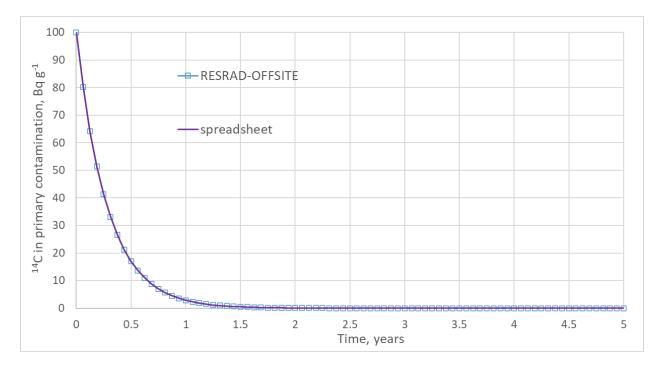


Figure 11.8 Verification of the Temporal Variation of the Concentration of ¹⁴C Remaining in the Primary Contamination

11.2 CONCENTRATION IN PLANT

The movement of ¹⁴C from the soil to plant by root uptake and from air by photosynthesis are modeled as being the same as the movement of stable carbon. The computation of the soil-to-plant root uptake transfer factor for ¹⁴C, based on the fraction of root uptake-derived carbon in the plant, is shown in Figure 11.9.

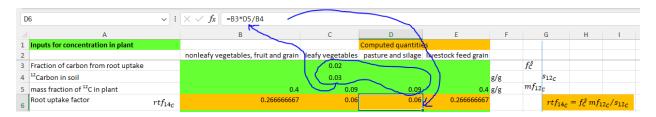


Figure 11.9 Screen Shot of Calculation of Root Transfer Factor of ¹⁴C for Each Plant Type

The ¹⁴C in plants from the foliar uptake of ¹⁴CO₂ followed by photosynthesis is modeled using air-to-plant concentration ratios when the agricultural fields are not collocated with the primary contamination. The calculation of the air-to-plant concentration ratio is shown in Figure 11.10. The ¹⁴C in plants from the foliar uptake of ¹⁴CO₂ and photosynthesis is modeled using the soil-to-air-to-plant concentration ratios for contamination in the agricultural fields. The calculation of the soil-to-air-to-plant concentration ratio is shown in Figure 11.11. The calculation of the cover and depth factor for photosynthesis from secondary contamination at the offsite location is shown in Figure 11.12.

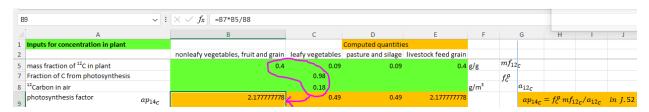


Figure 11.10 Screen Shot of Calculation of Air-to-Plant Concentration Ratios which Are Used to Model Photosynthesis following Atmospheric Transport

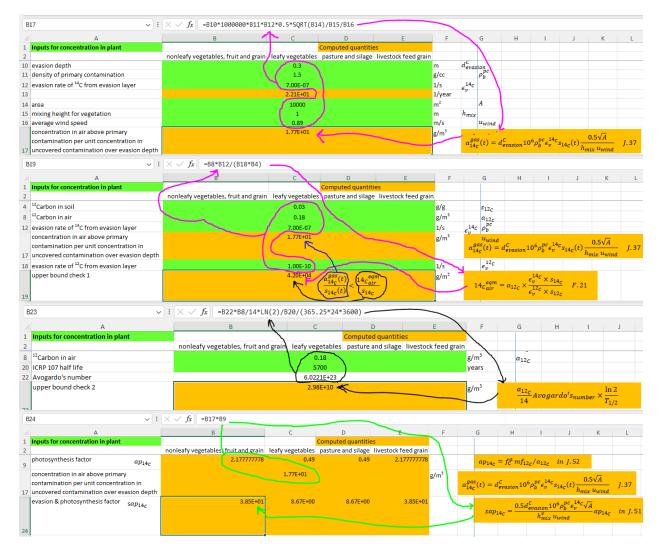


Figure 11.11 Screen Shots of Calculation of Soil-to-Air-to-Plant Concentration Ratios which Are Used to Model Photosynthesis from Contaminated Soil in the Farmed Areas

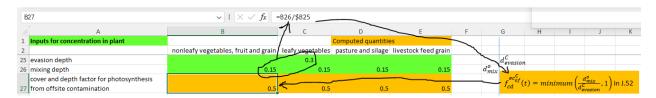


Figure 11.12 Screen Shot of Calculation of Cover and Depth Factor for Photosynthesis Resulting from Secondary Contamination in the Offsite Location

The ¹⁴C in plants from the foliar deposition of particles containing it is modeled in the same manner as for the other radionuclides. The computation of the air-to-plant concentration ratios that are used in this model are in shown in Figure 11.13.

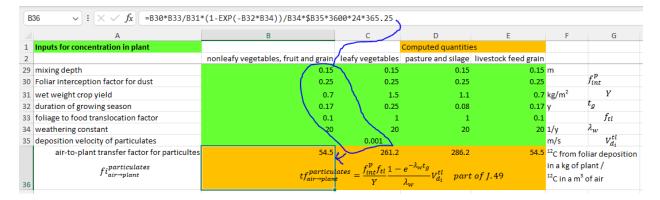


Figure 11.13 Screen Shot of Calculation of Air-to-Plant Concentration Ratios which Are Used to Model Foliar Deposition of particulates

The calculation of the concentration of ¹⁴C in plants (fruit, grain, and leafy vegetables) at a specific time, 0.25 years, and the verification of the code calculated value at that time are shown in Figure 11.14. The concentration to release ratios, $\left(\frac{\chi}{Q}\right)_{offsite}^{gas}$, for transport of a gas from the primary contamination to the offsite locations and the concentrations of ¹⁴C in the soil and in air used in these calculations were obtained for RESRAD-OFFSITE output. The chi over Q ratios were verified in Section 4.1. The calculation of the concentration in offsite soils was verified in Section 5.2. The component calculations for the concentration of particulates in air were verified in Sections 2.4 and 4.1. The verification of the temporal concentration of ¹⁴C in plants (pasture and silage) is shown in Figure 11.15. The figure on the left shows the verification when the concentration is orders of magnitude lower.

				,	~ i 🗙	$\checkmark f_x$	-0 +10	00*Q\$15*Q	33 +Q\$18*U33 +	+1000*(Q\$16*Y33	3+Q\$17*Q\$1	4*Q33)												
Α	В	С	D	E	F	G	/ н	1	Л К	- L	М	Ν	O P	Q	R	s	т	U	v	w	х	Y	Z	AA	AB
				7	$p_c(t) =$	$p_{on_s}^{ru}(t) +$	$p_{aa_e}^{ru}(t)$	$+ p_{af}^{fp}(t) +$	$-p_{on}^{ps}(t) + p_{of}^{ps}(t)$	1.50				_											
			Plot Area			(1	1					(7)9		~	(d ^e									
									$p_{of}^{ps}(t)$	$= 10^3 f_{cd}^*$	$c_{ev}(t)d_{ev}^{C}$	asion A10 ⁶ p	$e_b^{pc} \epsilon_v \left(\frac{\chi}{Q}\right)_{a_i}^g a p_{14}$	$s_{14c}(t) +$	10 ³ minin	$um\left(\frac{d}{d}\right)$	(ax , 1) :	sap _{14c} s ₁₄₀	(t) J.5	2					
									$p_{on}^{ps}(t) = 10^3 f_a$																
									cP c2		*1									-1					
								$p_{of_i}^{fp}(t)$	$= \frac{f_{int}^p f_{tt}}{Y} \frac{1 - e^{-\lambda_t}}{\lambda_w}$	$-V_{d_i}^{tl}\left(\frac{\chi}{Q}\right)$	$\int_{a_l}^{a_l} AR_l^{tl}(t)$) J.49	Using all pa	ticulates o	oncentra	tion at o	ffsite loo	ation ins	tead of	$\left(\frac{\chi}{Q}\right)_{o_i}^{ti} AR_i^t$	tl(t) in sp	read shee	et calcuati	ons	
							$p_{aa}^{ru}(t)$	$= 10^3 rtf_{13}$	$J_{14c}^{o}(t) J.47$																
						$p_{on_i}^{ru}(t)$	$= 10^{3} f_{a}$	$f_{cd}^{root}(t)rtf$	$f_{i}s_{i}(t) J.45$	$f_a = 0$	when e	ntirely of	fsite												
													f ecol	t) 0.	5 0.5	5 0.5	0.5								
													rtf14				0.266667								
													ap14		0.4	0.49	2.177778								
													sap ₁₄		8.67134	8.671348	38.53933								
													fi ^{particula}	54.4721	54.47218	54.47218	54.47218								
														soil	to plant &	soil to air te	plant	foliar	intercept	ion of part	iclates		airte	plant	
1						Spread	isheet			RESRAD	OFFSITE											econ (+)	d ^C evasion ^A	106 pc	$\left(\frac{\chi}{2}\right)^{g}$
																$L_{4c}^{o}(t)$			18'01	$AR_{i}^{tl}(t)$		Jed (0)	evasion	10 05 61	(Q)
	Concentrat	tion in				concentr				concent	tration in				concentrat	tion in soil			entration in	n air in part			tration in a	ir in carbo	
	fruit grain			fru		la afo	pasture and	livestock feed	fruit			livestock		fruit grain		pasture	livestock			pasture	livestock			pasture	livestoc feed
	nonleafy		RESRAD-OFFSI	gra TE DOR		leafy vegetable		grain	grain nonleafy	leafy	pasture silage	feed grain		nonleafy	leafy	silage	feed grain	grain nonleafy	leafy	silage	feed grain	grain nonleafy	leafy		grain
	Bq/Kg		spreadsheet	10	in curry	- CBC10011	Shoge	Brann	nonicut	icory	Suge	Brann	6		icary	Stroge	8.0111	nonicary	reary	Shoge	Brann	nomeary	reary	Shoge	Bronn
ear		spreadshee							nlv	lv	ps	Ifg	f _{cd} ^{econ}	t) _{snlv}	slv	sps	slfg	anly	alv	aps	alfg	$a_{nly}^{g}(t)$	$a_{ly}^{g}(t)$	$a_{ps}^{g}(t)$	$a_{lfg}^{g}(t$
0	1088160	1087881.67	1.000256	10	87881.7	208501.2	73084.73	565264	108816	208495.3	73079.29	565287.8	0.833	33) () () (0.000119	0.000101	3.42E-05	5 6.08E-0	5.00E+02	2 4.26E+02	1.49E+02	2.60E+0
0.0625		871933.88			1933.88		58577.19			167108.3			0.833		7 5.6E-0			9.56E-05			5 4.88E-0				
0.125		698852.025				133940.5		363124		133936.8			0.833					7.66E-05							
0.1875		560127.231						2.91E+05				291054.7		41 8.55E-0											
0.25		448939.614 359823.03						2.33E+05 186964.3	449054.		24171.39	233279.1 186972.1		43 7.68E-0 45 6.57E-0				4.92E-05 3.94E-05							
0.3125		288396.356					19374.69			55271.89			0.833		7 4.62E-0			3.94E-05 3.16E-05							
								120104.7		44300.11			0.83	25 4 495-0	7 2 795-0			2.53E-05							
0.4375	231207.2																								

Figure 11.14 Screen Shot of Calculation and Verification of Concentration of ¹⁴C in Plants

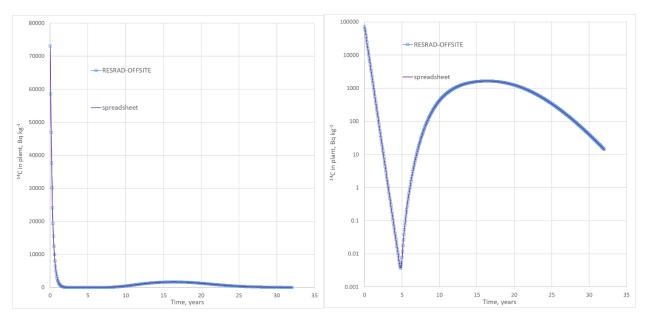


Figure 11.15 Verification of Temporal Variation of ¹⁴C Concentration in Plants

11.3 CONCENTRATION IN MEAT AND MILK

The transfer of ¹⁴C ingested by the livestock to milk and meat is modeled as being the same as the transfer of stable ¹²C that is ingested by the livestock to meat and milk. The calculations of the intake to concentration in meat factor and the intake to concentration in milk factor for ¹⁴C are shown in Figure 11.16. The use of these factors to compute the concentrations of ¹⁴C in meat and milk from livestock water, pasture and silage, feed grain, and the soil associated with the livestock feeds is illustrated in Figure 11.17. The verification of the temporal concentrations of ¹⁴C in milk and meat are shown in Figure 11.18 and Figure 11.19, respectively.

The plots on the left of both figures show the verification when the concentration is high, while the plots on the right of both figures show the verification during early times when the concentration is orders of magnitude lower and is mainly due to foliar deposition.

C21				~ :	$\times \checkmark f_x$	=C16/	(C4*B11+0	C5*B12+C6	5*B13+(C	7+C8)*B14	L)			
А	В	С	D	Е	F	G	н	1	J	к	L	м	N	0
1 Inputs for concentration in	meat and milk		Compute	ed quantitie	2									
2														
3	beef cattle da	· · ·												
4 water	50	160		I ^{livstock} Iwater										
5 pasture and silage	14	44	kg/d	Normal and	$I_{ps}^{livstock}$									
5 livestock feed grain	54	11	kg/d	$I_{lfg}^{livstock}$										
7 soil in pasture and silage	0.1	0.4	kg/d		I ^{livstock} ps soil									
soil in livestock feed grain	0.4	0.1	kg/d	I ^{livstock} I _{lfg} soil	•									
Э		\neg												
0	¹² C concent	ration												
1 in water	2.00E-0			¹² C _{water}										
2 in pasture and silage	0.09	11		int macor	$^{12}C_{ps}$									
3 in feed grain	0.4			$^{12}C_{lfg}$										
4 in soil	0.03	\mathcal{J}		:: •) g	¹² C _{soil}									
5 meat	0.24			¹² C _{meat}	Last Dott									
6 milk		0.07			$^{12}C_{milk}$									
7		\sim												
8 intake to meat factor	1.05E-02			¹⁴ C					12	C_{meat}				
9		imf	meat =	14 gintak	$\frac{l}{l} = \frac{l}{l}$	+10 12 -		attle 12				attla -	cattle)	12 - 575
0				¹⁴ C _{mea} ¹⁴ C ^{intak}	I_{wat}^{cut}	$ter = C_w$	$a_{ter} + I_p^{a}$		$P_{ps} + I_{lf}^{co}$	$g^{\mu\nu} = C$	$I_{fg} + (I_p^{a})$	$\frac{1}{s} \frac{1}{soil} + I$	lfg soil)	¹² C soil
1 intake to milk factor	5	8.36E-03												
2			imf	=	milk					${}^{12}_{\square}C^{\square}_{milk}$				
3			unt) mi	$_{lk} = \frac{\frac{14}{14}}{\frac{14}{14}C}$	intake milk	Icow 1	² C _{water}	$+ I_{ns}^{cow 1}$	${}^{2}C_{ns} +$	$I_{lfg}^{cow} \stackrel{12}{=} C$	$\frac{1}{16a} + (I)$	cow	(cow	12C
4					mun	water i	water	<i>p</i> 5	P3	ijg i!	ijg (-]	5501	<i>ijg soli)</i>	ELLE SOL
5								¹² C						
6			IMTF =	164	stock 1	-	-	Canimal	product			livestock	12 -	F.29
7				Intake ^{tta}	iter X	C _{water} +	$\sum_{feed} Int$	ake _{feed}	$\sim \times \frac{1}{C_f}$	$eed + \Sigma_{ag}$	_{ri} Intake	soil X	C _{soil}	

Figure 11.16 Screen Shot of Intake to Concentration in Meat and Intake to Concentration in Milk Factors for ¹⁴C

							~	$: \times \checkmark f_x$	=T\$10*(\$4 *L13+	T\$5*M13+T	\$6*N1	L3+(T\$7*(013+T\$8*	P13)*100	9)					
	А	в	С		D	Е	F	G H	1	J	К	L	м	N	0	Р	Q	R	s	т	U
							$m_i(t)$	$= imf_i \left[q_{ing}^p \right]$	$p_i^f(t) + q_{in}^s$	$_{g}\left\{ s_{i}^{o}(t) ight\}$	+ f _a f _{vm} (t)	$\frac{\rho_b^{pc}}{\rho_b^{mix}}$	$s_i(t)$ 10	$3 + q_{ing}^w w$	$t_i^{ls}(t) 10^{-2}$	J. 53					
											$f_a = 0$ w	vhen	entirely (offsite							
ŀ	2						sprea	dsheet	RESRAC	-OFFSITE	w	ater	fe	ed	s	oil			beef cattl	dairy cow	
		Concentra	tion in												with	with		water	50	160	q_{in}^{w}
													pasture	livestock	pasture	livestock		pasture and silage	14	44	q_{in}^p
													and	feed	and	feed		livestock feed grain	54	11	-110
		milk		RES	RAD-OFFS	SITE)	meat	milk	meat	milk	wat	er	silage	grain	silage	grain		soil in pasture and silage	0.1	0.4	q_{in}^s
		Bq/L		spre	eadsheet		Bq/kg	Bq/L	Bq/kg	Bq/L	Bq/		Bq/kg	Bq/kg	Bq/kg	Bq/kg		soil in livestock feed grain	0.4	0.1	-11/
Ye	ear	RESRAD-C	spreadshee	t 🔪							w_i^l	s(t)1	$0^{-3} p_i^{f}$	(t)	s _i ^o	(t)		intake to meat factor	1.05E-02		im
	0	78818.34	78818.3404		1		3.31E+05	7.88E+04	3.31E+05	7.88E+04	4 0.0	0E+00	73079.29	565287.8	0.00E+00	0.00E+00		intake to milk factor		8.36E-03	
	0.0625	63172.66	63172.6558		1		2.65E+05	6.32E+04	2.65E+05	6.32E+04	4 0.0	0E+00	58572.83	453076.4	1.90E-07	3.38E-07					
	0.125	50632.68	50632.6807		1		2.13E+05	5.06E+04	2.13E+05	5.06E+04	4 0.0	0E+00	46945.93	363139.3	2.48E-07	4.39E-07					
	0.1875	40581.89	40581.8932		1		1.70E+05	1000)	1.70E+05	4.06E+04	4 0.0	0E+00	37626.98	291054.7	2.46E-07	4.36E-07					
	0.25	32526.22	32526.2164		1		1.37E+05	3.25E+04	1.37E+05	3.25E+04	4 0.0	0E+00	30157.87	233279.1	2.21E-07	3.92E-07					
	0.3125	26069.61	26069.609		1		1.09E+05	2.61E+04	1.09E+05	2.61E+04	4 0.0	0E+00	24171.39	186972.1	1.89E-07	3.35E-07					
	0.375	20894.66	20894.6616		1		8.77E+04	2.09E+04	8.77E+04	2.09E+04	4 0.0	0E+00	19373.25	149857.2	1.57E-07	2.79E-07					

Figure 11.17 Screen Shot of Calculation and Verification of ¹⁴C in Meat and Milk

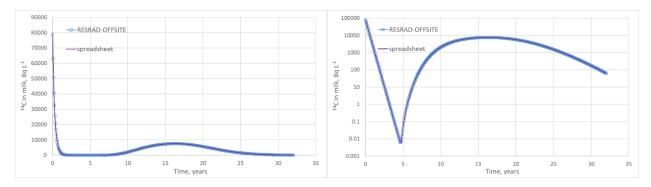


Figure 11.18 Verification of Temporal Concentration of ¹⁴C in Milk

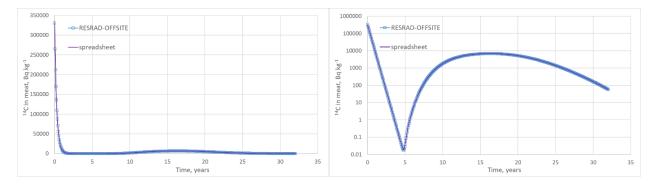


Figure 11.19 Verification of Temporal Concentration of ¹⁴C in Meat

11.4 INHALATION

The ¹⁴C inhalation dose in RESRAD-OFFSITE 4.0 is modeled as being from the inhalation of both ¹⁴C in respirable particles and ¹⁴CO₂. The calculation of the inhalation dose from the ¹⁴C in respirable particles is shown in Figure 11.20. The calculation of the concentration of ¹⁴C in the air above the primary contamination per unit concentration and the calculation of the rate of release of ¹⁴C per unit concentration of ¹⁴C in the primary contamination are shown in Figure 11.21. The calculation of the time-integrated concentration of ¹⁴C in the air above the primary contamination over a period of a year beginning at 0.25 years is shown in Figure 11.22. The calculation of the time-integrated concentration of ¹⁴C in the air above the offsite dwelling location over a period of a year beginning at 0.25 years is shown in Figure 11.23. The calculation of the inhalation dose from inhaling ¹⁴CO₂ is shown in Figure 11.24. The computation of the ¹⁴C inhalation dose from both the respirable particles and carbon dioxide is shown in Figure 11.25. The temporal variation of the ¹⁴C inhalation dose is verified in Figure 11.26.

		~ : X	$\checkmark f_x$	=C\$9*(F\$	\$9*G12+J\$	9*K12+L\$	8*M12+N\$8	8*012+P\$	58*Q12+R\$	8*S12)									
	А	В	с	D	E	F	G	н	1	J	к	L	М	N	0	Р	Q	R	S
1 2 3	(D ^{rp} inh	$(t) = FI_{in}$	$h\left[\left(f_{oc}^{opc}\right)\right]$	$+ f_{oc}^{ipc} F_{du}$	$\left(\int_{t}^{t+1} a_{p}^{r} \right)$	$c^{p}(t) dt + ($	$f_{oc}^{ood} + j$	$\int_{0c}^{iod} F_{du} \Big) \int$	$a_{od}^{t+1}(t)$	$dt + \sum_{i=1}^{4}$	$f_{oc}^{agi}\int_{t}^{t+1}$	$a_{agi}^{rp}(t)$	$dt DC_{ini}^{rp}$	recast	ing C.6			
4 5 6			DC ^{rp} inh	6,15E-06		,	$a_{pc}^{rp}(t) dt$			J	$a_{od}^{rp}(t) d$	\int_t	$a_{nlv}^{rp}(t)a$	it ∫	$a_{lv}^{rp}(t) a$	it J	$a_{ps}^{rp}(t) dt$	\int_{t}^{t}	$a_{lfg}^{rp}(t) dt$ 2.2E-05
7	Year		FI _{inh}	f _{oc} opc	f_{oc}^{ipc}	F _{du}		foc	foc	F _{du}		f ^{niv}		f ^{lv} _{oc}		f _{oc} ^{ps}		f_{oc}^{lfg}	
8	0	7.61E-06	8400	0.1	0.1	r 0.4	8.47E-04	0.1	0.3	0.4	7.82E-05	0.1	4.32E-05	0.1	3.65E-05	0.1	1.24E-05	0.1	2.2E-05
9		5.89E-06				0.14	6.56E-04	`		0.22	6.06E-05		3.35E-05		2.83E-05		9.6E-06		1.71E-05
10	0.125	4.56E-06	1.5 FI _{inh}	DC_{int}^{rp} ($(f^{opc} + f^{i})$	ipc F.)	5.08E-04	()	$\frac{cood}{ac} + f_{ac}^{ia}$	d_{Fdy}	4.69E-05		2.59E-05		2.19E-05		7.43E-06		1.32E-05
11	0.1875	3.53E-06		tun (Joc Jo	c •au)	3.93E-04	V	00 · 700	- uu)	3.63E-05		2.01E-05		1.7E-05		5.76E-06		1.02E-05
12	0.25	S12)					3.04E-04				2.81E-05		1.55E-05		1.31E-05		4.46E-06	Ī	7.92E-06
13	0.3125	2.12E-06					2.36E-04				2.18E-05		1.2E-05		1.02E-05		3.45E-06		6.13E-06
14	0.375	1.64E-06					1.83E-04				1.69E-05		9.31E-06		7.87E-06		2.67E-06		4.75E-06
15	0.4375	1.27E-06					1.41E-04				1.31E-05		7.21E-06		6.1E-06		2.07E-06		3.68E-06
16	0.5	9.83E-07					1.09E-04				1.01E-05		5.58E-06		4.72E-06		1.6E-06		2.85E-06

Figure 11.20 Screen Shot of Computation of Inhalation Dose from ¹⁴C in Respirable Particulates

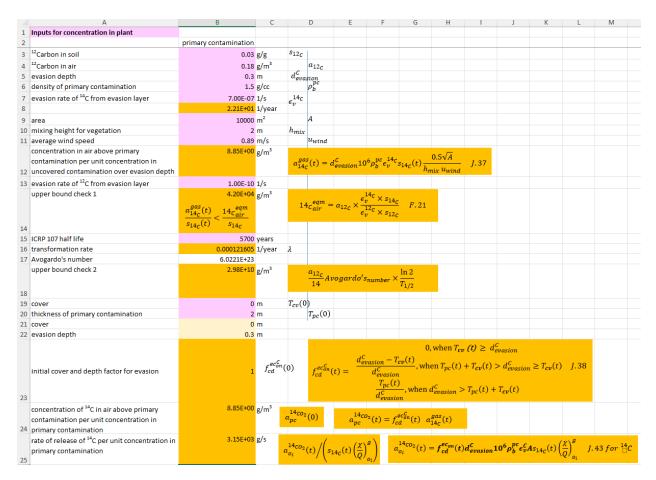


Figure 11.21 Screen Shot of Calculation of the Concentration of ¹⁴C in Air above the Primary Contamination per Unit Concentration in the Primary Contamination and the Rate of Release of ¹⁴C per Unit Concentration in Primary Contamination

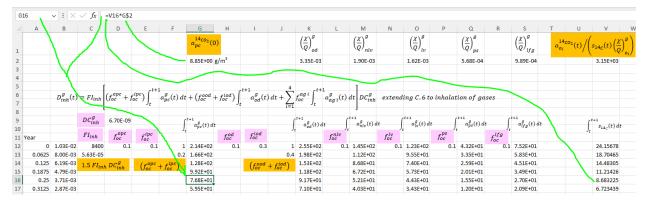


Figure 11.22 Screen Shot of the Calculation of the Annual Time-Integrated Concentration of ¹⁴C in Air above the Primary Contamination at 0.25 Years

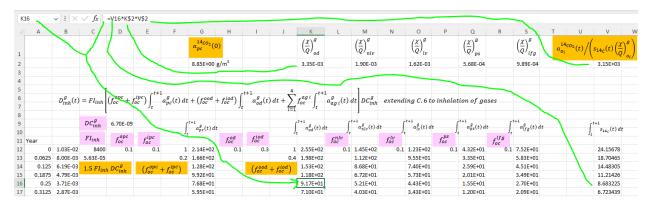


Figure 11.23 Screen Shot of the Calculation of the Annual Time-Integrated Concentration of ¹⁴C in Air above the Offsite Dwelling Site at 0.25 Years

		▼ : ×	$\checkmark f_x$	=C\$9*(F\$	\$9*G12+J	59*K12+L	\$8*M12+N\$	8*012+P\$	8*Q12+R \$	8*512)												
	А	В	<u>_</u>	D	E	F	G	н	1	J	К	L	м	N	O F		Q	R	s	т	U	v
1 2 3	($D_{inh}^{g}(t)$	= FI _{inh}	$(f_{oc}^{opc} +)$	f_{oc}^{ipc}) \int_{t}^{t+}	$a_{pc}^{g}(t) dt$	$+ (f_{oc}^{ood})$	$+ f_{oc}^{iod} \int_{t}$	$a_{od}^g(t)$	$dt + \sum_{l=1}^{4} \frac{1}{l}$	$\int_{1}^{agi} \int_{t}^{t+}$	$a^g_{agi}(t) a$	it DC ^g _{inh}	extending	C.6 to inh	alatior	ı of ga	ses				
4 5 6			DC ^g _{inh}	6.70E-09		J	$a_{pc}^{\theta}(t) d$				$\int_{t}^{t+1} a_{od}^{g}(t) d$		$a_{nlv}^{g}(t) a$		$g_{lv}(t) dt$	\int_{t}^{t+1}	a ^g ps(t) d	.)	$a_{lfg}^{t+1}(t) a$	lt	\int_{t}^{t}	$s_{14_c}(t) dt$
7	Year		FIinh	f _{oc} ^{opc}	f_{oc}^{ipc}			foc	f_{oc}^{iod}			foc		foc	f _{oo}	c _		f_{oc}^{lfg}				
8	0	1.03E-02	8400	0.1	0.1	1	2.14E+02	0.1	0.3		1 2.55E+02	0.1	1.45E+02	0.1 1.2	3E+02	0.1 4.	32E+01	0.1	7.52E+01			24.15678
9	0.0625	8.00E-03	5.63E-05	N	$\mathbf{\nabla}$	0.2	1.66E+02			0.	4 1.98E+02		1.12E+02	9.5	5E+01	3.	35E+01		5.83E+01			18.70465
10	0.125	6.19E-03	1.5 FIini	DC^{g}	(for	⊥ f ^{ipc})	1.28E+02		(food	$+ f_{oc}^{iod}$	1.53E+02		8.68E+01	7.4	0E+01	2.	59E+01		4.51E+01			14.48305
11	0.1875	4.79E-03		inn	Joc	Joc J	9.92E+01		(100	· Joc)	1.18E+02		6.72E+01	5.7	3E+01	2.	01E+01		3.49E+01			11.21426
12	0.25	S12)					7.68E+01				9.17E+01		5.21E+01	4.4	3E+01	1.	55E+01		2.70E+01			8.683225
13	0.3125	2.87E-03					5.95E+01				7.10E+01		4.03E+01	3.4	3E+01	1.	20E+01		2.09E+01			6.723439
14	0.375	2.23E-03					4.61E+01				5.50E+01		3.12E+01	2.6	6E+01	9.	32E+00		1.62E+01			5.205972
15	0.4375	1.72E-03					3.57E+01				4.26E+01		2.42E+01	2.0	6E+01	7.	21E+00		1.26E+01			4.030995
16	0.5	1.33E-03					2.76E+01				3.30E+01		1.87E+01	1.5	9E+01	5.	59E+00		9.72E+00			3.121207

Figure 11.24 Screen Shot of Computation of Inhalation Dose from the Inhalation of ¹⁴CO₂

	А	В	С	D	E	F	G	Н
1	Inhalation	dose						
2					RESRAD-OFFSITE		gas	particulate
3	Year	RESRAD-OFFSITE	spreadsheet		Spreadsheet			
4	0	1.03E-02	=G4+H4		1.00		1.03E-02	7.61E-06
5	0.0625	8.00E-03	8.00E-03		1.00		8.00E-03	5.89E-06
6	0.125	6.20E-03	6.20E-03		1.00		6.19E-03	4.56E-06
7	0.1875	4.80E-03	4.80E-03		1.00		4.79E-03	3.53E-06
8	0.25	3.71E-03	3.71E-03		1.00		3.71E-03	2.73E-06
9	0.3125	2.88E-03	2.88E-03		1.00		2.87E-03	2.12E-06
10	0.375	2.23E-03	2.23E-03		1.00		2.23E-03	1.64E-06
11	0.4375	1.72E-03	1.72E-03		1.00		1.72E-03	1.27E-06
12	0.5	1.34E-03	1.34E-03		1.00		1.33E-03	9.83E-07

Figure 11.25 Screen Shot of the Calculation of the ¹⁴C Inhalation Dose from Respirable Particles and Carbon Dioxide

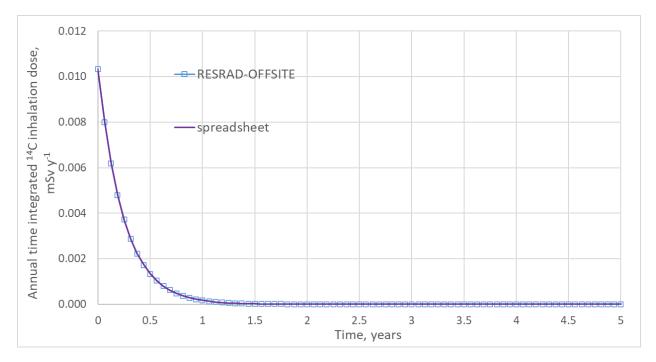


Figure 11.26 Verification of the Temporal Variation of the ¹⁴C Inhalation Dose

APPENDIX 1: COMPONENTS OF RESRAD-OFFSITE VERSION 4.0

1.1 MAIN USER INTERFACE, RESOWIN.EXE

Purpose of ResOwin.exe: This is the main interface of RESRAD-OFFSITE which pops up when the code is launched. It is used to perform the following:

- 1. To activate the exposure pathways, to input the site-specific values, to make choices to define the scenario being analyzed, and to write this information to the input files to be used by some of the other executables.
- 2. To specify the radionuclide transformation data and associated inputs to be used for the analysis and to generate the transformation chain data for the computational code.
- 3. To select the dose and slope factor library to be used for the analysis and to write the dose and risk factor library files for the computational code.
- 4. To specify sensitivity analysis on inputs.
- 5. To specify probabilistic/uncertainty analysis and to specify relationships between input variables.
- 6. To facilitate the computation of area factors using the probabilistic analysis feature with relationships.
- 7. To launch the appropriate FORTRAN executables to perform deterministic, sensitivity, and probabilistic/uncertainty analyses.
- 8. To view the text output.
- 9. To launch the deterministic graphics viewer.
- 10. To view the probabilistic/uncertainty graphics.
- 11. To view help information about any input or option in the interface.
- 12. To view pdf files of the User's Manual, the user's guide to the code.
- 13. To launch the dose conversion factor editor.

Data Files Read by ResOwin.exe:

- 1. RESRADOF.INI is an ASCII file that contains the user preferences for the appearance of the interface and the names of the directories that contain the dose conversion factor files, the meteorological files, and the input files. The interface will create this file if it is missing. It will also rewrite this file every time the code is exited to reflect current user preferences.
- 2. VARIABOF.inf is an ASCII file that contains for each variable, the active pathway codes, the bounds, the default value, the FORTRAN name, the descriptive name and units, the name of the primary form the variable resides in, and the RESRAD default distribution.
- 3. NewICRP38.idx is an ASCII file that contains the radionuclide transformation data in International Commission on Radiological Protection Pub. 38 (ICRP-38) (ICRP 1983) and the RESRAD default distribution coefficients for each radionuclide.
- 4. ICRP-07.NDX is an ASCII file that contains the radionuclide transformation data in International Commission on Radiological Protection Pub. 1047 (ICRP-107) (ICRP 2008).

- 5. ICRP-07_Kd.NDX is an ASCII file that contains the RESRAD default distribution coefficients for the radionuclides in ICRP-107.
- 6. NucDist.inf is an ASCII file that contains the RESRAD default probabilistic distributions for radionuclide-dependent properties.
- 7. The DCF database files Master_dcf_2k.mdb and Master_dcf_ICRP07.mdb contain the dose conversion factors, slope factors, and transfer factors for the ICRP-38 and ICRP-107 radionuclides, respectively.
- 8. Current.lib is an ASCII file created by the interface, and it contains the dose and risk factors from the currently selected library. It is rewritten every time the dose or slope factor library is changed in the Title form.
- 9. Default.lib is an ASCII file created by the interface that contains the dose and risk factors from the current default library. It is rewritten every time a dose or slope factor library change in the Title form necessitates a new default library.
- 10. MyFonts.dat is an ASCII file containing information about the fonts and the printer driver installed on the computer. It is generated by the code if it is missing. It should be regenerated if the fonts installed on the computer are changed.
- 11. Message.fil is a single-line text file indicating the computation being performed in the FORTRAN executables.
- 12. *Input file name*.NID.CSV is a comma-separated values file containing all the radionuclideindependent inputs in the input file currently in the interface.
- 13. *Input file name*.NDP.CSV is a comma-separated values file containing all the radionuclidedependent inputs in the input file currently in the interface.

Pdf Files Available from ResOwin.exe:

- 1. UsersGuide.pdf, Volume 2 of the User's Manual for RESRAD-OFFSITE code Version 4 is accessible via the Help menu.
- 2. UsersManual.pdf, Volume 1 of the User's Manual for RESRAD-OFFSITE code Version 4 is accessible via the Help menu.
- 3. MapGuideRO.pdf describes how to use the map interface and is accessible via a button on the map interface.
- 4. GWFlowlineRO.pdf describes how to input a curved flow path in the map interface and is accessible via a button on the trace groundwater path view of the map interface.
- 5. AreaFactors.pdf describes the procedure for computing area factors.

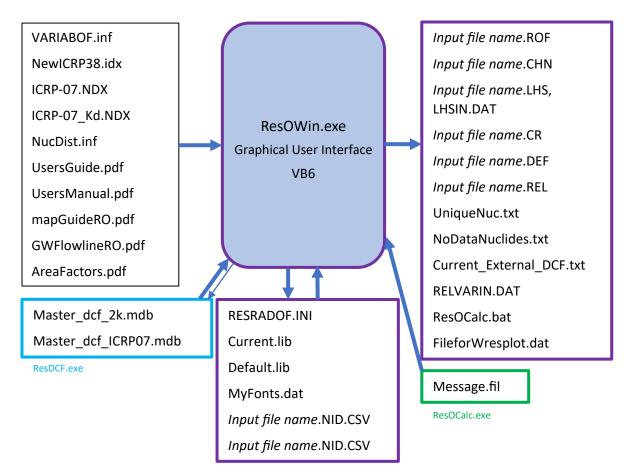
Data Files Written by ResOwin.exe:

- 1. RESRADOF.INI is an ASCII file that contains the user preferences for the appearance of the interface and the names of the directories that contain the dose conversion factor files, the meteorological files, and the input files. The interface will create this file if it is missing. It will also rewrite this file every time the code is exited to reflect the current user preferences.
- 2. *Input file name*.ROF is an ASCII file containing the values for all the input variables used in RESRAD-OFFSITE to define the scenario.

- 3. *Input file name*.CHN is an ASCII file containing the transformation chain data for the radionuclides in the scenario being analyzed.
- 4. *Input file name*.LHS is an ASCII file containing the probabilistic/uncertainty distributions for the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed.
- 5. *Input file name*.CR is an ASCII file specifying the probabilistic/uncertainty outputs that are to be subjected to linear regression analysis with the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed.
- 6. *Input file name*.DEF is an ASCII file containing the default values for all the variables used in RESRAD-OFFSITE to define the scenario. This file is deleted when the computational code completes its calculations.
- 7. *Input file name*.REL is an ASCII file containing any relationships between variables, with variables selected for probabilistic/uncertainty analysis being among the "independent" variables.
- 8. *Input file name*.NID.CSV is a comma-separated values file containing externally formatted values for all the radionuclide-independent inputs in the input file currently in the interface.
- 9. *Input file name*.NDP.CSV is a comma-separated values file containing externally formatted values for all the radionuclide-dependent inputs in the input file currently in the interface.
- 10. Current.lib is an ASCII file that contains the dose and risk factors from the currently selected library. It is rewritten every time the dose or slope factor library is changed in the Title form.
- 11. Default.lib is an ASCII file that contains the dose and risk factors from the current default library. It is rewritten every time a dose or slope factor library change in the Title form necessitates a new default library.
- 12. UniqueNuc.txt is a text file containing the number and names of all the radionuclides in the transformation chain of the radionuclides in the current input file.
- 13. NoDataNuclides.txt is a text file containing a list of radionuclides missing one or more dose or slope factor.
- 14. Current_External_DCF.txt is a text file containing the default external exposures dose factors, the scenario-specific external exposure dose and slope factors, and the fitting factors for all the radionuclides in the current input file.
- 15. MyFonts.dat is an ASCII file containing information about the fonts and the printer driver installed on the computer. It is generated by the code if it is missing. It should be regenerated if the fonts installed on the computer are changed.
- 16. RELVARIN.DAT is an ASCII file containing the description of the dependent related variables, the relationship between the variables, and the sample values of the dependent related variables.
- 17. FileforWresplot.dat contains the names of the graphics file and the input file.

Batch File Written by ResOwin.exe:

1. ResOCalc.bat is the set of instructions for executing the FORTRAN executables necessary to perform the calculations for the current input file.



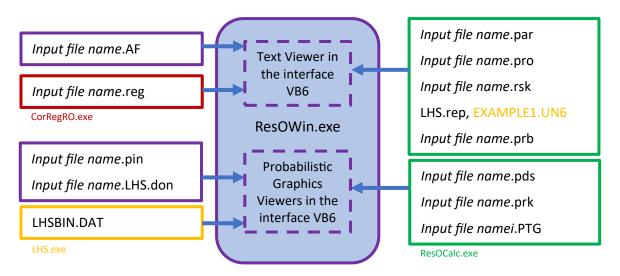
Data Transfer Diagram for ResOWin.exe

Text Reports Read and Displayed in the Text Viewer within ResOWin:

- 1. SUMMARY.REP or *Input file name*.par contains the table of contents and the text of the main report consisting of the input echo, dose attributed to the initially present radionuclides, soil guideline, and run time information.
- 2. INTRISK.REP or *Input file name*.rsk contains the table of contents and the text of the intake and risk report.
- 3. DAUDOSE.REP or *Input file name*.pro contains the table of contents and the text of the dose attributed to the radionuclides at the location and time of exposure report.
- 4. MCSUMMAR.REP or *Input file name*.prb contains the table of contents and the probabilistic text report.
- 5. LHS.REP or *Input file name*.smp contains the probabilistic sampling report of LHS.exe, EXAMPLE1.UN6, with a table of content added to it.
- 6. Regression.REP or *Input file name*.reg contains the regression coefficient of the dependent variables sorted in the order of importance.
- 7. AreaFactorText.REP or *Input file name*.AF contains tables of the area factors for each radionuclide in file executed under generate area factors option.

Data Files Read and Displayed in the Probabilistic Graphics Viewers within ResOWin:

- 1. *Input file name*.LHS.don, identical to *Input file name*.LHS, is an ASCII file containing the probabilistic/uncertainty distributions for the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed. This file is created after the input variables have been sampled to indicate that the sampling has been performed.
- 2. *Input file name*.pin, identical to LHSBIN.DAT, is an ASCII file containing the sample values for each variable selected for probabilistic/uncertainty analysis. This file is created after the input variables have been sampled to indicate that the sampling has been performed.
- 3. *Input file name*.rel is an ASCII file containing any relationships between variables, with variables selected for probabilistic/uncertainty analysis being among the "independent" variables and the sample values for any related variables.
- 4. *Input file name*.pds, identical to UNCPEAK.ASC, is an ASCII file containing the peak doses and the times of the peak doses (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
- 5. *Input file name*.prk, identical to UNCPEAKR.ASC, is an ASCII file containing the peak risks (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
- 6. *Input file namei*.PTG, where *i* is any number from 1 to the number of repetitions, is an ASCII file containing the probabilistic temporal graphics data.



Data Transfer Diagram for the Text and Probabilistic Graphics Viewers in ResOWin.exe

1.2 MAIN COMPUTATIONAL CODE, RESOCALC.EXE

Purpose of ResOCalc.exe: This is the main computational executable of RESRAD-OFFSITE which computes the dose, risk, and concentration for deterministic, sensitivity, and probabilistic/uncertainty runs.

Description of ResOCalc.exe: This computational executable reads the data files; performs a sequence of computations to calculate the concentration in environmental media, radiological dose, and excess cancer risk to a single receptor; and outputs the results to a number of text and binary files. The executable repeats the sequence of calculations for sensitivity and probabilistic/uncertainty simulations after changing the values of the variables selected for sensitivity or probabilistic/uncertainty analysis.

This computational code does the following in sequence:

- 1. Reads the dimensions for dynamically allocatable variables from the DB Name list part of the input file; use these to allocate the variables just before the call to the subroutine that uses the variables.
- 2. Reads from Current_External_DCF.txt the external exposure dose (default and current) and slope (current) factors and fitting factors for all the radionuclides in the current input file.
- 3. Reads the default values and the scenario-specific values of the inputs from the default (*.DEF) and the input (*.ROF) files.
- 4. Reads from the chain file (*.CHN) the radionuclide transformation data.
- 5. Performs the calculations that need to be done only once for an input file; these are the calculations that do not need to be repeated for different calculation times nor for sensitivity nor probabilistic runs.
- 6. For probabilistic runs, reads the probabilistic distributions and the probabilistic sample values for each variable selected for probabilistic/uncertainty analysis. Also reads in sample values for any related variables.
- 7. For sensitivity runs, sets the current sensitivity analysis input to the appropriate value. Resets previous sensitivity analysis input to base value.
- 8. Performs the calculations that need to be done once for a deterministic run and once for each sensitivity or probabilistic/uncertainty simulation.
- 9. Computes or reads the activity in and the releases from the primary contamination for each computation time.
- 10. Performs atmospheric transport calculations for each computation time.
- 11. Performs groundwater transport calculations to compute the concentration in well water and input rate to a surface water body at each computation time; or reads the concentration in well water.
- 12. Computes or reads the concentration in the surface water at each computation time.
- 13. Computes the concentrations in the agricultural areas, in plant, meat, and milk at each computation time.
- 14. Computes dose and risk from each of the nine exposure pathways and finds the peak dose.
- 15. Writes text reports.
- 16. For runs that include both sensitivity analysis and probabilistic/uncertainty analysis, sets the last sensitivity analysis input to its base value.
- 17. Determines the statistics for the probabilistic dose and risk.

Data Files Read by ResOCalc.exe:

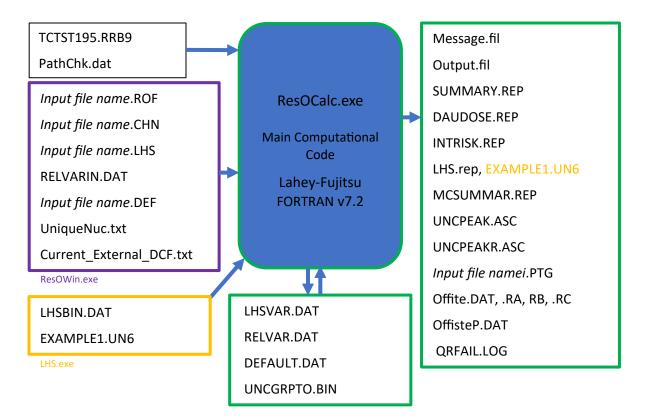
- 1. *Input file name*.ROF is an ASCII file containing the values for all the input variables used in RESRAD-OFFSITE to define the scenario.
- 2. *Input file name*.CHN is an ASCII file containing the transformation chain data for the radionuclides in the scenario being analyzed.
- 3. *Input file name*.LHS is an ASCII file containing the probabilistic/uncertainty distributions for the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed.
- 4. LHSBIN.DAT is an ASCII file containing the sample values for each variable selected for probabilistic/uncertainty analysis.
- 5. RELVARIN.DAT (*Input file name*.REL) is an ASCII file containing any relationships between variables, with variables selected for probabilistic/uncertainty analysis being among the "independent" variables and the sample values for any related variables.
- 6. *Input file name*.DEF is an ASCII file containing the default values for all the variables used in RESRAD-OFFSITE to define the scenario. This file is deleted when the computational code completes its calculations.
- 7. UniqueNuc.txt is a text file containing the number and names of all the radionuclides in the transformation chain of the radionuclides in the current input file.
- 8. Current_External_DCF.txt is a text file containing the default external exposures dose factors, the scenario-specific external exposure dose and slope factors, and the fitting factors for all the radionuclides in the transformation chain of the radionuclides in the current input file.
- 9. TCTST195.RRB is a binary file containing area factor information for seven different thicknesses of cover, six different thicknesses of contamination, twelve different radii, and 23 different levels of gamma energies.
- 10. pathchk.dat is a text file containing active pathway codes for the inputs as listed in the order they appear in Default.inc and thus in the input echo.
- 11. DEFAULT.dat an ASCII file listing the default values of the inputs in name lists for each form.
- 12. UNCGRPTO.BIN is a binary file containing the total dose at each graphic time point for each probabilistic simulation.
- 13. WSCONC.DAT is a user-created text file containing the concentrations of the radionuclides in the water in the surface water body.
- 14. WWCONC.DAT is a user-created test file containing the concentrations of the radionuclides in well water.

Files Written by ResOCalc.exe:

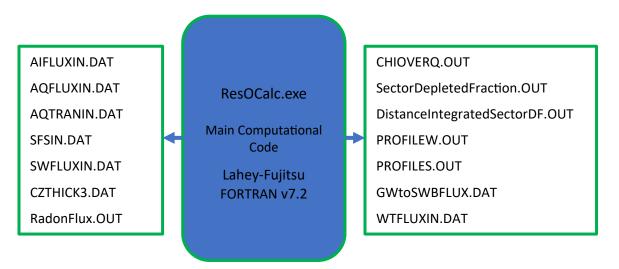
- 1. Output.fil, a text file listing the progress of the computational code as it works its way sequentially through the calls.
- 2. DEFAULT.dat is an ASCII file listing the default values of the inputs in name lists for each form.

- 3. SUMMARY.OUT, containing the text of the main report consisting of the input echo, dose attributed to the initially present radionuclides, soil guideline, etc., is appended to SUMMARY.REP, which initially contains the table of contents to the report.
- 4. INTRISK.OUT, containing the text of the intake and risk report, is appended to INTRISK.REP, which initially contains the table of contents of the report.
- 5. DAUDOSE.OUT, containing the text of the dose attributed to the radionuclides at the location and time of the exposure report, is appended to DAUDOSE.REP, which initially contains the table of contents of the report.
- 6. MCSUMMAR.OUT, containing the probabilistic text report, is appended to MCSUMMAR.REP, which initially contains the table of contents of the report.
- 7. LHS.REP contains the probabilistic sampling report of LHS.exe.
- 8. UNCPEAK.ASC is an ASCII file containing the peak doses and the time of the peak doses (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
- 9. UNCPEAKR.ASC is an ASCII file containing the peak risks (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
- 10. UNCGRPTO.BIN is a binary file containing the total dose at each graphic time point for each probabilistic simulation.
- 11. *Input file namei*.PTG, where *i* is any number from 1 to the number of repetitions, is an ASCII file containing the probabilistic temporal graphics data.
- 12. LHSVAR.DAT is an ASCII file containing the probabilistic sample values for the current probabilistic simulation.
- 13. RELVAR.DAT is an ASCII file containing the sample values of the dependent related variables for the current probabilistic simulation.
- 14. OFFSITE.DAT is a binary file containing information about the current run including the number of radionuclides, the parent and progeny pointers, the number of environmental media, the number of reporting and calculation times, units.
- 15. Offsite.RA, Offsite.RB, and Offsite.RC are binary files containing risk, dose, and concentration, respectively, at graphical times for the deterministic simulation, for each sensitivity simulation, and for each probabilistic simulation.
- 16. Message.fil a single-line text file indicating the computation being performed.
- 17. CHIOVERQ.OUT is an ASCII file containing the atmospheric concentrations to release (chi/Q) ratios for each radionuclide at the different offsite exposure locations.
- 18. SectorDepletedFraction.OUT is an ASCII file which has 17 columns of data; the first is the distance from the point release, and the next 16 contain the depleted source strengths at the distances in the first column in each of the 16 sectors, expressed as fractions of the release. The 16 columns are in the order N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW.
- 19. DistanceIntegratedSectorDF.OUT is an ASCII file which has 17 columns of data; the first is the distance from the point release, and the next 16 contain the integrals of the depleted source strengths over the distance in the first column in each of the 16 sectors. The 16 columns are in the order N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW.

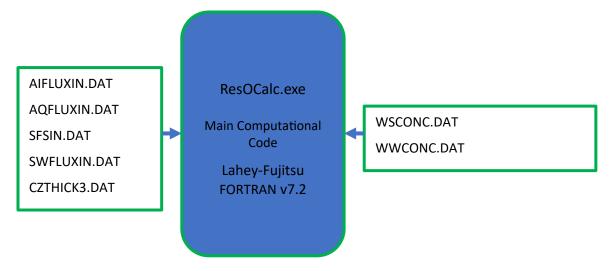
- 20. PROFILEW.OUT is an ASCII file containing data on the horizontal and vertical concentration profiles of each radionuclide in the aquifer in the plane containing the well.
- 21. PROFILES.OUT is an ASCII file containing data on the horizontal and vertical concentration profiles of each radionuclide in the aquifer in the plane containing the surface water body.
- 22. QRFAIL.LOG is an ASCII file listing information about groundwater transport calculations that reached the upper limit of numerical integration points before achieving the user-specified convergence criterion.
- 23. RadonFlux.OUT is an ASCII file listing the release rates of the radon isotopes (g) from the primary contamination and from the accumulations in offsite locations.
- 24. Summary.REP is the main text report with a table of content, consisting of the input echo, dose attributed to the initially present radionuclides, soil guideline, etc. The other text reports, INTRISK.REP, DAUDOSE.REP, and MCSUMMAR.REP, are created in a similar fashion by adding tables of contents to the corresponding OUT files.
- 25. AIFLUXIN.DAT is an ASCII file listing the release, attached to particulates, to the atmosphere from the surface layer, in pCi/yr.
- 26. AQFLUXIN.DAT is an ASCII file listing the release, in the aqueous phase, to water at the downgradient edge of the primary contamination, in pCi/year.
- 27. AQTRANIN.DAT is an ASCII file listing the transfer to infiltration or gradual injection in the part of the primary contamination that is above the water table, in pCi/yr, and the instantaneous injection in the part of the primary contamination that is above the water table, in pCi.
- 28. GWtoSWBFLUX.DAT is the transfer, in aqueous phase, from the aquifer to the surface water body, in pCi/year.
- 29. SFSIN.DAT is the concentration in the primary contamination, in pCi/g, averaged over the primary contamination. Currently includes the release immune form for all transfer options and the release susceptible form for the rate-controlled and the equilibrium dissolution transfer mechanisms, but not the aqueous or adsorbed phases of the radionuclides in transit in the primary contamination.
- 30. WTFLUXIN.DAT is the transfer, in aqueous phase, across the water table to the aquifer, in pCi/yr.
- 31. SWFLUXIN.DAT is the release, in eroded material, to surface runoff from the surface layer, in pCi/yr. It includes the mass of material eroded from the primary contamination and the surface layer, in g/yr, the mass of suspended sediment in the surface water body, in g, and the mass of bottom sediment on which the radionuclides are in adsorption-desorption equilibrium with the water in the surface water body.
- 32. CZTHICK3.DAT contains columns listing the calculation times in years, the concentration of the radionuclides in the surface mixing layer of the soil as a fraction of the concentration in the physically undisturbed primary contamination, the thickness of the clean cover in meters, the thickness of the contaminated mixing layer in meters, and the thickness of the physically undisturbed (unmixed) thickness of the primary contamination.



Data Transfer Diagram for ResOCalc.exe



Intermediate Data Diagram for ResOCalc.exe



Overriding User Data Input Diagram for ResOCalc.exe

1.3 DETERMINISTIC GRAPHICS DATA CONVERTER, GRPHCNV5.EXE

Purpose of GrphCnv5.exe: This FORTRAN executable reads the dose, risk, and concentration from the RESRAD-OFFSITE binary output files and writes the ASCII deterministic and sensitivity graphics data file, GRAPHICS.ASC, that will be read by WResPlot.exe.

Description of GrphCnv5.exe: This is a small, simple code that reads the data in the four files listed below and writes the dose, concentration, and risk data to an ASCII file in a format that can easily be used by the deterministic graphics executable WResPlot.exe.

Files Read by GrphCnv5.exe:

- 1. Offsite.dat is a binary file containing information about the current run including the number of radionuclides, the parent and progeny pointers, the number of environmental media, the number of reporting and calculation times, units.
- 2. Offsite.RA, Offsite.RB, and Offsite.RC are binary files containing risk, dose, and concentration, respectively, at graphical times for the deterministic simulation, for each sensitivity simulation, and for each probabilistic simulation.

Files Written by GrphCnv5.exe:

1. GRAPHICS.ASC is an ASCII file containing the dose, concentration, and risk data in a format that can be used by WResPlot.exe.

1.4 DETERMINISTIC GRAPHICS VIEWER, WRESPLOT.EXE

Purpose of WResPlot,exe: This executable displays the deterministic and sensitivity output (dose, risk, or concentration) of the RESRAD-OFFSITE (and the RESRAD-ONSITE) code in graphical form.

Data Files Read by WRESPLOT.exe:

- 1. FileforWresplot.dat to read the name of the graphics file.
- 2. VARIABOF.INF to read in the description of the variables for use when sensitivity analysis is performed.
- 3. GRAPHICS.ASC, *Input file name*.grp is an ASCII file containing the dose, concentration, and risk data.

APPENDIX 2: VERIFICATION OF AIR RELEASE FROM THE SURFACE MIXING LAYER

The spreadsheet calculations of the air release of particulates from the surface layer at the primary contamination are performed for ⁹⁰Sr using the equations described in G.15 of Appendix G of the RESRAD-OFFSITE Manual. First, the concentration in the mixing layer using Equation G.67 is calculated, and after that, the air release is calculated using Equation G.69. Releases associated with both respirable and total particulates can be calculated. Special models are used for gaseous/vapor releases of tritium (³H) as water vapor, ¹⁴C as carbon dioxide, and radon (²²⁰Rn and ²²²Rn). Verification of special radionuclides is done separately. The spreadsheet calculations are compared with the code output file AIFLUXIN.DAT.

Table A2.1 lists parameters used in calculating air release rate from the surface layer.

Radionuclide and Radionuclide-Specific Parameters	⁹⁰ Sr
Half-life (yr)	29.12
Cut-off half-life (d)	30
Primary Contamination and Cover Parameters	
Rainfall and runoff factor (/yr)	160
Dry bulk density (g/cm ³)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Depth of soil mixing layer (m)	0.15
Deposition velocity of all particulates (to compute atmospheric release) (m/s)	0.001
Mass loading of all particulates (g/m ³)	0.0001
Primary contamination thickness (m)	Case 1 – 0.1
	Case 2 – 1.2
Cover thickness (m)	0.05
Area of primary contamination (m ²)	10000

Table A2.1 Parameters Used in Air Release Calculations

The comparison is done for two thicknesses of primary contamination (two input files used are air release comp sr90.rof and air release comp case2.rof). Figure A2.1 shows the Case 1 comparison of the calculated air release rate using an EXCEL spreadsheet with the air release rate from the code. The detailed comparison is in the EXCEL spreadsheet (air-release-case1.xlsx). Figure A2.2 shows the Case 2 comparison of the calculated air release rate using an EXCEL spreadsheet with the air release rate using an EXCEL spreadsheet with the air release rate from the code (air-release-case2.xlsx). The spreadsheets can be used for comparing results for other cover and primary contamination thicknesses. The EXCEL spreadsheet calculations in general match the code output.

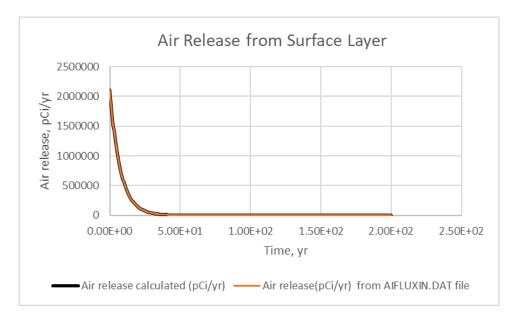


Figure A2.1 Air Release to Atmosphere from the Surface Layer (Case 1)

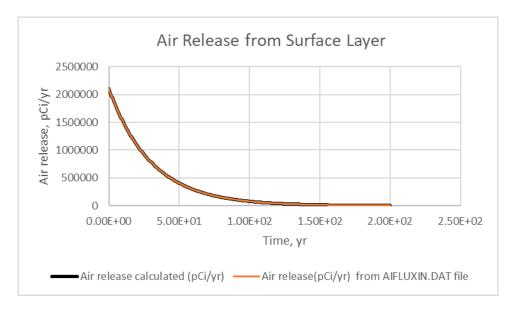


Figure A2.2 Air Release to Atmosphere from the Surface Layer (Case 2)

APPENDIX 3: VERIFICATION OF EROSION RELEASE FROM PRIMARY CONTAMINATION

The spreadsheet calculations of the erosion release of particulates from the primary contamination are performed for ⁹⁰ Sr using the equations described in the Appendix G of the RESRAD-OFFSITE Manual. First, the eroded material rate is calculated using Equations G.24 and G.25, and after that, the erosion rate is calculated using Equation G.68. The two input files used are erosion release comp case1.rof and erosion release comp case2.rof. The spreadsheet calculations are compared with the code output file SWFLUXIN.DAT.

Table A3.1 lists the parameters used in calculating the air release rate from the surface layer.

Radionuclide and Radionuclide-Specific Parameters	⁹⁰ Sr
Half-life (yr)	29.12
Cut-off half-life (d)	30
Primary Contamination and Cover Parameters	
Rainfall and runoff factor (/yr)	160
Dry bulk density (g/cm ³)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Depth of soil mixing layer (m)	0.15
Primary contamination thickness (m)	Case 1 – 0.1
	Case 2 – 1.2
Cover thickness (m)	0.05
Area of primary contamination (m ²)	10000

Table A3.1 Parameters Used in Erosion Release Calculations

Figure A3.1 shows the comparison of the calculated erosion rate for Case 1 using an EXCEL spreadsheet with the erosion rate from the code. The detailed comparison is in the EXCEL spreadsheet "erosion-release-case1.xlsx." Figure A3.2 shows the comparison of the calculated erosion rate for Case 2 using an EXCEL spreadsheet with the erosion rate from the code. The detailed comparison is in the EXCEL spreadsheet "erosion-release-case2.xlsx." The spreadsheets can be used for comparing the results for other cover and primary contamination thicknesses. The EXCEL spreadsheet calculations in general match the code output.

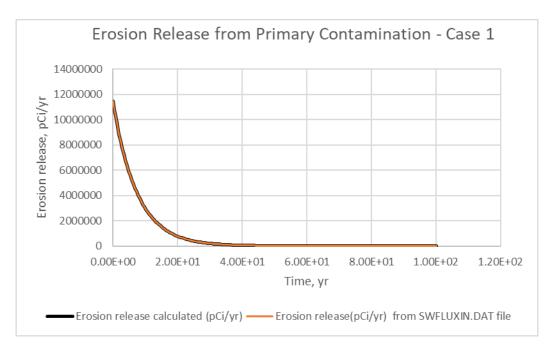


Figure A3.1 Erosion Release from Primary Contamination – Case 1

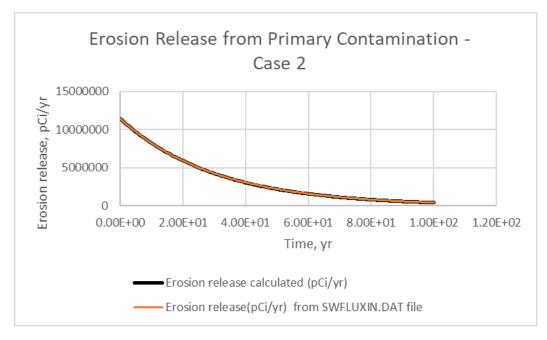


Figure A3.2 Erosion Release from Primary Contamination – Case 2

APPENDIX 4: VERIFICATION OF ATMOSPHERIC TRANSPORT MODEL

The atmospheric transport model used in RESRAD-OFFSITE is a Gaussian plume dispersion model based on an area source release. As a radioactive plume travels downwind, its radionuclide content decreases due to deposition on the ground. The model considers two deposition mechanisms, dry and wet, to account for radionuclide depletion from the plume.

The earlier versions of the code (before Version 4.0) computed the concentration in the air above the offsite receptor and accumulation locations that did not overlap with the primary contamination. A formulation to compute the deposition on a catchment that could potentially overlap the primary contamination was added to Version 4. Details of the model are presented in Appendix I of the RESRAD-OFFSITE User's Manual Yu et al. (2020).

The RESRAD-OFFSITE V&V report (Yu et al. 2011) verified the earlier model. Six input files (air dispersion run1.rof, air dispersion run2.rof, ... air dispersion run6.rof) are created based on the information in the V&V report and are run with the new version. Table A4.1 shows the site layout and atmospheric transport parameters used in air dispersion calculations. The results in Tables 4-2 and 4-3 in the V&V report are compared with Version 4 results. Table A4.2 and Table A4.3 show the comparison of the old spreadsheet calculations, old code results, and Version 4 results for CHIOVERQ (normalized air concentration). Version 4 results are taken from the CHIOVERQ.OUT file created after each run in the directory where RESRAD-OFFSITE code is installed. There is practically no difference in the spreadsheet calculations and Version 4 results.

	Distance,		Elevation,	Directional	Stability	Wind
Receptor Area	m	Direction	m	Frequency	Category	Speed (m/s)
Fruit grain non-leafy vegetable plot	100	North	0	0.05	А	0.89
Leafy vegetables plot	200	South	5	0.1	В	2.46
Pasture, silage growing area	500	East	10	0.25	D	6.93
Grain field	1000	West	15	0.2	С	4.47
Dwelling site	10000	Northeast	20	0.4	F	9.61

 Table A4.1 Site Layout and Atmospheric Transport Parameters Used in Point-to-Point Air

 Dispersion Calculations

Note: Elevation is only used with plume rise.

Note that only wet deposition was not checked in the V&V report. A new spreadsheet incorporating RESRAD-OFFSITE Manual Appendix I equations is made to calculate the normalized air concentration for different stability classes. The spreadsheet includes both Pasquill-Gifford and Briggs dispersion models but only includes wet deposition. A separate RESRAD-OFFSITE input file (air dispersion run7) is used. Table A4.4 compares the spreadsheet calculations with RESRAD-OFFSITE Version 4 results with no deposition for both Pasquill-Gifford and Briggs dispersion models and wet deposition only with the Pasquill-Gifford dispersion model.

	Valı	Values from V&V Report Table 4-2						
	Spreadsheet	Spreadsheet x Directional Frequency	Previous OFFSITE	OFFSITE Version 4				
Run 1 - Briggs Rural Dispersion Coe	Run 1 - Briggs Rural Dispersion Coefficients, no dry or wet deposition							
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05				
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05				
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06				
Grain field	6.14E-06	1.23E-06	1.23E-06	1.23E-06				
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07				
Run 2 - Pasquill-Gifford dispersion c	oefficient with dry	deposition, no wet deposition						
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05				
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05				
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06				
Grain field	7.26E-06	1.45E-06	1.45E-06	1.45E-06				
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07				
Run 3 - Pasquill-Gifford dispersion c	oe <u>ff</u> icient with dry	deposition and wet deposition	n					
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05				
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05				
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06				
Grain field	7.02E-06	1.40E-06	1.40E-06	1.40E-06				
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07				

Table A4.2 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m³) in V&V Report (with Plume Rise) with RESRAD-OFFSITE Version 4

Note: The spreadsheet calculations do not include the directional wind frequency.

	Valu	es from V&V Report Table 4	-3					
	SpreadsheetSpreadsheet x directionalPreSpreadsheetfrequencyOFF							
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition								
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05				
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05				
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06				
Grain field	7.34E-06	1.47E-06	1.47E-06	1.47E-06				
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07				
Run 5 - Pasquill-Gifford dispersion c	oefficient with dry	deposition, no wet deposition						
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05				
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05				
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06				
Grain field	7.26E-06	1.45E-06	1.45E-06	1.45E-06				
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07				
Run 6 - Pasquill-Gifford dispersion c	oefficient with dry	deposition and wet deposition	1					
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05				
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05				
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06				
Grain field	7.03E-06	1.41E-06	1.40E-06	1.40E-06				
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07				

Table A4.3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m³) in V&V Report (without Plume Rise) with Version 4

	New Spreadsheet	Spreadsheet x Directional Frequency	Version 4.0
Run 1 - Briggs rural dispersion coefficients, no dry or v	•	Directional Trequency	v cr3i0ii 4.0
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.60E-05
Leafy vegetables plot	1.69E-04	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.38E-06
Grain field	6.14E-06	1.23E-06	1.23E-06
Dwelling site	5.21E-07	2.09E-07	2.09E-07
Run 4 - Pasquill-Gifford rural dispersion coefficients, n	o dry or wet depo	osition	
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.85E-06	7.86E-06
Grain field	7.34E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07
Run 7 - Pasquill-Gifford dispersion coefficient with we	t deposition	•	
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.73E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.98E-05
Pasture, silage growing area	3.11E-05	7.77E-06	7.77E-06
Grain field	7.10E-06	1.42E-06	1.42E-06
Dwelling site	4.45E-07	1.78E-07	1.78E-07

 Table A4.4 Comparison of RESRAD-OFFSITE (Version 4) Normalized Air Concentration with

 New Spreadsheet Calculations

The code outputs the intermediate results of the atmospheric transport calculations of the deposition in the catchment to the SectorDepletedFraction.OUT file. The file includes the distance from the point release and the depleted source strength in the 16 sectors at the distance in the first column, expressed as fraction of the release. The values in this file are compared with the EXCEL spreadsheet calculations for both wet and dry deposition by considering wet and dry deposition individually. Table A4.5 and Table A4.6 compare the RESRAD-OFFSITE source depletion due to dry and wet deposition, respectively, at few select distances from the spreadsheet calculations. Differences of less than 1 percent are observed in all stability classes. The full comparison is in the EXCEL spreadsheet wet and dry depleted fraction comparison.xlsx.

Depleted Fraction from the Code (Dry Deposition - Run 5)					Depleted F Spreadshee	raction Due et	to Dry Depo	sition Calcul	ated Using	
Distances (m)	North - A (0.89 m/s)	Northeast -F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)	A (0.89 m/s)	F (9.61 m/s)	D (6.93 m/s)	B (2.46 m/s)	C (4.47 m/s)
2.03E+01	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01
5.22E+01	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01
1.01E+02	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01
2.00E+02	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01
5.02E+02	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01
1.00E+03	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01
1.50E+03	9.72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	9.73E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01
2.00E+03	9.72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	9.72E-01	9.81E-01	9.86E-01	9.84E-01	9.87E-01

 Table A4.5 Comparison of RESRAD-OFFSITE Deposition Depletion Due to Dry Deposition with

 Spreadsheet Calculations

 Table A4.6 Comparison of RESRAD-OFFSITE Depletion Due to Wet Deposition with Spreadsheet

 Calculations

Depleted Fraction from the Code (Wet Deposition - Run 5)					Depleted F Spreadshe	raction Due et	to Wet Depo	sition Calcul	ated Using	
Distances (m)	North - A (0.89 m/s)	Northeast -F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)	A (0.89 m/s)	B (2.46 m/s)	C (4.47 m/s)	D (6.93 m/s)	F (9.61 m/s)
2.03E+01	9.97E-01	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.97E-01	9.99E-01	9.99E-01	1.00E+00	1.00E+00
5.22E+01	9.91E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.91E-01	9.97E-01	9.98E-01	9.99E-01	1.00E+00
1.01E+02	9.83E-01	1.00E+00	9.98E-01	9.94E-01	9.97E-01	9.83E-01	9.94E-01	9.97E-01	9.98E-01	1.00E+00
2.00E+02	9.67E-01	1.00E+00	9.96E-01	9.88E-01	9.93E-01	9.66E-01	9.88E-01	9.93E-01	9.96E-01	1.00E+00
5.02E+02	9.20E-01	9.99E-01	9.89E-01	9.70E-01	9.83E-01	9.18E-01	9.69E-01	9.83E-01	9.89E-01	9.99E-01
1.00E+03	8.46E-01	9.98E-01	9.79E-01	9.41E-01	9.67E-01	8.42E-01	9.40E-01	9.66E-01	9.78E-01	9.98E-01
1.50E+03	7.79E-01	9.98E-01	9.68E-01	9.14E-01	9.51E-01	7.73E-01	9.11E-01	9.50E-01	9.68E-01	9.98E-01
2.00E+03	7.16E-01	9.97E-01	9.58E-01	8.86E-01	9.36E-01	7.10E-01	8.83E-01	9.34E-01	9.57E-01	9.97E-01

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APPENDIX 5: VERIFICATION OF SURFACE WATER MODEL

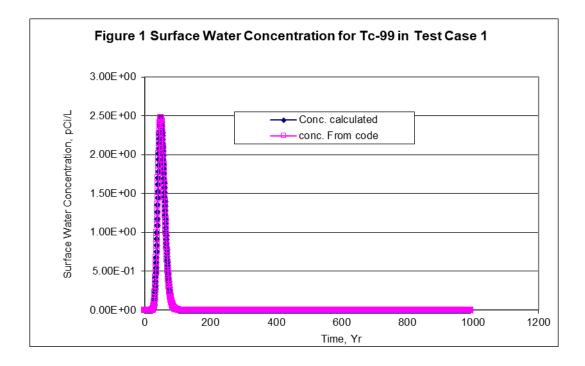
A limited verification of the surface water body model in RESRAD-OFFSITE code is performed for ⁹⁹Tc and ²³⁸U contamination. The water concentration in the surface water body for the principal radionuclide from an EXCEL spreadsheet calculation is compared with the code surface water concentration.

Verification is done all four modes of entry of radionuclides into the surface water body: (1) influx of dissolved radionuclides in the water intercepted from the aquifer; (2) influx of radionuclides adsorbed on soil eroded from the primary contamination; (3) influx of radionuclides transported by air, then deposited on the catchment, and ultimately washed out into the surface water body; and (4) influx of radionuclides transported by air and deposited on the surface water body.

The code considers four ways of removal of radionuclides from the surface water body: (1) loss of radionuclides, both dissolved in the water and adsorbed on the suspended sediments, in the stream outflow; (2) loss of radionuclides, both dissolved in the water and adsorbed on the suspended sediments, in the water extracted for use; (3) loss of radionuclides dissolved in the water that seeps into the aquifer; and (4) loss of radionuclides adsorbed on the deeper layers of the sediments that are assumed to be isolated from the water by the recently buried sediments. The surface water body is modeled as being continuously mixed throughout the year. The radionuclides dissolved in the suspended sediment and the radionuclides in the recent bottom sediments. The equations in Section J.2 (Yu et al. 2020) are used in the EXCEL spreadsheet for calculations.

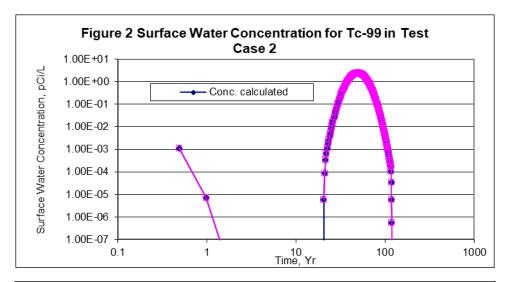
For comparing surface water concentration from the influx of dissolved radionuclides in the water intercepted from the aquifer, the rate at which radionuclide enters the surface water body with the water that is intercepted from the aquifer is taken from the code (GWtoSWFLUX.DAT). For comparing surface water concentration from the influx of radionuclides adsorbed on soil eroded from the primary contamination, the release in eroded material to surface runoff from the surface layer is taken from the code (SWFLUXIN.DAT). For comparing the surface water concentration from the influx of radionuclides transported by air, then deposited on the catchment, and ultimately washed out into the surface water body, the rate at which radionuclide is deposited over the catchment is taken from the code (SectorDepletedFraction.OUT). For comparing the surface water concentration from the influx of radionuclides transported by air and deposited on the surface water body, the release rate of radionuclide particulates in air from primary contamination was taken from the code (AIRFLUXIN.DAT).

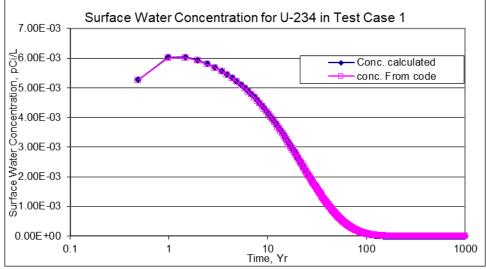
The RESRAD-ONSITE exponential release model is used. Test 1 is at all default parameter values except cover = 5 cm, primary contamination zone thickness = 15 cm. Figure 1 shows the surface water concentration for 99 Tc in Test Case 1.

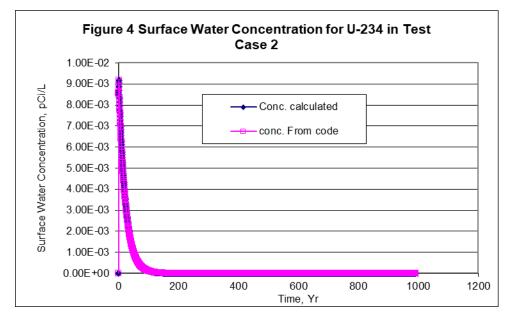


In Test 2, cover = 0 cm, settling velocity of sediment = 0.01 cm/s, density of bottom sediment = 1.2 gm/cm³, volume of surface water body = 100,000 m³. Figure 2 shows the surface water concentration for ⁹⁹Tc in Test Case 2. The surface water concentration from the spreadsheet calculations matches the code results, as shown in Figure 1 and Figure 2. The same calculations were repeated with ²³⁴U. The results are shown in Figure 3 and Figure 4 for Test Case 1 and Test Case 2, respectively.

RESRAD-OFFSITE input files used in the surface water model are: SURF-WATER-CHECK-TC99-TEST1.ROF, SURF-WATER-CHECK-TC99-TEST2.ROF, SURF-WATER-CHECK-U234-TEST1.ROF, and SURF-WATER-CHECK-U234-TEST2.ROF, and the EXCEL spreadsheets that show the calculations are: "surface water conc verification-Tc99-test1.xlsx," "surface water conc verification-Tc99-test2.xlsx," and "surface water conc verification-U234-test2.xlsx."







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APPENDIX 6: VERIFICATION OF ACCUMULATION IN OFFSITE SURFACE SOIL

A limited verification of the accumulation in offsite surface soil in the RESRAD-OFFSITE code is performed. The radionuclide concentration in the surface soil for the principal radionuclide from the EXCEL spreadsheet calculation is compared with the code's surface soil concentration.

The code models the influx of radionuclides from the primary contamination in the surface soil layer at the offsite locations by three mechanisms: irrigation with contaminated water from the well or from the surface water body, deposition of contaminated particulates following atmospheric transport, and deposition of eroded material transported by runoff. At offsite locations, it considers mixing of the surface layer, erosion of the surface layer, linear adsorption-desorption partitioning between the solid and aqueous phases of the surface layer, and radiological transformations of each radionuclide and its parent radionuclides.

Verification is accomplished for all three modes of entry of radionuclides into the surface soil for non-leafy vegetable field with ¹⁴C. Different radionuclides (¹³⁷Cs for pasture and silage field, ⁴¹Ca for leafy vegetable field, and ⁶⁰Co for grain field) were used to verify offsite soil concentrations at different offsite locations. For ¹⁴C, ¹³⁷Cs, and ⁶⁰Co surface water was used for irrigation and ⁴¹Ca groundwater was used for irrigation. The equations in Appendix J (Yu et al. 2020) were used in an EXCEL spreadsheet for the calculations.

For comparing offsite soil concentrations from the influx of radionuclides adsorbed on soil eroded from the primary contamination, the release in eroded material to surface runoff from the surface layer is taken from the code (SWFLUXIN.DAT). For comparing the offsite soil concentrations from the deposition of particulates containing radionuclides from the atmosphere, the concentration in air at an offsite location is taken from the code. For comparing the offsite soil concentration from irrigation, the irrigation water concentration is taken from the code.

RESRAD-ONSITE exponential release model is used. Table A6.1 shows some of the input parameters used in RESRAD-OFFSITE code run.

Parameters	Values
Deposition velocity (m/s)	0.001
Storage time (d)	0
Precipitation rate (m/yr)	1
Sediment delivery to offsite location	1
Radionuclide Parameters	
¹⁴ C half-life, yr	5730
¹⁴ C distribution coefficient (cm ³ /g)	0
⁴¹ Ca half-life (yr)	140000
⁴¹ Ca distribution coefficient (cm ³ /g)	50
⁶⁰ Co half-life (yr)	5.271
⁶⁰ Co distribution coefficient (cm ³ /g)	1000
¹³⁷ Cs half-life (yr)	30
¹³⁷ Cs distribution coefficient (cm ³ /g)	4600
Offsite Soil Parameters in Different Agricultural Areas	
Fraction of area directly over primary contamination	0
Irrigation applied (m/yr)	0.2
Evapotranspiration coefficient	0.5
Runoff coefficient	0.2
Mixing depth (m)	0.15
Volumetric water content	0.3
Dry bulk density (g/cm ³)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Duration of growing season for fruit, grain, and leafy vegetables (yr)	0.17
Duration of growing season for leafy vegetables (yr)	0.25
Duration of growing season for pasture and grass (yr)	0.08
Duration of growing season for grain (yr)	0.17
Weathering removal constant for all plant types (per yr)	20
Foliar interception factor for irrigation for all plant types ^a	0.25
Foliar interception factor for dust for all plant types	0.25

Table A6.1 Input Parameters Used in RESRAD-OFFSITE Code Run

^a For ¹⁴C, the foliar interception factor for irrigation = 0.

The EXCEL spreadsheet calculations are in the following files:

soil conc accumulation in leafy field-Ca-41.xlsx,

soil conc accumulation in pasture field-Cs-137.xlsx,

soil conc accumulation in grain field-Co-60.xlsx, and

soil conc accumulation in nonleafy field-C-14.xlsx.

The seven RESRAD-OFFSITE input files used in the verification were: offsiteaccumulation-test1.rof, offsite-accumulation-test2.rof, offsite-accumulation-Test3.rof, offsiteaccumulation-Test4.rof, offsite-accumulation-Test4-air-dep-only.rof, offsite-accumulation-Test4-erosion-only.rof, and offsite-accumulation-Test4-surface-water-only.rof.

Figure A6.1 shows the comparison of ⁴¹Ca soil concentration in leafy vegetable field. The "offsite-accumulation-test1.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in leafy field-Ca-41.xlsx" spreadsheet.

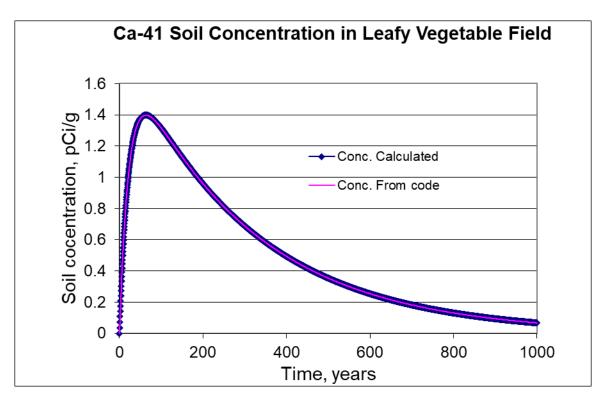


Figure A6.1 Ca-41 Soil Concentration in Leafy Vegetable Field

Figure A6.2 shows the comparison of ¹³⁷Cs soil concentration in the pasture and silage field. The "offsite-accumulation-test2.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in pasture field-Cs-137.xlsx" spreadsheet.

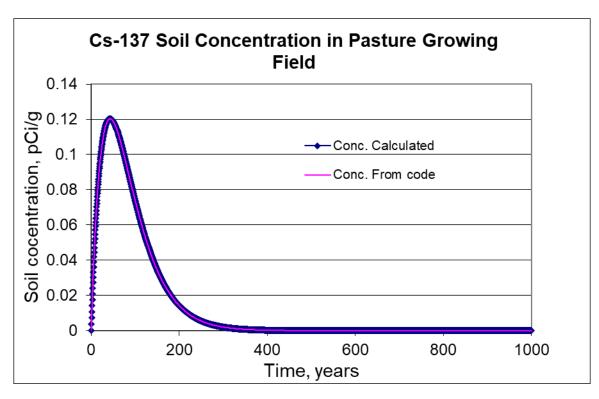


Figure A6.2¹³⁷Cs Soil Concentration in Pasture and Silage Field

Figure A6.3 shows the comparison of ⁶⁰Co soil concentration in a grain field. The "offsite-accumulation-test3.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in grain field-Co-60.xlsx" spreadsheet.

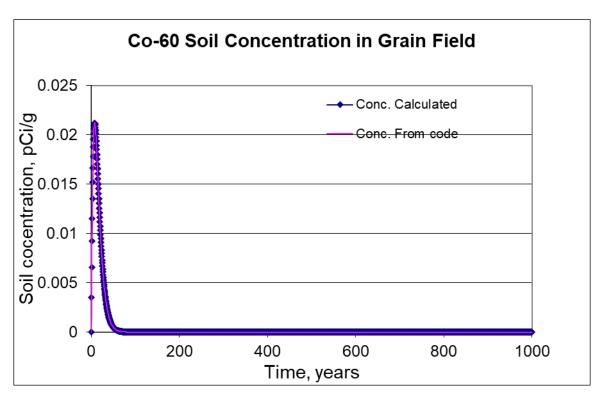


Figure A6.3 ⁶⁰Co Soil Concentration in Grain Field

Figure A6.4 shows the comparison of ¹⁴C soil concentration in a nonleafy vegetables field. The "offsite-accumulation-test4.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

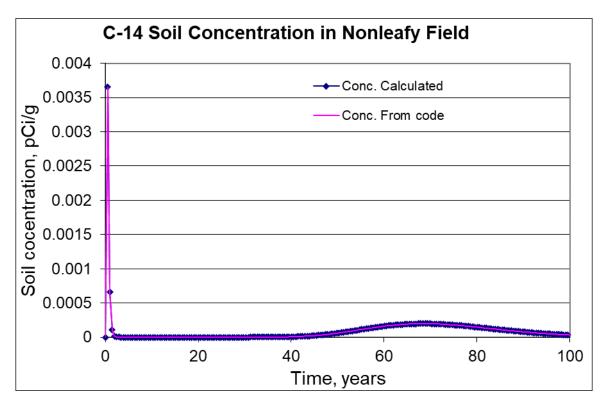


Figure A6.4 ¹⁴C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field

Figure A6.5 shows the comparison of ¹⁴C soil concentration in a nonleafy vegetables field from erosion in the primary contaminated area. The "offsite-accumulation-test4-erosion-only.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

Figure A6.6 shows the comparison of ¹⁴C soil concentration in a nonleafy vegetables field from air particulate deposition. The "offsite-accumulation-test4-air-dep-only.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

Figure A6.7 shows the comparison of ¹⁴C soil concentration in a nonleafy vegetables field from irrigation with contaminated surface water. The "offsite-accumulation-test4-surface water only.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

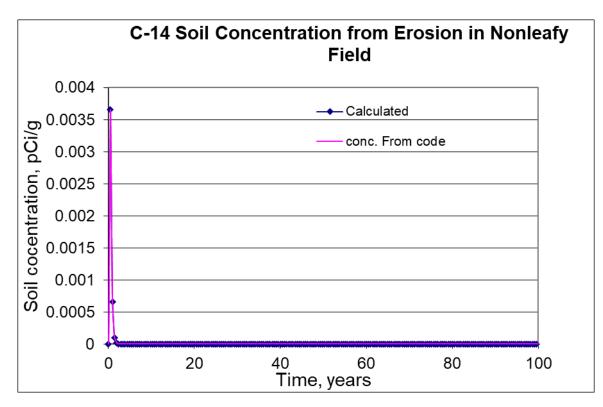


Figure A6.5 ¹⁴C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field from Erosion

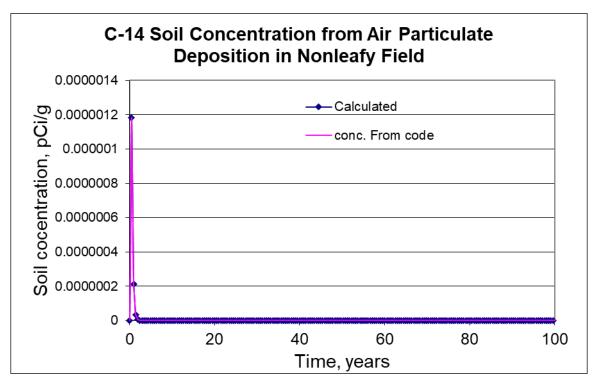


Figure A6.6 ¹⁴C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field from Air Particulate Deposition

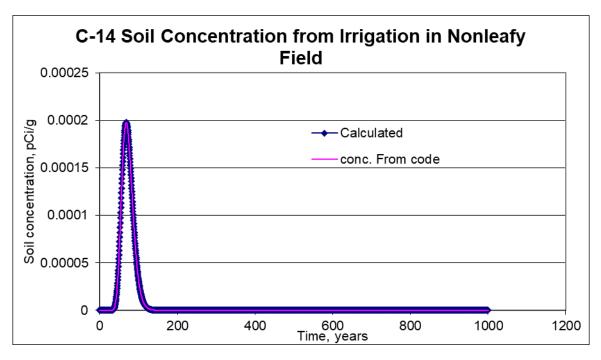


Figure A6.7 ¹⁴C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field from Irrigation

APPENDIX 7: VERIFICATION OF PLANT, MEAT, MILK, AND AQUATIC FOOD CONCENTRATIONS AND INGESTION PATHWAY DOSES

Verification of the accumulation of radionuclides in plants, meat, milk, and aquatic foods in RESRAD-OFFSITE code is performed for ⁹⁰Sr. The concentrations along with intake rates and ingestion dose coefficient are used to calculate pathway doses.

The code models the root uptake from the primary and secondary contaminations, the foliar interception of particulates released from the primary contamination but not from the secondary contamination, foliar interception of contaminated irrigation water, translocation of the radionuclides intercepted by the foliage to the edible part of the plant, and losses due to weathering. The code models two classes of vegetables (leafy and fruit, grain, and nonleafy) and two classes of animal feed (grain and pasture and silage).

The code computes the concentrations of the radionuclides in meat and milk using transfer factors that are in essence ratios of the concentrations to the intake rates. It models the intake of radionuclides from ingesting livestock feed and water and the incidental ingestion of soil with the feed.

The code computes the concentrations of the radionuclides in two classes of aquatic food—fish and crustaceans—using transfer factors or bioaccumulation factors. These factors are simply the ratios of the concentrations in the aquatic food to the concentrations in the water where the fish lived.

The formulations as described in Appendix J (J.4, J.5, and J.6) of RESRAD-OFFSITE Manual (Yu et al. 2020) were used in the EXCEL spreadsheet for calculating food concentrations (plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx). The spreadsheet results are compared with the concentrations available in the deterministic graphics.

The formulations as described in Section 4.4 of the RESRAD-OFFSITE Manual (Yu et al. 2020) were used in the EXCEL spreadsheet for calculating the ingestion pathway dose from food and water.

The RESRAD-OFFSITE exponential release model is used. It is assumed surface water is used for human consumption, animal intake, and irrigation. The eroded material from primary contamination by runoff is deposited in the surface water body. The site layout, atmospheric parameters, and surface water body parameters are kept at code defaults. Table 1 lists other parameters used in calculating plant, meat, milk, and aquatic food concentrations and pathway doses.

Radionuclide and Radionuclide Specific Parameters	⁹⁰ Sr
Half-life (yr)	29.12
Cut-off half-life (d)	30
Distribution coefficient (cm ³ /g)	30
Plant root uptake transfer factor (pCi/kg per pCi/kg)	0.3
Meat transfer factor (pCi/kg per pCi/d)	0.008
Milk transfer factor (pCi/L per pCi/d)	0.002
Fish bioaccumulation factor (pCi/kg per pCi/L)	60
Crustacea bioaccumulation factor	100
General Parameters	Values
Deposition velocity of all particulates (m/s)	0.001
Storage time (d)	0
Precipitation rate (m/yr)	1
Depth of soil mixing layer (m)	0.15
Contaminated zone thickness (m)	
Cover thickness (m)	
Dry bulk density of contaminated zone and cover (g/cm ³)	1.5
Soil erodibility factor for contaminated zone and cover	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Irrigation applied (m/yr)	0.2
Evapotranspiration coefficient	0.5
Runoff coefficient	0.2
Offsite Soil Parameters in Different Agricultural Areas	
Fraction of area directly over primary contamination	0
Irrigation applied (m/yr)	0.2
Evapotranspiration coefficient	0.5
Runoff coefficient	0.2
Mixing depth (m)	0.15
Volumetric water content	0.3
Dry bulk density (g/cm ³)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1

Table 1 Parameters Used in Food Concentrations and Ingestion PathwayDose Calculations

Table 1 (Cont.)

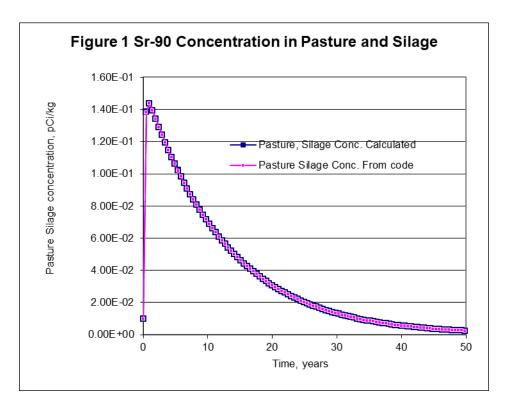
Wet crop yield for fruit, grain, and leafy vegetables (kg/m²)0.7Wet crop yield for leafy vegetables (kg/m²)1.5Wet crop yield for gasture and silage (kg/m²)1.1Wet crop yield for grain (kg/m²)0.7Foliage to food transfer coefficient for fruit, grain, and leafy vegetables0.1Foliage to food transfer coefficient for pasture and grass1.0Foliage to food transfer coefficient for grain0.1Foliage to food transfer coefficient for grain0.1Duration of growing season for fasture and grass (yr)0.25Duration of growing season for pasture and grass (yr)0.08Duration of growing season for pasture and grass (yr)0.08Duration of growing season for all plant types (per yr)20Foliar interception factor for irrigation for all plant types0.25Meat and Mik Cow Intake Parameters0Beef cattle water intake (L/d)160Beef cattle pasture intake (kg/d)14Dairy cow water intake (kg/d)14Dairy cow soil intake from pasture and silage (kg/d)0.4Beef cattle pasture intake (kg/d)0.1Dairy cow soil intake from grain (kg/d)0.4Beef cattle soil intake from grain (kg/d)0.4Dairy cow soil intake from grain (kg/d)0.4Beef cattle soil intake from grain (kg/d)0.4Beef	Plant Accumulation Parameters	
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CF non-leafy0.5CF meat1		
CF meat 1		
	CF milk	1

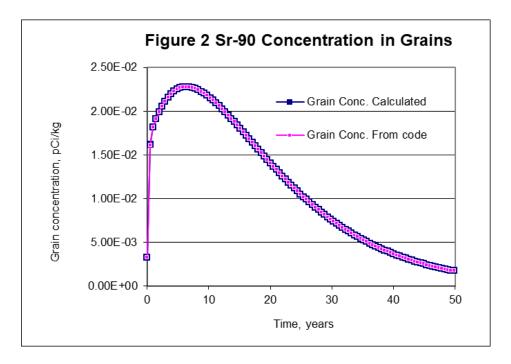
Separate EXCEL spreadsheets for calculating surface water concentration and accumulation in different offsite agricultural areas were created for ⁹⁰Sr contamination and were used in this verification. The surface water model and the accumulation in offsite locations were verified separately.

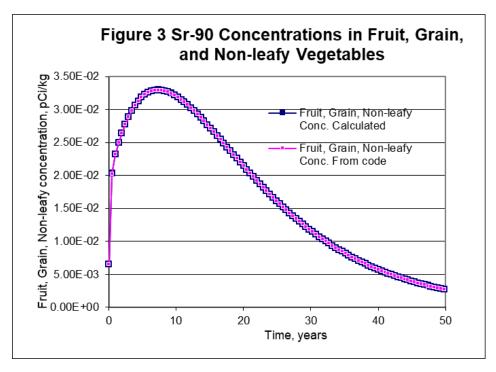
Plant Concentration Comparisons

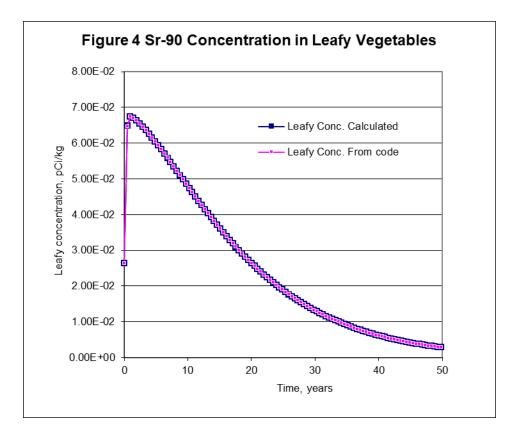
For calculating plant concentrations, it is assumed plants are grown in agricultural areas that are not on primary contamination. The soil concentration in agricultural areas is taken from spreadsheets "soil conc accumulation in nonleafy field-Sr-90.xlsx," "soil conc accumulation in leafy field-Sr-90.xlsx," "soil conc accumulation in pasture field-Sr-90.xlsx," and "soil conc accumulation in grain field-Sr-90.xlsx" in the "Soil accumulation in agricultural areas" subfolder; surface water concentration is taken from the spreadsheet "surface water conc verification-sr90.xlsx" in the "surface water concentration calculations" subfolder. The other inputs used in the EXCEL spreadsheet include the release rate to air from primary contamination (AIRFLUXIN.DAT), erosion release (SWFLUX.DAT), and CHIOVERQ files (intermediate results generated in the code).

Figures 1-4 show the comparison of the calculated plant concentrations using the EXCEL spreadsheet in four different types of plants with the concentrations from the code. The detailed comparison is in the EXCEL spreadsheet "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" under the "plant food concentration" worksheet. The EXCEL spreadsheet calculations in general match the code output.





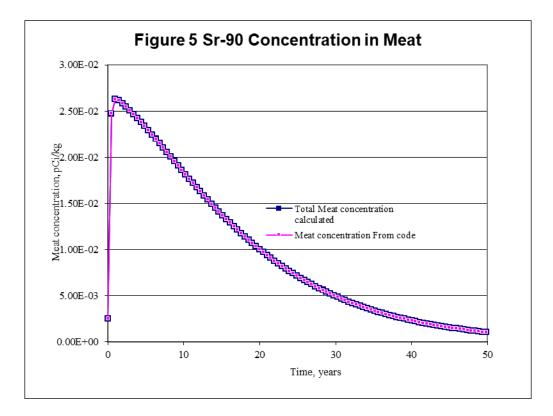


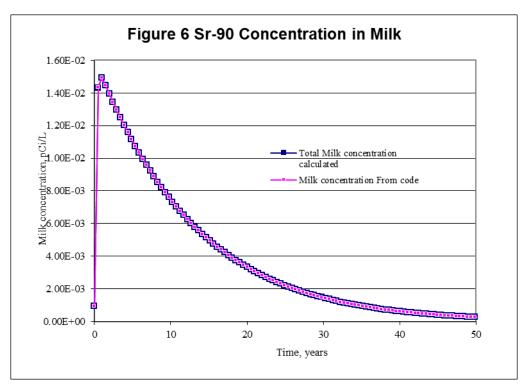


Meat and Milk Concentrations Comparison

For calculating meat and milk concentrations, the soil concentration in the livestock feed areas is taken from spreadsheets "soil conc accumulation in pasture field-Sr-90.xlsx" and "soil conc accumulation in grain field-Sr-90.xlsx" in the "Soil accumulation in agricultural areas" subfolder; surface water concentration is taken from the spreadsheet "surface water conc verification-sr90.xlsx" in the "surface water concentration calculations" subfolder; and the pasture and grain concentration is taken from the "plant food concentration" worksheet. The calculated meat and milk concentrations are in the "meat and milk concentration" worksheet in the "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" EXCEL spreadsheet.

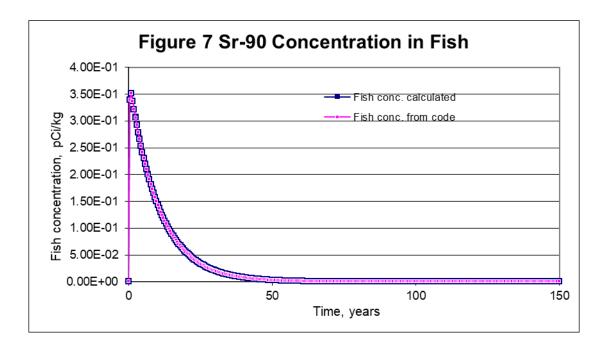
Figures 5 and 6 compare the calculated meat and milk concentrations using the EXCEL spreadsheet with the concentrations from the code. The detailed comparison is in the EXCEL spreadsheet "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" under the "meat and milk concentration" worksheet. The EXCEL spreadsheet calculations in general match the code output.

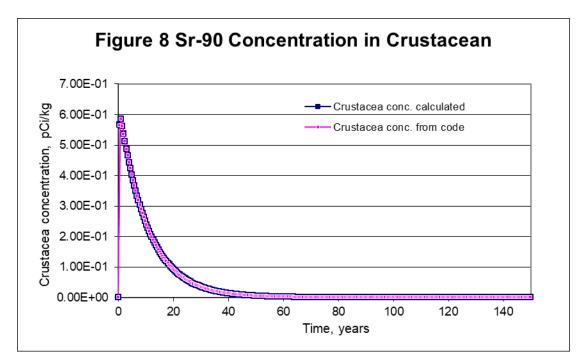




Aquatic Food Concentrations Comparison

For calculating aquatic food (fish and crustacea) concentrations, the surface water concentration is taken from the spreadsheet "surface water conc verification-sr90.xlsx" in the "surface water concentration calculations" subfolder. The calculated fish and crustacean concentrations are in the "aquatic food concentration" worksheet in the "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" EXCEL spreadsheet.

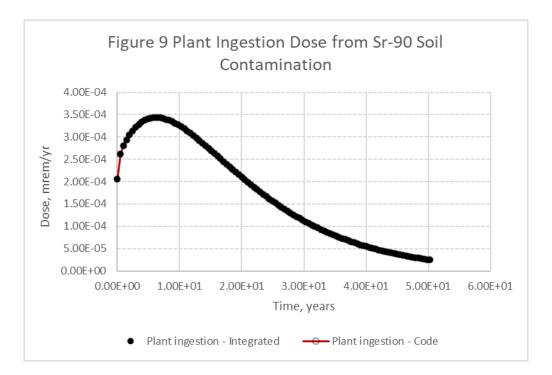


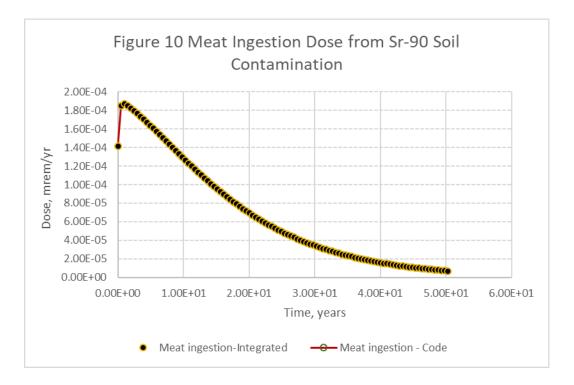


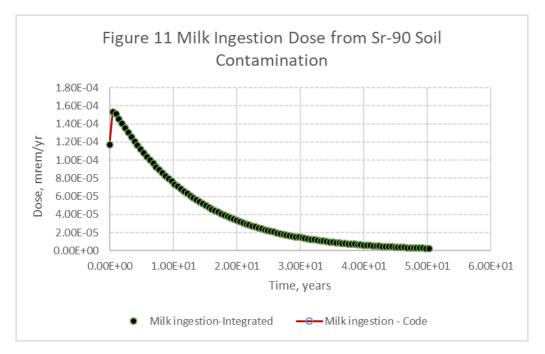
Ingestion Pathway Doses from Food and Water

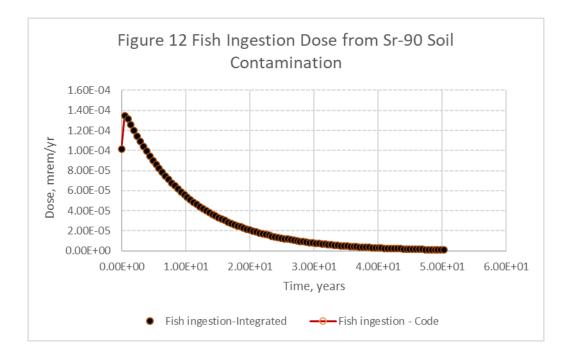
For calculating the ingestion pathway dose from food and water, the surface water concentration is taken from the spreadsheet "surface water conc verification-sr90.xlsx" in the "surface water concentration calculations" subfolder. The plant food concentrations are taken from the "plant food concentration" worksheet; the meat and milk concentrations are taken from the "meat and milk concentration" worksheet; and the aquatic food concentrations are taken from the "aquatic food concentration" worksheet. The calculated ingestion pathway doses are in the "ingestion pathway doses" worksheet in the "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" EXCEL spreadsheet.

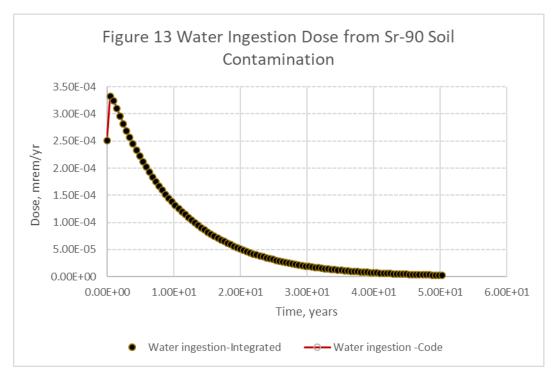
The instantaneous dose rates calculated at the calculation time points are used to calculate the time-integrated dose over a period of 1 year, as described in Appendixes E.1 and E.2 of the RESRAD-OFFSITE Manual (Yu et al. 2020), and compared with the code results. Figures 9-13 compare the EXCEL spreadsheet integrated dose with the code results from different foods and water ingestion.











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APPENDIX 8: VERIFICATION OF SOIL INGESTION PATHWAY DOSE

RESRAD-OFFSITE computes the exposure from the incidental ingestion of soil by summing the product of the dose conversion factor or slope factor for the radionuclide from the chosen dose factor library, the incidental ingestion rate of the soil, the fraction of time spent at the onsite or offsite location, and the concentration of the radionuclide in the soil at the onsite or offsite location. For the onsite location, if the area is less than 1000 m², an area factor correction (ratio of contaminated area/1,000) is applied.

For verifying soil ingestion pathway doses, four test cases are used. In all four test cases, the ICRP-38 nuclide database and FGR-11 internal dose library are used. Table A8.1 lists some of the parameters that are different from the code defaults used in the dose calculations. For two test cases, the receptor was outside on the primary contaminated area, and for the other two test cases, the receptor was in different agriculture fields. Table A8.1 also lists the input files used in different runs.

Soil Ingestion When Receptor Is on Primary Contamination

For verifying the dose when the receptor was on the primary contamination, two test cases (soil-ingestion-1.rof and soil-ingestion-2.rof) were used. The receptor was placed outside on the primary contamination, and the contaminated area, thickness, and cover thickness were varied. Table A8.1 lists the parameters used in the run that are different from the code defaults. Only the soil ingestion pathway was kept active in the run, and the soil ingestion pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for the soil ingestion pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

For EXCEL spreadsheet calculations, the primary contamination soil concentration was taken from the code (graphic interface) and the surface layer concentration was calculated. The surface layer concentration along with the area factor, occupancy factor, soil ingestion rate, and ingestion dose coefficients were used to calculate the soil ingestion dose. The detailed calculations are in two EXCEL spreadsheets (soil-ingestion-pathway-onsite-receptor-case1 and soil-ingestion-pathway-onsite-receptor-case2). Figures A8.1-A8.4 compare the calculated soil ingestion dose with the soil ingestion dose from the code.

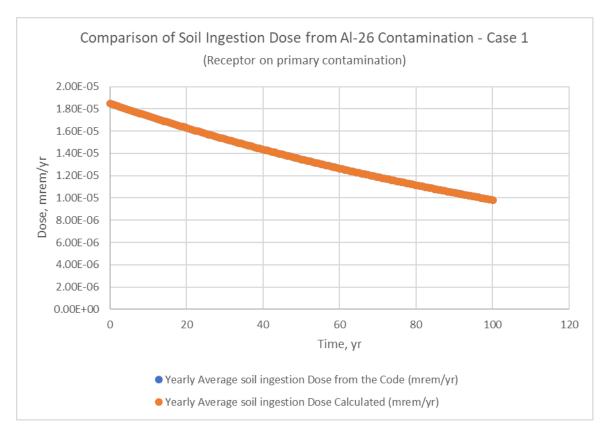


Figure A8.1 Soil Ingestion Dose Comparison for ²⁶Al Contamination – Case 1

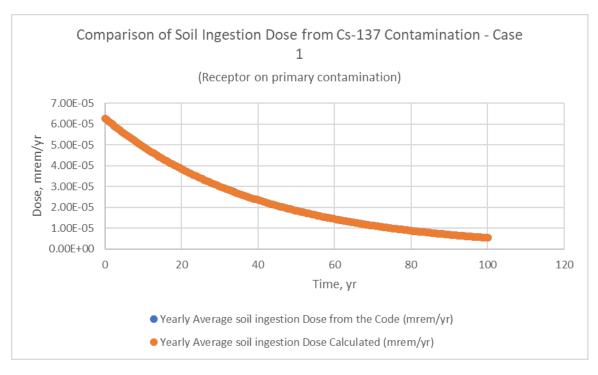


Figure A8.2 Soil Ingestion Dose Comparison for ¹³⁷Cs Contamination – Case 1

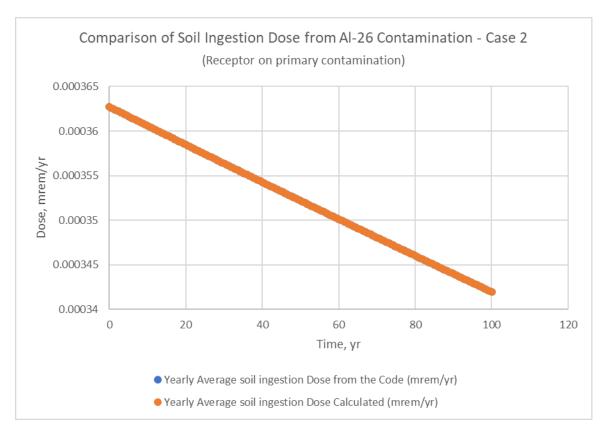


Figure A8.3 Soil Ingestion Dose Comparison for ²⁶Al Contamination – Case 2

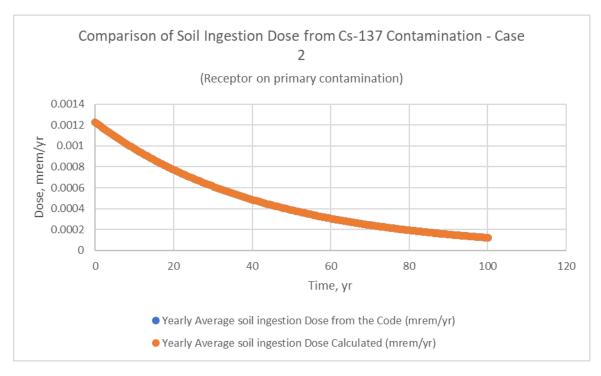


Figure A8.4 Soil Ingestion Dose Comparison for ¹³⁷Cs Contamination – Case 2

Soil Ingestion When Receptor Is Offsite

For verifying dose when the receptor was offsite, two test cases (soil-ingestion-3.rof and soil-ingestion-4.rof) were used. In Case 3, the receptor was placed outside in the pasture and silage field, and in Case 4, the receptor was placed outside in the non-leafy agricultural area. Table A8.1 lists the parameters used in the run that are different from the code defaults. Only the soil ingestion pathway was kept active in the run, and the soil ingestion pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for inhalation pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

For EXCEL spreadsheet calculations, the soil concentration in agricultural areas was taken from the code (graphic interface). The soil concentration in agricultural areas along with the occupancy factor, soil ingestion rate, and ingestion dose coefficients were used to calculate the soil ingestion dose. The detailed calculations are in the EXCEL spreadsheets (soil-ingestion-pathway-offsite-receptor). Figures A8.5-A8.8 compare the calculated soil ingestion dose with the soil ingestion dose from the code.

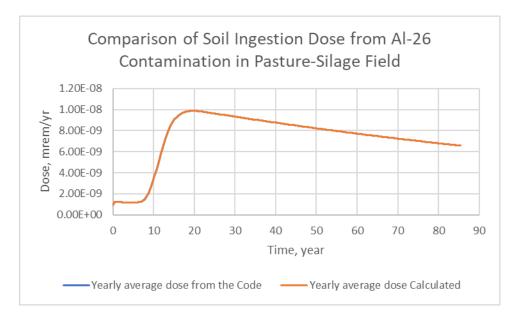


Figure A8.5 Soil Ingestion Dose Comparison for ²⁶Al Contamination – Case 3

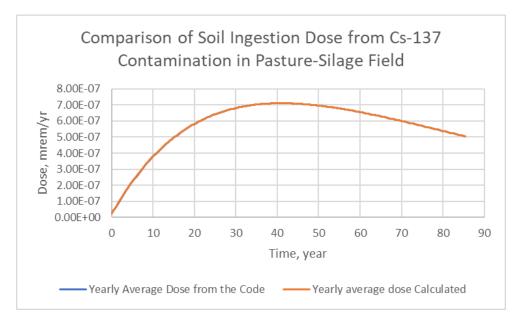


Figure A8.6 Soil Ingestion Dose Comparison for ¹³⁷Cs Contamination – Case 3

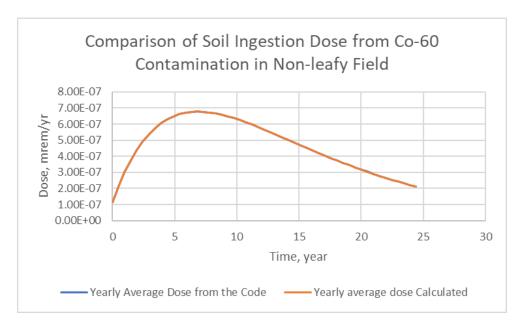


Figure A8.7 Soil Ingestion Dose Comparison for ⁶⁰Co Contamination – Case 4

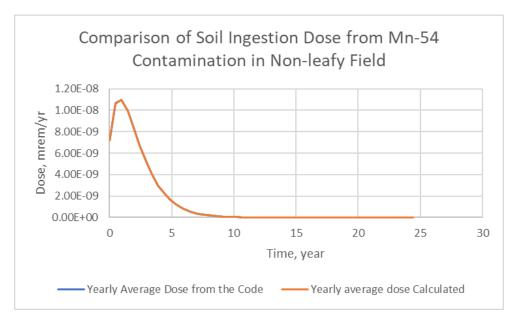


Figure A8.8 Soil Ingestion Dose Comparison for ⁵⁴Mn Contamination – Case 4

Table A8.1 Parameters Used in Different Test G	Cases That Are Different from Code Defaults
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Test Case	Receptor Occupancy & Location	Radionuclides Selected	PC Parameters	Cover Parameters	Sediment Deliver Ratio	RESRAD- OFFSITE Input File
1	100% outside on PC	²⁶ Al and ¹³⁷ Cs	Area = 100 m^2 , thickness = 0.05 m , density = 1.6 g/cm^3	None	None	soil- ingestion- 1.rof
2	100% outside on PC	²⁶ Al and ¹³⁷ Cs	Thickness = 0.5 m , density = 1.6 g/cm^3	Thickness = 0.05 m	None	soil- ingestion- 2.rof
3	100% time in pasture field (1450 m away from PC)	²⁶ Al and ¹³⁷ Cs	Thickness = 0.05 m, density = 1.6 g/cm ³	None	100% to pasture field	soil- ingestion- 3.rof
4	100% time in non-leafy field (Code default location)	⁶⁰ Co and ⁵⁴ Mn	Thickness = 0.05 m, density = 1.6 g/cm ³ ,	None	100% to non-leafy field	soil- ingestion- 4.rof

Note: ²⁶Al Kd was changed from default to 1000 cm³/g in the contaminated zone in Test Cases 1-3.

APPENDIX 9: VERIFICATION OF PARTICULATE INHALATION PATHWAY DOSE

The code calculates the inhalation pathway dose/risk from the primary contamination and the secondary contamination for indoor and outdoor receptors. The inhalation pathway dose is the product of dose conversion factor or slope factor for the radionuclide from the chosen dose factor library, an occupancy and indoor filtration factor to account for the time spent at the location and for the filtration of dust by any building components while indoors, the inhalation rate, and the concentration of the radionuclide in air at the exposure location.

The concentration of radionuclides in the air above the primary contamination depends on the mass loading of particulates in the air above the primary contamination, the concentration of radionuclides in the surface soil, and the area factor that accounts for uncontaminated dust from outside the primary contamination. For calculating the area factor, it is assumed a very large area is contaminated. The concentration of radionuclides attached to respirable particulates in the air above the primary contamination is the product of the respirable fraction of particulates and the total air concentration.

The concentration of radionuclides in air at an offsite location has two components. The first is the concentration of radionuclides attached to particulates released from the primary contamination and transported by air to the offsite location. The second is the concentration of radionuclides attached to particulates that are re-suspended from the accumulation at the offsite location.

For verifying inhalation pathway doses, four test cases are used. In all four test cases, the ICRP-107 nuclide database and the DCFPAK3.02 adult internal dose library are used. Table A9.1 list the parameters that are different from the code defaults used in dose calculations. For two test cases, the receptor was outside on the primary contaminated area, and for other two test cases, the receptor was on the dwelling site. Table A9.1 also lists input files used in different runs.

Test Case	Receptor Occupancy & Location	Radionuclides Selected	Primary Contamination Parameters	Cover Parameters	RESRAD- OFFSITE Input File
1	100% outside on PC	²⁶ Al and ¹³⁷ Cs	Area = 1000000 m^2 , thickness = 0.5 m , density = 1.6 g/cm^3	None	inhalation-1.rof
2	100% inside on PC	²⁶ Al and ¹³⁷ Cs	Area = 100 m^2 , thickness = 0.1 m , density = 1.6 g/cm^3	Thickness = 0.05 m	inhalation -2.rof
3	100% time outside on the dwelling site	²⁶ Al and ¹³⁷ Cs	Thickness = 0.5 m , density = 1.6 g/cm^3	None	inhalation -3.rof
4	100% time inside on the dwelling site	²⁶ Al and ¹³⁷ Cs	None	None	inhalation -4.rof

Table A9.1 Parameters That Are Different from Code Defaults in the Test Cases

Inhalation Dose When Receptor Is on Primary Contamination

For verifying dose when the receptor was on the primary contamination, two test cases (inhalation-1.rof and inhalation-2.rof) were used. The receptor was placed outside/inside on the primary contamination, and the contaminated area, thickness, and cover thickness were varied. Table A9.1 lists the parameters used in the run that are different from the code defaults. Only the inhalation pathway was kept active in the run, and the inhalation pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for the inhalation pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

For EXCEL spreadsheet calculations, the primary contamination soil concentration was taken from the code (graphic interface) and the surface layer concentration and air concentration above the primary contamination were calculated. The air concentration along with the respirable fraction, area factor, occupancy factor, inhalation rate, and inhalation dose coefficients were used to calculate the inhalation pathway dose. The detailed calculations are in two EXCEL spreadsheets ("inhalation-pathway-onsite-receptor-case1" and "inhalation-pathway-onsite-receptor-case2"). Figures A91-A9.4 compare the calculated inhalation pathway dose with the inhalation pathway dose from the code.

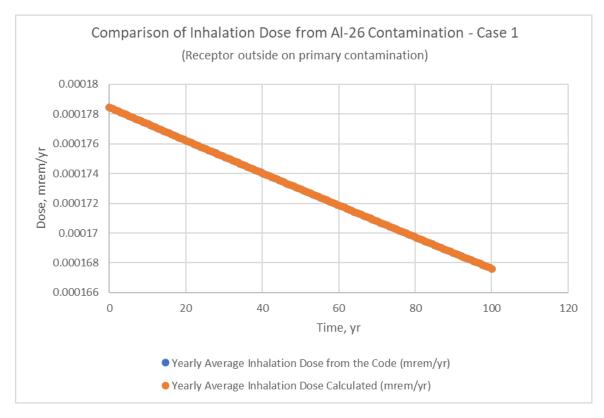


Figure A9.1 Inhalation Dose Comparison for ²⁶Al Contamination – Case 1

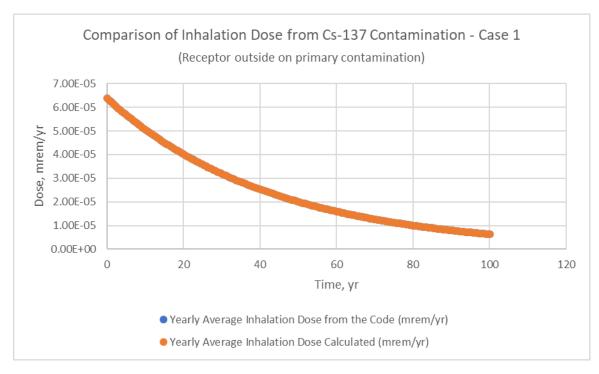


Figure A9.2 Inhalation Dose Comparison for ¹³⁷Cs Contamination – Case 1

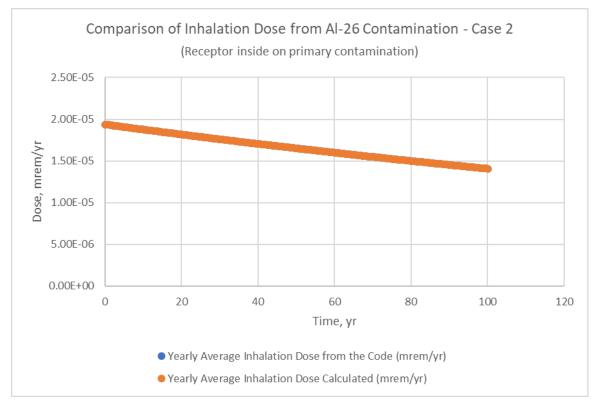


Figure A9.3 Inhalation Dose Comparison for ²⁶Al Contamination – Case 2

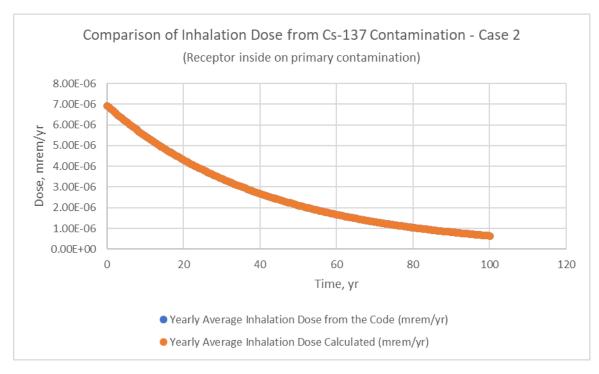


Figure A9.4 Inhalation Dose Comparison for ¹³⁷Cs Contamination – Case 2

Inhalation Dose When Receptor Is offsite

For verifying dose when the receptor was offsite, two test cases (inhalation-3.rof and inhalation-4.rof) were used. In Case 3, the receptor was placed outside on the dwelling site, and in Case 4, the receptor was placed inside on the dwelling site. Table A9.1 lists the parameters used in the run that are different from the code defaults. Only the inhalation pathway was kept active in the run, and the inhalation pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for the inhalation pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

In the EXCEL spreadsheet, the air concentration at the offsite location was calculated for both components. The concentration of radionuclides attached to particulates released from the primary contamination and transported by air to the offsite location was calculated from the release rate of the radionuclides from the primary contamination and CHIOVERQ. CHIOVERQ was taken from the code (from the CHIOVERQ.OUT file generated after the run in the code's root directory), and the air release rate from the primary contamination was calculated. For calculating the air release rate from the primary contamination, first, the surface layer concentration was calculated. For calculating the surface layer concentration, the primary contamination concentration was taken from the graphic interface.

The concentration of radionuclides attached to particulates that are re-suspended from the accumulation at the offsite location was calculated from the offsite soil concentration and the mass loading of particulates at the offsite location. The offsite location soil concentration was taken from the code (graphical interface).

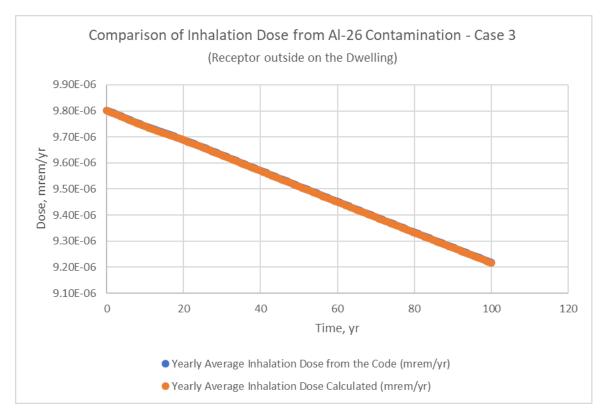


Figure A9.5 Inhalation Dose Comparison for Al-26 Contamination – Case 3

The air concentration at the offsite location along with the respirable fraction, occupancy factor, inhalation rate, and inhalation dose coefficients were used to calculate the inhalation pathway dose. The code dose results were taken from the graphic interface. The detailed calculations are in the EXCEL spreadsheets (inhalation-pathway-offsite-receptor). Figures A9.5-A9.8 compare the calculated inhalation dose with the inhalation dose from the code.

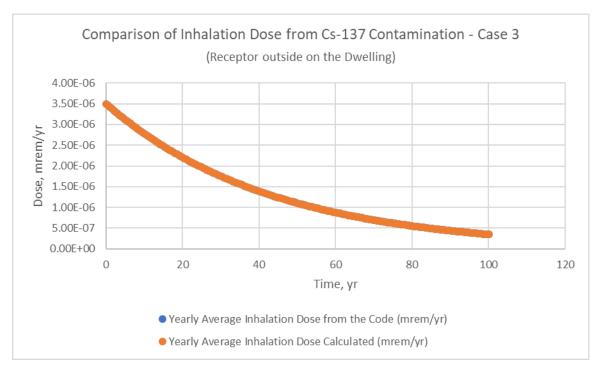


Figure A9.6 Inhalation Dose Comparison for ¹³⁷Cs Contamination – Case 3

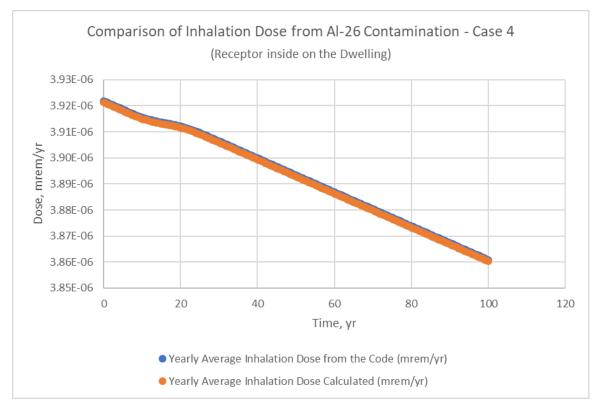


Figure A9.7 Inhalation Dose Comparison for ²⁶Al Contamination – Case 4

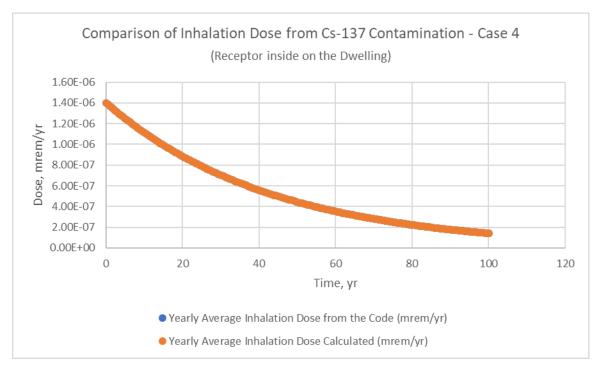


Figure A9.8 Inhalation Dose Comparison for ¹³⁷Cs Contamination – Case 4

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APPENDIX 10: VERIFICATION OF EXTERNAL MODEL AND EXTERNAL EXPOSURE PATHWAY DOSE

RESRAD-OFFSITE calculates the external pathway dose/risk from the primary contamination and secondary contamination for indoor and outdoor receptors. The exposure for each of the situations is computed as the product of the following:

- The dose conversion factor or slope factor for external radiation, for a volume source of infinite thickness and infinite area, from the chosen dose factor library ([mrem/yr]/[pCi/g] or [risk/yr]/[pCi/g]);
- The concentration of the radionuclide in the soil (pCi/g);
- An occupancy and indoor shielding factor to account for the time spent at the location and for the shielding from any building components while indoors;
- A cover and depth factor to account for the finite thickness of the contamination and for any intervening clean cover between the contamination and the receptor; and
- An area and shape factor to account for the finite area and shape of the contaminated soil and for the position (location) of the receptor in relation to the contaminated area.

All the above factors, with the exception of the occupancy factor, depend on the radionuclide. The shape of the primary contamination can be specified to be circular or polygonal. The location of the onsite and offsite dwellings in relation to the primary contamination can also be specified. The offsite areas (dwelling and agricultural areas) are assumed to be circular, with the receptor located at the center of the circle, when calculating the exposure from external radiation.

For verifying the external model and the external exposure pathway doses, four test cases are used. In all four test cases, the ICRP-38 nuclide database and the FGR-12 external exposure dose library are used.

External dose from Primary Contamination

For verifying the dose from primary contamination, two test cases (external-1.rof and external-2.rof) were used. The receptor was placed outside on the primary contamination, and the contaminated area and thickness were varied. The yearly average external pathway dose for seven radionuclides with varying half-lives was estimated with the RESRAD-OFFSITE code and compared with the calculated dose at time zero. For calculations, the dose was taken from the ANL/EAD/TM-84 (Kamboj et al. 1998) report and was corrected for decay. The code results were taken from the summary report. Table A10.1 shows the comparison. The dose results obtained with the code match (less than 1% difference) the calculated results.

				Source area = 1000000 m ² , thickness = 50 cm			Source radius = 100 m ² , thickness = 5 cm			
Radionu clide	Half-life, yr	Decay Constant (/yr)	Yearly Average Concentrat ion, pCi/g	Yearly Dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD /TM-84, mrem/yr	Yearly Dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/T M-84, mrem/yr	
²⁶ Al	7.16E+05	9.68E-07	1.00E+00	1.73E+01	1.73E+01	1.73E+01	5.82E+00	5.92E+00	5.92E+00	
⁵⁷ Co	7.42E-01	9.35E-01	6.50E-01	3.31E-01	3.26E-01	5.01E-01	1.87E-01	1.84E-01	2.83E-01	
⁶⁰ Co	5.27E+00	1.32E-01	9.37E-01	1.51E+01	1.52E+01	1.62E+01	5.20E+00	5.20E+00	5.55E+00	
¹³⁷ Cs	3.00E+01	2.31E-02	9.89E-01	3.37E+00	3.37E+00	3.41E+00	1.32E+00	1.31E+00	1.33E+00	
⁵⁴ Mn	8.56E-01	8.10E-01	6.85E-01	3.57E+00	3.54E+00	5.16E+00	1.34E+00	1.32E+00	1.93E+00	
²³⁴ U	2.45E+05	2.83E-06	1.00E+00	4.01E-04	4.02E-04	4.02E-04	2.71E-04	2.86E-04	2.86E-04	
²³⁵ U	7.04E+08	9.85E-10	1.00E+00	7.57E-01	7.57E-01	7.57E-01	3.90E-01	3.85E-01	3.85E-01	

Table A10.1 Comparison of External Exposure Pathway Dose for Onsite Receptor

Note: Used high Kd in contaminated zone (at least 1000 cm³/g), very less erosion (support practice factor = 0.001).

The code results are taken from the summary report (page 44) at time zero after the run.

The dose results in ANL/EAD/TM-84 are at time zero for the instantaneous dose (do not account for yearly average).

The calculated results correct ANL/EAD/TM-84 results for the yearly average dose.

External Dose from Secondary Contamination

For comparing the external dose from the secondary contamination, two test cases (external-3.rof and external-4.rof) were developed. In both test cases, the secondary contaminated areas were very far, so there was no direct external exposure. In one case, the receptor was located 100% of the time in the pasture and silage field (external-3.rof), and in the other case, the receptor was located 100% of the time in the non-leafy vegetable field (external-4.rof). Only the external exposure pathway was active. The code-generated external pathway dose from the graphical interface was compared with the calculated dose. For calculating dose, the soil concentration in the agricultural field was taken from the code and the depth-cover-factor and area-shape factors were taken from the ANL/EAD/TM-84 report for different radionuclides. Figures A10.1-A10.4 compare the results. The detailed calculations are in the external-exposure-pathway.xlsx spreadsheet.

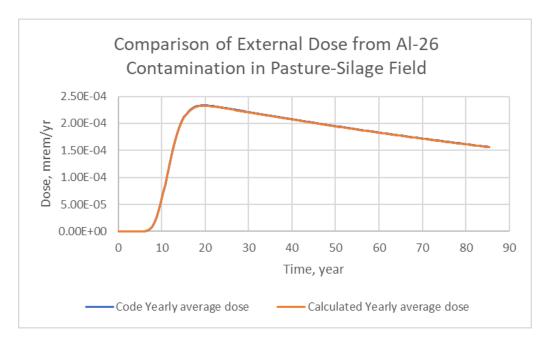


Figure A10.1 External Dose from ²⁶Al Contamination in Pasture and Silage Field

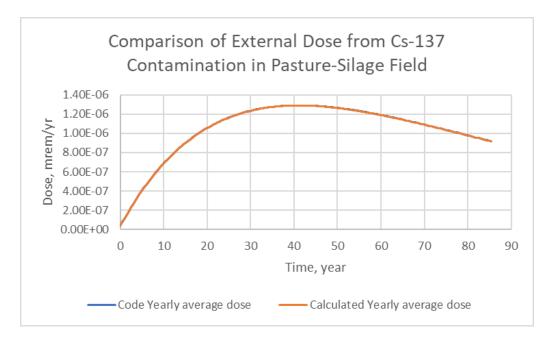


Figure A10.2 External Dose from ¹³⁷Cs Contamination in Pasture and Silage Field

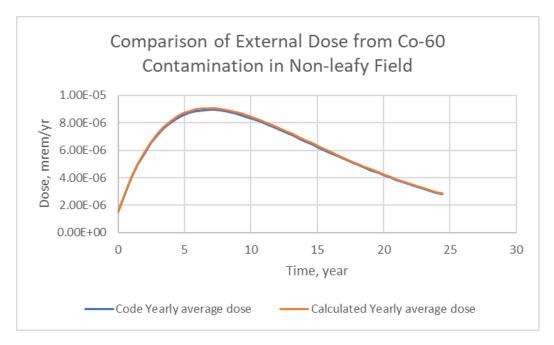


Figure A10.3 External Dose from ⁶⁰Co Contamination in Non-leafy Vegetable Field

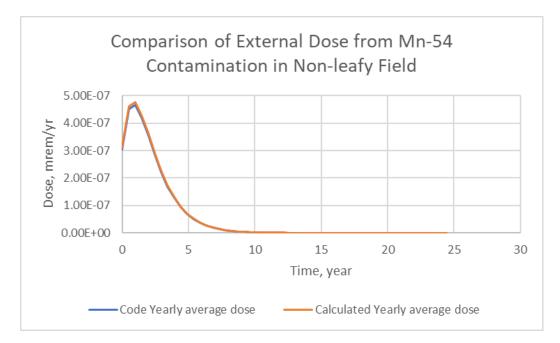


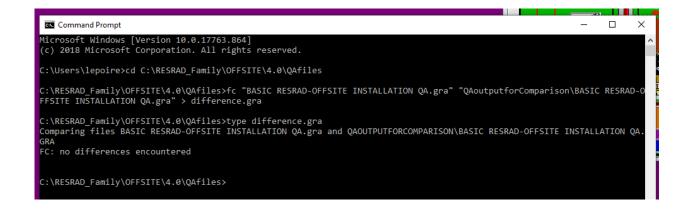
Figure A10.4 External Dose from ⁵⁴Mn Contamination in Non-leafy Vegetable Field

APPENDIX 11: TEST CASES FOR RELEASE TESTING OF RESRAD-OFFSITE VERSION 4.0

The test cases were copied from the test case, quality control, and quality assurance document. The testers were to perform the test as stipulated in the document. These test cases are reproduced here without editing to retain the text in the test case document in order to maintain authenticity.

11.1 TEST CASE 001

Project	RESRAD-OFFSITE							
Test Case ID	RESOFF-TEST-001							
Test Summary	Test installation and operation on various operating systems							
Created By/Date	DJL 8/22/2019							
Test Objective	Test installation and operation on various operating systems							
Procedure	Install and run software on the range of operating systems the version is designed for. Note and document any issues. Specifically test for font installation.							
	Steps:							
	 Install Look at ReadMe Launch code Run QA file, BASIC RESRAD-OFFSITE INSTALLATION QA.ROF (up one folder level, then in the QAFiles folder. Make sure folder is the one just installed.) Open graphics, report, look at font Do file comparison in DOS (fc like below) or equivalent for a set of output result files. 							



Required Data

Expected Successful installations. Should see only expected differences (e.g., date and time in reports) **Results**

11.2 TEST CASE 002

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-002
Test Summary	Tests OFFSITE Nuclide Decay and Ingrowth
Created By/Date	DJL 11/14/2019
Test Objective	Test features of OFFSITE Nuclide Decay and Ingrowth
Procedure	Run case 1, compare to expected results below, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case1.ROF
Expected Results	Verification of RESRAD-OFFSITE Verification Report, Table 2.10 (below)

				· · · ·	· ·			· · ·		· · ·	· · · · · · · · · · · · · · · · · · ·	
	U-2	238	U-2	34	Th-:	230	Ra-2	226	Pb-	210	Po-2	210
Time (yr)	RESRAD- OFFSITE	Spread- sheet	RESRAD- OFFSITE	Spread- sheet								
0	100	100	0	0	0	0	0	0	0	0	0	0
1	9.97E+01	9.97E+01	2.83E-04	2.83E-04	1.27E-09	1.27E-09	1.84E-13	1.84E-13	1.40E-15	1.40E-15	3.71E-16	4.01E-16
2	9.93E+01	9.93E+01	5.63E-04	5.63E-04	5.08E-09	5.08E-09	1.47E-12	1.47E-12	2.25E-14	2.25E-14	9.98E-15	1.00E-14
3	9.90E+01	9.90E+01	8.42E-04	8.42E-04	1.14E-08	1.14E-08	4.94E-12	4.94E-12	1.13E-13	1.13E-13	6.21E-14	6.22E-14
4	9.87E+01	9.87E+01	1.12E-03	1.12E-03	2.02E-08	2.02E-08	1.17E-11	1.17E-11	3.54E-13	3.54E-13	2.21E-13	2.21E-13
5	9.84E+01	9.84E+01	1.39E-03	1.39E-03	3.15E-08	3.15E-08	2.28E-11	2.28E-11	8.58E-13	8.58E-13	5.80E-13	5.80E-13
50	8.47E+01	8.47E+01	1.20E-02	1.20E-02	2.86E-06	2.86E-06	2.05E-08	2.05E-08	6.04E-09	6.04E-09	5.76E-09	5.76E-09
75	7.80E+01	7.80E+01	1.66E-02	1.66E-02	6.09E-06	6.09E-06	6.52E-08	6.52E-08	2.56E-08	2.56E-08	2.47E-08	2.47E-08
100	7.18E+01	7.18E+01	2.03E-02	2.03E-02	1.03E-05	1.03E-05	1.46E-07	1.46E-07	6.84E-08	6.84E-08	6.66E-08	6.66E-08
125	6.60E+01	6.60E+01	2.34E-02	2.34E-02	1.52E-05	1.52E-05	2.69E-07	2.69E-07	1.43E-07	1.43E-07	1.39E-07	1.39E-07
150	6.08E+01	6.08E+01	2.58E-02	2.58E-02	2.07E-05	2.07E-05	4.38E-07	4.38E-07	2.54E-07	2.54E-07	2.49E-07	2.49E-07
175	5.59E+01	5.59E+01	2.77E-02	2.77E-02	2.68E-05	2.68E-05	6.57E-07	6.57E-07	4.08E-07	4.08E-07	4.01E-07	4.01E-07
200	5.15E+01	5.15E+01	2.92E-02	2.92E-02	3.32E-05	3.32E-05	9.26E-07	9.26E-07	6.07E-07	6.07E-07	5.97E-07	5.97E-07
225	4.74E+01	4.74E+01	3.02E-02	3.02E-02	3.98E-05	3.98E-05	1.25E-06	1.25E-06	8.53E-07	8.53E-07	8.40E-07	8.40E-07
250	4.36E+01	4.36E+01	3.09E-02	3.09E-02	4.67E-05	4.67E-05	1.61E-06	1.61E-06	1.15E-06	1.15E-06	1.13E-06	1.13E-06
275	4.01E+01	4.01E+01	3.13E-02	3.13E-02	5.37E-05	5.37E-05	2.03E-06	2.03E-06	1.48E-06	1.48E-06	1.46E-06	1.46E-06
300	3.69E+01	3.69E+01	3.14E-02	3.14E-02	6.07E-05	6.07E-05	2.49E-06	2.49E-06	1.87E-06	1.87E-06	1.84E-06	1.84E-06
350	3.13E+01	3.13E+01	3.10E-02	3.10E-02	7.48E-05	7.48E-05	3.54E-06	3.54E-06	2.76E-06	2.76E-06	2.73E-06	2.73E-06
400	2.65E+01	2.65E+01	3.00E-02	3.00E-02	8.85E-05	8.85E-05	4.73E-06	4.73E-06	3.81E-06	3.81E-06	3.76E-06	3.76E-06
450	2.25E+01	2.25E+01	2.86E-02	2.86E-02	1.02E-04	1.02E-04	6.04E-06	6.04E-06	4.98E-06	4.98E-06	4.92E-06	4.92E-06
500	1.90E+01	1.90E+01	2.69E-02	2.69E-02	1.14E-04	1.14E-04	7.43E-06	7.43E-06	6.25E-06	6.25E-06	6.18E-06	6.18E-06
550	1.61E+01	1.61E+01	2.51E-02	2.51E-02	1.26E-04	1.26E-04	8.88E-06	8.88E-06	7.60E-06	7.60E-06	7.51E-06	7.51E-06
600	1.36E+01	1.36E+01	2.32E-02	2.32E-02	1.37E-04	1.37E-04	1.04E-05	1.04E-05	8.99E-06	8.99E-06	8.89E-06	8.89E-06
650	1.16E+01	1.16E+01	2.13E-02	2.13E-02	1.46E-04	1.46E-04	1.19E-05	1.19E-05	1.04E-05	1.04E-05	1.03E-05	1.03E-05
700	9.79E+00	9.79E+00	1.94E-02	1.94E-02	1.56E-04	1.56E-04	1.34E-05	1.34E-05	1.18E-05	1.18E-05	1.17E-05	1.17E-05
750	8.30E+00	8.30E+00	1.76E-02	1.76E-02	1.64E-04	1.64E-04	1.49E-05	1.49E-05	1.32E-05	1.32E-05	1.31E-05	1.31E-05
800	7.03E+00	7.03E+00	1.59E-02	1.59E-02	1.71E-04	1.71E-04	1.63E-05	1.63E-05	1.46E-05	1.46E-05	1.45E-05	1.45E-05
850	5.95E+00	5.95E+00	1.43E-02	1.43E-02	1.78E-04	1.78E-04	1.77E-05	1.77E-05	1.60E-05	1.60E-05	1.58E-05	1.58E-05
900	5.04E+00	5.04E+00	1.28E-02	1.28E-02	1.84E-04	1.84E-04	1.90E-05	1.90E-05	1.73E-05	1.73E-05	1.71E-05	1.71E-05
950	4.27E+00	4.27E+00	1.15E-02	1.15E-02	1.89E-04	1.89E-04	2.03E-05	2.03E-05	1.85E-05	1.85E-05	1.84E-05	1.84E-05
1000	3.62E+00	3.62E+00	1.02E-02	1.02E-02	1.94E-04	1.94E-04	2.15E-05	2.15E-05	1.97E-05	1.97E-05	1.95E-05	1.95E-05

 Table 2-10
 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Concentration of Nuclide in the Unmixed Portion of the Primary Contamination for Case I Concerning U-238 and Its Progenies, with Notable Disagreement Highlighted

11.3 TEST CASE 003-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-003-001
Test Summary	Tests OFFSITE Source Term Mixing Concentration
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Mixing Concentration
Procedure	Run case 2, compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case2.ROF
Expected Results	Verification of RESRAD-OFFSITE Table 2.5 (below)

Table 2-5 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Modification Factor for the Concentration of Nuclides in the Mixing Zone for Case II Concerning Cs-137, with Notable Disagreement Highlighted

Time (yr)	RESRAD-OFFSITE	Spreadsheet
349	0	0
350	0	1.510E-07
351	6.644E-03	6.645E-03
352	1.324E-02	1.324E-02
353	1.980E-02	1.980E-02
354	2.631E-02	2.631E-02
355	3.278E-02	3.278E-02
375	1.535E-01	1.535E-01
400	2.835E-01	2.835E-01
425	3.935E-01	3.935E-01
450	4.866E-01	4.866E-01
475	5.654E-01	5.654E-01
500	6.321E-01	6.321E-01
525	6.886E-01	6.886E-01
550	7.364E-01	7.364E-01
575	7.769E-01	7.769E-01
600	8.111E-01	8.111E-01
625	8.401E-01	8.401E-01
650	8.647E-01	8.647E-01
675	8.854E-01	8.854E-01
700	9.030E-01	9.030E-01
725	9.179E-01	9.179E-01
750	9.305E-01	9.305E-01
775	9,412E-01	9.412E-01
800	9.502E-01	9.502E-01
825	9.579E-01	9.579E-01
850	9.643E-01	9.643E-01
851	9.579E-01	9.579E-01
852	9.516E-01	9.516E-01
853	9.452E-01	9.452E-01
854	9.389E-01	9.390E-01
855	9.327E-01	9.327E-01
875	8.163E-01	8.163E-01
900	6.910E-01	6.910E-01
925	5.849E-01	5.849E-01
950	4.951E-01	4.951E-01
1000	3.548E-01	3.548E-01

11.4 TEST CASE 003-002

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-003-002
Test Summary	Tests OFFSITE Source Term Mixing Concentration
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Mixing Concentration
Procedure	Run case 3, compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case3.ROF
Expected Results	Verification of RESRAD-OFFSITE Table 2.6 (below)

Table 2-6

Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Modification Factor for the Concentration of Nuclides in the Mixing Zone for Case III Concerning H-3, with Notable Disagreement Highlighted

Time (yr)	RESRAD-OFFSITE	Spreadsheet
149	0	0
150	Ő	6.066E-08
151	6.231E-03	6.232E-03
152	1.243E-02	1.243E-02
153	1.859E-02	1.859E-02
154	2.471E-02	2.471E-02
155	3.080E-02	3.080E-02
160	6.071E-02	6.071E-02
165	8.975E-02	8.975E-02
170	1.179E-01	1.179E-01
175	1.453E-01	1.453E-01
180	1.719E-01	1.719E-01
185	1.977E-01	1.977E-01
190	2.227E-01	2.227E-01
200	2.705E-01	2.705E-01
210	3.156E-01	3.156E-01
220	3.579E-01	3.579E-01
230	3.978E-01	3.978E-01
240	4.353E-01	4.353E-01
250	4.705E-01	4.705E-01
260	5.036E-01	5.036E-01
270	5.347E-01	5.347E-01
280	5.638E-01	5.638E-01
290	5.913E-01	5.913E-01
300	6.170E-01	6.170E-01
350	6.170E-01	6.170E-01
400	6.170E-01	6.170E-01
500	6.170E-01	6.170E-01
600	6.170E-01	6.170E-01
700	6.170E-01	6.170E-01
800	6.170E-01	6.170E-01
900	6.170E-01	6.170E-01
1000	6.170E-01	6.170E-01

11.5 TEST CASE 003-003

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-003-003
Test Summary	Tests OFFSITE Source Term Mixing Concentration
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Mixing Concentration
Procedure	Run case 8, compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case8.ROF

Expected Results

Table 2-8 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Modification Factor for the Concentration of Nuclides in the Mixing Zone for Case VIII Concerning Ra-226, with Notable Disagreement Highlighted

99 0 0 100 0 2.491E-07 101 4.404E-03 4.404E-03 102 8.790E-03 8.790E-03 103 1.316E-02 1.316E-02 104 1.751E-02 1.751E-02 105 2.185E-02 2.185E-02 105 2.04E-01 2.004E-01 150 2.004E-01 2.004E-01 200 3.640E-01 3.640E-01 250 4.964E-01 4.964E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.679E-01 375 6.679E-01 7.055E-01 475 7.391E-01 7.391E-01 525 7.689E-01 7.689E-01	1
101 4.404E-03 4.404E-03 102 8.790E-03 8.790E-03 103 1.316E-02 1.316E-02 104 1.751E-02 1.751E-02 105 2.185E-02 2.185E-02 125 1.051E-01 1.051E-01 150 2.004E-01 2.004E-01 200 3.640E-01 3.640E-01 250 4.964E-01 4.964E-01 250 4.964E-01 5.524E-01 325 6.256E-01 6.670E-01 375 6.670E-01 7.055E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
102 8.790E-03 8.790E-03 103 1.316E-02 1.316E-02 104 1.751E-02 1.751E-02 105 2.185E-02 2.185E-02 125 1.051E-01 1.051E-01 150 2.044E-01 2.004E-01 200 3.640E-01 3.640E-01 250 4.964E-01 4.964E-01 250 4.964E-01 5.524E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
103 1.316E-02 1.316E-02 104 1.751E-02 1.751E-02 105 2.185E-02 2.185E-02 125 1.051E-01 1.051E-01 150 2.004E-01 2.004E-01 175 2.865E-01 2.865E-01 200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
104 1.751E-02 1.751E-02 105 2.185E-02 2.185E-02 125 1.051E-01 1.051E-01 150 2.004E-01 2.004E-01 175 2.865E-01 2.865E-01 200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.679E-01 375 6.679E-01 7.055E-01 425 7.055E-01 7.391E-01	
105 2.185E-02 2.185E-02 125 1.051E-01 1.051E-01 150 2.004E-01 2.004E-01 175 2.865E-01 2.865E-01 200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.256E-01 375 6.679E-01 7.055E-01 425 7.055E-01 7.391E-01	
125 1.051E-01 1.051E-01 150 2.004E-01 2.004E-01 175 2.865E-01 2.865E-01 200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.679E-01 375 6.679E-01 7.055E-01 425 7.055E-01 7.391E-01	
150 2.004E-01 2.004E-01 175 2.865E-01 2.865E-01 200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.679E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
175 2.865E-01 2.865E-01 200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.256E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
200 3.640E-01 3.640E-01 225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.256E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
225 4.338E-01 4.338E-01 250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.256E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
250 4.964E-01 4.964E-01 275 5.524E-01 5.524E-01 325 6.256E-01 6.256E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
275 5.524E-01 5.524E-01 325 6.256E-01 6.256E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
325 6.256E-01 6.256E-01 375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
375 6.679E-01 6.679E-01 425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
425 7.055E-01 7.055E-01 475 7.391E-01 7.391E-01	
475 7.391E-01 7.391E-01	
525 7.689E.01 7.689E.01	
575 7.954E-01 7.954E-01	
625 8.189E-01 8.189E-01	
675 8.398E-01 8.398E-01	
725 8.583E-01 8.583E-01	
775 8.747E-01 8.747E-01	
825 8.892E-01 8.892E-01	
875 9.021E-01 9.021E-01	
899 9.077E-01 9.077E-01	
900 9.080E-01 9.080E-01	
901 9.057E-01 9.057E-01	
925 8.530E-01 8.530E-01	
950 8.013E-01 8.013E-01	
975 7.527E-01 7.527E-01	
1000 7.071E-01 7.071E-01	

11.6 TEST CASE 005

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-005 ID

Test Tests OFFSITE Source Term Leaching Summary

Created DJL 7/29/2019

By/Date

Test Test features of OFFSITE Source Term Leaching

Objective

Procedure Run cases 1; compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'

Required VROFF_Case1.ROF Data

2

	U-238		U-234		Th-230		Ra-226		Pb-210		Po-210	
Time (yr)	RESRAD- OFFSITE	Spread- sheet										
0	9.96E+09	9.96E+09	0.00E+00	0.00E+00								
ĩ	9.87E+09	9.87E+09	2.80E+04	2.80E+04	1.06E-04	1.06E-04	1.30E-05	1.30E-05	6.94E-08	6.94E-08	1.95E-07	1.81E-07
2	9.79E+09	9.79E+09	5.55E+04	5.55E+04	4.19E-04	4.19E-04	1.03E-04	1.03E-04	1.11E-06	1.11E-06	4.84E-06	4.85E-06
3	9.71E+09	9.71E+09	8.26E+04	8.26E+04	9.36E-04	9.36E-04	3.46E-04	3.46E-04	5.56E-06	5.56E-06	3.00E-05	3.00E-05
4	9.63E+09	9.63E+09	1.09E+05	1.09E+05	1.65E-03	1.65E-03	8.15E-04	8.15E-04	1.73E-05	1.73E-05	1.06E-04	1.06E-04
5	9.55E+09	9.55E+09	1.35E+05	1.35E+05	2.56E-03	2.56E-03	1.58E-03	1.58E-03	4.17E-05	4.17E-05	2.77E-04	2.77E-04
25	8.02E+09	8.02E+09	5.68E+05	5.68E+05	5.50E-02	5.50E-02	1.69E-01	1.69E-01	1.99E-02	1.99E-02	1.79E-01	1.79E-01
50	6.33E+09	6.33E+09	8.97E+05	8.97E+05	1.79E-01	1.79E-01	1.09E+00	1.09E+00	2.26E-01	2.26E-01	2.11E+00	2.11E+00
75	4.85E+09	4.85E+09	1.03E+06	1.03E+06	3.17E-01	3.17E-01	2.90E+00	2.90E+00	7.98E-01	7.98E-01	7.57E+00	7.57E+00
100	3.57E+09	3.57E+09	1.01E+06	1.01E+06	4.27E-01	4.27E-01	5.19E+00	5.19E+00	1.71E+00	1.71E+00	1.63E+01	1.63E+01
150	1.51E+09	1.51E+09	6.43E+05	6.43E+05	4.32E-01	4.32E-01	7.80E+00	7.80E+00	3.17E+00	3.17E+00	3.05E+01	3.05E+01
200	1.41E+08	1.41E+08	8.02E+04	8.02E+04	7.63E-02	7.63E-02	1.82E+00	1.82E+00	8.36E-01	8.36E-01	8.07E+00	8.07E+00
250	4.27E+06	4.27E+06	3.03E+03	3.03E+03	3.83E-03	3.83E-03	1.13E-01	1.13E-01	5.63E-02	5.63E-02	5.44E-01	5.44E-01
300	1.29E+05	1.29E+05	1.10E+02	1.10E+02	1.78E-04	1.78E-04	6.23E-03	6.23E-03	3.27E-03	3.27E-03	3.17E-02	3.17E-02
350	3.90E+03	3.90E+03	3.87E+00	3.87E+00	7.81E-06	7.81E-06	3.16E-04	3.16E-04	1.73E-04	1.73E-04	1.67E-03	1.67E-03
400	1.18E+02	1.18E+02	1.34E-01	1.34E-01	3.30E-07	3.30E-07	1.50E-05	1.50E-05	8.49E-06	8.49E-06	8.23E-05	8.23E-05
450	3.56E+00	3.56E+00	4.54E-03	4.54E-03	1.35E-08	1.35E-08	6.85E-07	6.85E-07	3.96E-07	3.96E-07	3.84E-06	3.84E-06
500	1.08E-01	1.08E-01	1.53E-04	1.53E-04	5.41E-10	5.41E-10	3.01E-08	3.01E-08	1.77E-08	1.77E-08	1.72E-07	1.72E-07
550	3.26E-03	3.25E-03	5.07E-06	5.07E-06	2.13E-11	2.13E-11	1.28E-09	1.28E-09	7.69E-10	7.69E-10	7.46E-09	7.46E-09
600	9.84E-05	9.84E-05	1.67E-07	1.67E-07	8.24E-13	8.24E-13	5.35E-11	5.35E-11	3.25E-11	3.25E-11	3.15E-10	3.15E-10
650	2.97E-06	2.97E-06	5.47E-09	5.47E-09	3.15E-14	3.15E-14	2.18E-12	2.18E-12	1.34E-12	1.34E-12	1.30E-11	1.30E-11
700	8.98E-08	8.98E-08	1.78E-10	1.78E-10	1.19E-15	1.19E-15	8.78E-14	8.78E-14	5.44E-14	5.44E-14	5.28E-13	5.28E-13
750	2.71E-09	2.71E-09	5.77E-12	5.77E-12	4.48E-17	4.48E-17	3.48E-15	3.48E-15	2.17E-15	2.17E-15	2.11E-14	2.11E-14
800	8.20E-11	8.20E-11	1.86E-13	1.86E-13	1.67E-18	1.67E-18	1.36E-16	1.36E-16	8.56E-17	8.56E-17	8.32E-16	8.32E-16
850	2.48E-12	2.48E-12	5.97E-15	5.97E-15	6.20E-20	6.20E-20	5.27E-18	5.27E-18	3.34E-18	3.34E-18	3.24E-17	3.24E-17
900	7.49E-14	7.49E-14	1.91E-16	1.91E-16	2.29E-21	2.29E-21	2.02E-19	2.02E-19	1.29E-19	1.29E-19	1.25E-18	1.25E-18
950	2.26E-15	2.26E-15	8.81E+05	8.81E+05	8.39E-23	8.40E-23	7.70E-21	7.70E-21	4.92E-21	4.92E-21	4.78E-20	4.78E-20
1000	6.84E-17	6.84E-17	8.74E+05	8.74E+05	3.07E-24	3.07E-24	2.91E-22	2.91E-22	1.87E-22	1.87E-22	1.82E-21	1.82E-21

 Table 2-16
 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Release Rates of Nuclide to Groundwater for Case I Concerning U-238 and Its Progenies, with Notable Disagreement Highlighted

11.7 TEST CASE 020-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-020-001
Test Summary	Tests OFFSITE gaseous and particulate C-14 inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE gaseous and particulate C-14 inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'INHALATION OF CARBON-14.ROF'
Expected Results	'C14 inhalation.xlsx' in 'Special radionuclides' V&V folder

11.8 TEST CASE 020-002

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-020-002
Test Summary	Tests OFFSITE tritium inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE tritium inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'INHALATION OF HYDROGEN-3.ROF'
Expected Results	'H3 inhalation.xlsx' in 'Special radionuclides' V&V folder

11.9 TEST CASE 020-003

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-020-003
Test Summary	Tests OFFSITE Rn-222 inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE Rn-222 inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'RN222 FROM HOUSEHOLD WATER USE.ROF'
Expected Results	'Rn 222 household water.xlsx' in 'Special radionuclides' V&V folder

11.10 TEST CASE 020-004

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-020-004
Test Summary	Tests OFFSITE Rn-220 inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE Rn-220 inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'RN220 FROM HOUSEHOLD WATER USE.ROF'
Expected Results	'Rn 220 household water.xlsx' in 'Special radionuclides' V&V folder

11.11 TEST CASE 027-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-27-001
Test Summary	Test the presentation of output reports.
Created By/Date	CW 10/17/2019
Test Objective	To test the presentation of output reports.
Procedure	 Run the code with initial concentration of 100 pCi/g for U-238. Three report files should be generated: Summary.rep, DAUDOSE.REP, and INTRISK.REP Open Summary.rep from report Reviewer, and check the following a. whether it includes Code name, version, T½ limit, running time, and page number, report type (Parent Dose Report), title, and input file name on each page Table of Contents should include the following elements and their corresponding page numbers.

- 4) Open DAUDOSE.REP and check the following
 - a. whether it includes Code name, version, T¹/₂ limit, running time, and page number, report type (Parent Dose Report), title, and input file name on each page
 - b. Table of Contents should include total dose components summed to progeny: Total Dose Contribution for each individual Radionuclides and Pathways
- 5) Open INTRISK.REP and check the following
 - a. whether it includes Code name, version, T ¹/₂ limit, running time, and page number, report type (Parent Dose Report), title, and input file name on each page
 - b. Table of Contents should include
 - i. Cancer Risk Slope Factors summary table should include library name, and parameter values (current value and default) and parameter name
 - ii. Excess Cancer Risk for each individual radionuclide and pathway at each report time

Required None. Data

Expected The reports should have the required content and format. **Results**

11.12 TEST CASE 027-002

Project	RESRAD-OFFSITE
Test Case ID	RESROFF-TEST-27-002s
Test Summary	Test the functionality of report Viewer
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of report Viewer
Procedure	 Run the code with initial concentration of 100 pCi/g for Ac-227. Click View->Text Output -> Parent Dose Report, the report Viewer should pop up and open SUMMARY.REP file. The File menu should function as its self-description. Edit menu should enable to select and copy of the present page Help menu should open the help file for the code with Report Viewer topic page opened. The Tool bar icons are also self-explained. a. The page up/down should work. Put the cursor on the page number box, type 3, and the press Enter key, and Page 3 should present. Click the dropdown arrow of page number, a list of pages should appear, select 8, and click Enter key. Page 8 should present. Repeat Step 2 using Toolbar icon, left side navigation panel -> View Output -> Parent Dose Report, Iconic Navigator Results Parent Dose Report.
Required Data	None.
Expected Results	The code should behave as described in each step.

File	Edit Help						
	Save	Ctrl+S	🕒 📄 📴 🛛 Page: 🚺 🗸 🤅	₹			
	Save All		eta T?Limit = 30 days	11/12/2019	10:33	Page	
	Printer Setup	F7	Parameters				
	Print	F8					
	Adjust Font		Contents				
	Make New MyFonts.Dat		gle Radionuclide Guidelines				
	View Another File	Ctrl+F	?				
			.ated) Parameter Summary	2			
	Exit Viewer						
			1	4			
]	33			
Con	taminated Zone and To			-			
Con	taminated Zone and To al Dose Components	tal Do	se Summary	33 34			
Con	taminated Zone and To al Dose Components Time = 0.0002+00	tal Do:]	33			
Con	<pre>taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00</pre>	tal Do	se Summary	33 34 35			
Con	<pre>taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00</pre>	tal Do:	se Summary	33 34 35 36			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+00	tal Do:	se Summary	33 34 35 36 37			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+00 Time = 1.2002+01	tal Do:	se Summary	33 34 35 36 37 38			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+00 Time = 1.2002+01 Time = 3.0002+01	tal Do	se Summary	33 34 35 36 37 38 39			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+00 Time = 1.2002+01 Time = 3.0002+01 Time = 7.5002+01	tal Do	se Summary	33 34 35 36 37 38 39 40			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+01 Time = 1.2002+01 Time = 7.5002+01 Time = 1.7502+02	tal Do	se Summary	33 34 35 36 37 38 39 40 41			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+00 Time = 1.2002+01 Time = 3.0002+01 Time = 7.5002+01 Time = 1.7502+02 Time = 4.2002+02	tal Dos	se Summary	33 34 35 36 37 38 39 40 41 41			
Con	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+01 Time = 1.2002+01 Time = 3.0002+01 Time = 7.5002+01 Time = 4.2002+02 Time = 9.7002+02	tal Dos	se Summary	33 34 35 36 37 38 39 40 41 42 43			
Con Lot	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+01 Time = 1.2002+01 Time = 3.0002+01 Time = 7.5002+01 Time = 1.7502+02 Time = 4.2002+02 Time = 5.7002+02	tal Dos	se Summary	33 34 35 36 37 38 39 40 41 42 43 43			
Con Tot Dos Sin Dos	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+01 Time = 1.2002+01 Time = 7.5002+01 Time = 7.5002+01 Time = 4.2002+02 Time = 9.7002+02 e/Source Ratios Summed e Per Nuclide Summed 0	tal Don	All Pathways Lines 11 Pathways	33 34 35 36 37 38 39 40 41 42 43 44 45			
Con Tot Sin Dos	taminated Zone and To al Dose Components Time = 0.0002+00 Time = 1.0002+00 Time = 3.0002+00 Time = 6.0002+01 Time = 1.2002+01 Time = 7.5002+01 Time = 7.5002+01 Time = 4.2002+02 Time = 9.7002+02 e/Source Ratios Summed e Per Nuclide Summed 0	tal Don	se Summary All Pathways Lines	33 34 35 36 37 38 39 40 41 42 43 44 45 45			

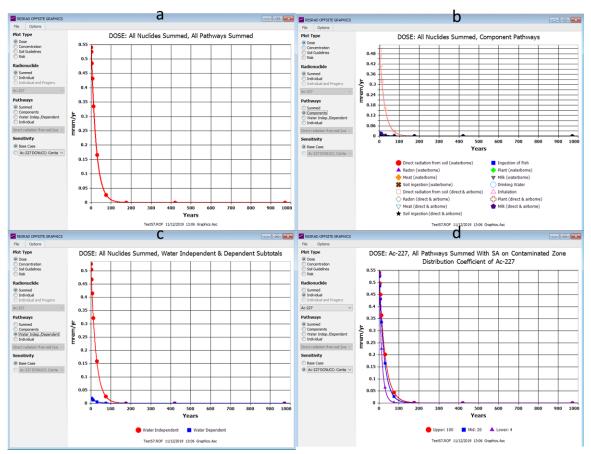
11.13 TEST CASE 028-001

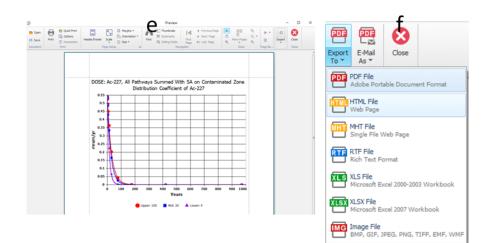
Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-28-001
Test Summary	Test the functionality of Wresplot
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Wresplot
Procedure	 Run the code with initial concentration of 100 pCi/g for Ac-227 and sensitivity analysis for precipitation and contaminated zone distribution coefficient. Save the project to Test57.rof and run the code. Click View/Deterministics Graphics to open Wresplot displaying the graph of current calculation. Check the bottom of the right panel; it should include the input file name, file generation data, and the graphics file name, Graphics.Asc by default. In the left panel, it should include Plot Type (including Dose, Concentration, Soil Guidelines, and Risk), Radionuclide (including Summed, Individual, and Individual and Progeny), Pathways (including Summed, components, water independent/dependent, and Individual), and Sensitivity (Base Case, and dropdown list for each sensitivity analysis parameter) Click every option for Plot Type, Radionuclide, Pathways, and Sensitivity, and check the plot in the right panel, including X and Y-axis, plot title, legend, etc. Moving the cursor along X-axis, a textbox with information of the year where the cursor is at and the corresponding Y-axis value should display next to the cursor. Under Sensitivity section, select each of the two parameters, then check the plot in the right panel. The File menu should function as the self-description of each submenu. Print Review submenu should bring up a window similar to Figure e. Clicking Print should bring up a printer selection window and clicking Export to should bring up a window as shown in Figure f for file format option. Export Graphics submenu should bring up a window similar to Figure e for file format selection. Depending on software installed in the testing computer, the formation options could be different for different computers.

- c. Export Data submenu should enable to save the data to a .csv file.
- 8) Repeat Step 2 using Toolbar icon, left side navigation panel -> View Output -> Deterministic Graphics, Iconic Navigator|Results| Deterministic Graphics.

Required None. Data

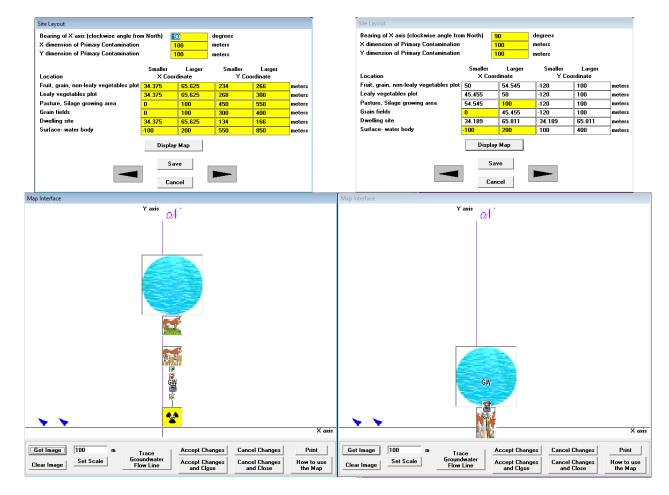
Expected The code should have the required elements and behave as described in each step. **Results**





Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-29-001
Test Summary	Test the functionality of Onsite Scenario Template.
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Onsite Scenario Template.
Procedure	 Launch the code. Click Modify Data -> Site Layout. The default site should look like the left figures in the Expected Results section. Click File -> Onsite Scenario Template. A new window with caption "Onsite Scenario Primary Contamination" should pop up. Click Save to close the window. Click Site Layout, and the site should look like the figure on the right side of the Expected Results section.
Required Data	None

Expected Results



11.15 TEST CASE 029-002

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-29-002 ID

Test Test if Simulate the RESRAD-Onsite Code works properly. **Summary**

Created	CW 10/17/2019
By/Date	

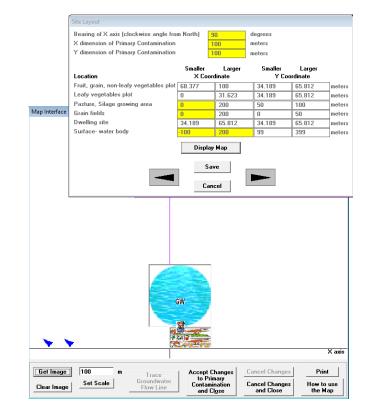
Test To test the functionality of Simulate the RESRAD-Onsite Code.

Objective

- **Procedure** 1) Launch the code. Click File -> Simulate the RESRAD-Onsite code. A new window with caption "Title & Radiological Data" should pop up. Click Close.
 - 2) Click Site Layout, and the site data should be identical to the figure shown in the Expected Results section.

Required	None
Data	

Expected Results



11.16 TEST CASE 030-001

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-30-001 ID

Test Test whether DCF Editor works properly. **Summary**

Created CW 10/17/2019 **By/Date**

TestTo test DCF Editor interface. The response of DCF Editor to the main interface is tested in controlObjectivelevel test and the data is checked elsewhere.

Procedure 1) Launch DCF Editor by clicking File-> DCF Editor from the main interface, or by double clicking DCF Editor executable from DCF installation folder. The default DCF folder is in c:\RESRAD_Family\DCF\3.1 for RESRAD-OFFSITE.

- 2) The DCF Editor version number, and creation date should display correctly.
- 3) The default should be the following
 - a. radionuclides library: ICRP107
 - b. Library option: Create a new DCF library
 - c. Base External DCF: DCFPAK3.02
 - d. Base internal DCF: DCFPAK3.02 (Adult)
 - e. Base risk library: DCFPAK3.02 Morbidity
- 4) Changing radionuclide library to ICRP 38 will change the external, internal, and risk library to FGR 12, FGR 11, and FGR 13 Morbidity, respectively.
- 5) With ICRP107 selected, click View a Default Library (Read Only), then View Library, and a new window of DCFPAK3.02 (Adult) library should pop out.
- 6) In the window, the default Selected Nuclide should be Ac-233, and for tabs, namely, Dose Conversion Factors, Slope Factors, Radon, and Transfer Factors, should present.
- 7) Click each tab and check whether all the layouts are shown properly, and whether the background of each text box is in yellow, whether the units are conventional units.
- 8) Change to Cs-137, and repeat Step 7.
- 9) Change to Zr-91 and repeat Step 7.
- 10) With Zr-97 selected and try to change the external, internal, and ingestion DCF. Any changes should not be allowed.

- 11) Click Dose Factors Help button on the Upper-right corner, and check whether the Help file works properly.
- 12) Click Another library, and the code should close this window and go back to the main interface of DCF Editor.
- 13) Select library to view to DOE STD-1196-2011 (Reference Person), and repeat Steps 6-12.
- 14) Select ICRP38 radionuclide library, and repeat Steps 6-13.
- 15) Click Help -> General Hep and check whether the Help file window pop up and whether the content in the right panel presents accordingly to the click of the contents list in the left panel.
- 16) Click F1 key from the main DCF Editor interface and repeat Step 15.
- 17) Click Help -> Context-Sensitive Help and check whether the Help file works properly.
- 18) Select ICRP107 and Create a new DCF library, type "Test DCF Editor' in the Box of "Type the name of the new DCF library", then type "This is test 006" in the Library Description box, and click Create Library button.
- 19) In the pop-up window, select Ac-227, then click the selection circle under Default DCFPAK3.02 in the External and Ingestion DCF frame, and type 0 in the text box, and the click Exit Program. This will change the ingestion and external DCF of Ac-227 to zero and save it to a new library named Test DCF Editor.
- 20) From RESRAD-OFFSITE main interface, click Change Title, then select Test DCF Editor from the drop-down list of Internal expose dose library.
- 21) Select Ac-227 from the Initial Concentrations form
- 22) Save the project as Test006.rof to UserFiles under the application folder, and run the code.
- 23) Open test006.rof and check whether the library "Test DCF Editor" in used
- 24) From the summary report (Page 2), check whether the external DCF was zero.

Required None. Data

Expected DCF Editor works properly.

- Results
- 1) Available DCF libraries changes correctly when radionuclide library is changed.
- 2) Can view DCF values
- 3) Can create new library by modifying a set of base libraries
- 4) The created library can be read in and used by RESRAD-OFFSITE code correctly
- 5) Menu works properly.

11.17 TEST CASE 031-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-31-001
Test Summary	Test the functionality of Sensitivity Analysis (Single Parameter)
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Sensitivity Analysis (Single Parameter)
Procedure	 Launch the code and open Initial Concentration form and select Ac-227, then open Radionuclide Specific Release form. Make sure menu View Sensitivity Input Summery is selected. Information as shown in Fig 1 should present at the bottom left corner of the main interface. Put cursor focus on the second text box with default value of 20, then click Form Options Sensitivity Analysis (Single Parameter) menu, a window like Fig 3 should pop up. Click OK. Check the bottom left corner of the main interface again. Information as shown in Fig 2 should present, indicating the available parameter for sensitivity analysis. Double clicking Fig 2 should bring up a window like Fig 3. Make sure the selected factor is 2. Open Distribution Coefficient Put cursor on Unsaturated Zone and click Form Options Sensitivity Analysis (Single Parameter) menu. Select factor 5 from the pop-up sensitivity analysis setting form, then save the form. Check the bottom left corner of the main interface again. Information as shown in Fig 4 should present, indicating the available parameter for sensitivity analysis setting form, then save the form. Check the bottom left corner of the main interface again. Information as shown in Fig 4 should present, indicating the available parameter for sensitivity analysis. Double clicking on the Variable DCACTU1 should bring up the sensitivity analysis setting window for the unsaturated zone 1 distribution coefficient, check if the selected factor is 5. Save project to Test52.rof, then open it in a text editor and check SDCACTC(1) = 2, SDCACTU1(1) = 5, NSENA = 2. 11)
Required Data	None.

Expected The code should behave as described in each step. **Results**

			Fig 3	
			Set Sensitivity Analysis Rang	e
	F	ig 1 OVariables	Variable Description: Distribution coefficient (of Ac-227 used to estimate leach ri
			Variable Name: DCACTC(Ac-227)	
Fig 4	Fig 2	DCACTC(Ac-227) */ 2	Multiply and Divide the variable's deterministic value by: $0 \frac{1.5}{0.2}$ $0 \frac{3}{5}$ $0 \frac{10}{10}$	Lower Value: 10 Base Value: 20 Upper Value: 40
Fig 4	DCACTC(Ac-227) */ 2	DCACTU1(Ac-227) *	<u>75</u> <u>0</u> K	<u>Cancel</u> <u>N</u> o Analysis
212130100	201010(10 221) 7 2	5 GHOT 0 1 (AC 221)		

11.18 TEST CASE 031-002

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-31-002
Test Summary	Test the functionality of setting Multiparameter Sensitivity Analysis
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of setting Multiparameter Sensitivity Analysis
Procedure	 Launch the code and open Initial Concentration form and select Ac-227, then follow User's Guide Section 6.3 to set multiparameter sensitivity analysis using the example shown in the left figure. Setting the Uniform Sensitivity range potions to 25%, 50%, and 99%, respectively. Save the form and then the project. Open the generated .rof file in a text editor and check NUM_SAMPS = 300, NUMVAR = 3, NUMRELVAR = 0. There should be file with file extension .LHS generated in the same folder as the .rof file.

5) There should be file with file extension .LHS generated in the same folder as the .rof file. Open it in a text editor and it should look like the right figure.

Required None. Data

Expected The code should behave as described in each step.

Results

Uncertainty and Probabilistic Analysis					FSITE Default Parameters			
	· · · ·	Post run regression t rank correlations Output specifications	RANDOM S NVAR 3 NOBS 10	SEED 1000				
Variable Description Kd of Ac-227 in Contaminated Kd of Ac-227 in Unsaturated Zone	Statistics of uncertain or Rainfall and runoff factor		NREPS 3 UNIFORM 15	25	DCACTC(1)			7 in Contaminated Zone
Rainfall and runoff factor	Distribution UNIFORM	▼ Minimum 1,599998	0 UNIFORM 10	none 30	Sensitivity 20 DCACTU1(1)	.25	0 Kd of Ac-22	1E+34 7 in Unsaturated Zone 1
		Maximum 318.4 Uniform sensitivity range options	0 UNIFORM 1.59999		Sensitivity 20 RAINEROS	.5	0 Rainfall and	1E+34 i runoff factor
		○ + - 5% about deterministic value	0 OUTPUT (1000 CORR DATA	Sensitivity 160	.99	0	1000
		 C + - 10% about deterministic value C + - 25% about deterministic value 						
		 ○ + - 50% about deterministic value (+ - 99% about deterministic value 						
	Previous parameter	Update Parameter stats and distribution						
	<u>R</u> emove parameter	Help Restore Parameter stats and distribution	H					
Sort alphabetically before run	Suppress uncertai	nty analysis this session <u>O</u> K						

11.19 TEST CASE 032-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-32-001
Test Summary	Test the functionality of setting Uncertainty/Probabilistic Analysis
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of setting Uncertainty/Probabilistic Analysis
Procedure	 Launch the code and open Initial Concentration form and select Ac-227, then open Distribution Coefficients form. Put the cursor on the Unsaturated Zone 1 text box, and click Form Options Uncertainty/Probabilistic Analysis menu. Uncertainty Analysis window like Fig a should pop up. Open Physical and Hydrological form, put cursor on Precipitation text box, and the click Form Options Uncertainty/Probabilistic Analysis menu. A window like Fig b should pop up. Note the two boxes in purple. Change the Distribution and associated values to those shown in Fig c, then click Update Parameters stats and distribution. Click OK to save the form and then save the project to Test53.rof. Open Test53.rof and check UM_SAMPS = 300, NUMVAR = 2, NUMRELVAR = 0. There should be file called Test53.LHS generated in the same folder as Test53.rof. Open it and it should look like Fig d.
Required Data	None.

Expected The code should behave as described in each step. **Results**

Uncertainty and Probabilistic Analysis	á	1		T	Jncertainty and Probabilistic Analy	/sis		b		
· · · · · · · · · · · · · · · · · · ·	Related inputs	Post run regression	ר ר	Т	Step by step analysis	Related in	puts	Post run regressio	n	
Sample specifications Param	eter distributions	Input rank correlations	Output specifications	'nΓ	Sample specifications	Parameter distri	butions	Input rank correlation	s Output specific	ations
Sample specifications Param Variable Description Kd of Ac-227 in Unsaturated Zone	Statistics of uncer Kd of Ac-227 in Ur Distribution TRI	tain or probabilistic paramete vadurated Zone T INCATED LOGNORMAL-N Mean (Mu) of underlying n ation (Sigma) of underlying n Lover qu Upper qu	ormal 6,72 ormal 222 antile 001 antile 939		Sample specifications Variable Description Kod Ac-221 in Unsaturated Zc Precipitation	Statisti Precipit Distrib There holder the dis distrib distrib	is no defa	ain or probabilistic para FORM ault distribution for t on will be deleted s modified. Please click the "Update F amend.	Minimum 39 Maximum 10 10 his variable. This pl hen the file is saver enter the approximation arameter Stats and meter stats and distribut	lace d unle: ate
	<u>R</u> emove parame	ter Help	Restore Parameter stats and distribution	μ		<u>R</u> em	ove parame	ter Help	Restore Parameter and distribution	
Sort alphabetically before run	⊽ Suppress u	ncertainty analysis this sessi	on <u>O</u> K		Sort alphabetically before ru	n 🔽	Suppress u	ncertainty analysis this	ession	<u>0</u> K
Uncertainty and Probabilistic Analysis	С				ITLE - RESRAD-OFFSITE I ANDOM SEED 1000	Default Para	ameters	d		
Step by step analysis	Related inputs	Post run regression			VAR 2					
Sample specifications Param	eter distributions	Input rank correlations	Output specifications		OBS 100					
Variable Description Kd of Ac-227 in Unsaturated Zone Precipitation		tain or probabilistic paramete ANGULAR Mar Mar		NI 6. 0 TI 0 0	REPS 3 RUNCATED LOGNORMAL-N .72 3.22 .001 none TRUM RIANGULAR 1 2	DCACTUI(1) 1 .999 NCATED LOGNO PRECIP r defined		Kd of Ac- 6.72 3.22 Precipita		ed Zone 1
			Restore Parameter stats							
	<u>Remove parame</u>	ter Help	and distribution	Н						

11.20 TEST CASE 033-001

ггојесі керкар-оггріг	Project	RESRAD-OFFSITE
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Test Case RESOFF-TEST-33-001 ID

Test Test the File navigation function from the left panel of GUI. **Summary**

Created CW 10/17/2019

By/Date

Test To test whether the File navigation button from the left panel work properly. **Objective**

- Procedure 1) Launch the code. The default main window panel should be divided into left panel and a blank right-side panel with an Iconic Navigator located on the upper-right corner. The left side panel containing the version number of the code, and seven navigation buttons.
 - 2) Clicking File button should bring the File Options form up.
 - 3) Test New and Save functions in General Scenarios section following RESOFF-TEST-35-001.
 - 4) Test Open and Save as functions in General Scenarios section following RESOFF-TEST-35-002.
 - 5) Test Onsite Scenario Template fie following RESOFF-TEST-35-004.
 - 6) Test Simulate RESARD (onsite) Code following RESOFF-TEST-35-005.

Required	None.
Data	

Expected	The same as test cases RESOFF-TEST-35-001, 002, 004
Results	

11.21 TEST CASE 033-002

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-33-002 ID

Test Test the Change Title navigation function from the left panel of GUI. **Summary**

Created CW 10/17/2019

By/Date

Test To test whether the Change Title navigation button from the left panel work properly. **Objective**

- **Procedure** 1) Launch the code and click Change Title button on the left panel. The "Title & Radiological Data" window should pop up.
 - 2) Under default setup, it should be identical to the left screenshot shown in Expected Results section.
 - 3) Change to ICRP 38 database, and the form should be identical to the right screenshot.

Required None. Data

Expected Results	Title & Radiological Data	Parameters	Title & Radiological Data <u>Iitle:</u> RESRAD-OFFSITE Default	Parameters	
	Location of dose, slope and transfer Radionuclide transformations based ICRP 60 based external, inhalation,	-	Location of dose, slope and transfer factor database: C:\RESRAD_FAMILY\DCF\3.1 Radionuclide transformations based on © ICRP 107 C ICRP 38 ICRP 60 based external, inhalation, and ingestion dose conversion factors		
	External exposure library Internal exposure dose library Slope factor (Risk) library Transfer factor library	ICRP 60 ICRP 72 (Adult) FGR 13 Morbidity RESRAD Default Transfer factors	External exposure library Internal exposure dose library Slope factor (Risk) library Transfer factor library	DCFPAK3.02 DCFPAK3.02 (Adult) CCFPAK3.02 Morbidity RESRAD Default Transfer factors	
	Calculation Time points <u>Number of points:</u> 2048 <u>Minimum time increment between</u> Update progress of computation m Save input file when a form is sa Use line draw <u>c</u> haracter	essage every: 1. V Seconds	Calculation Time points <u>Number of points:</u> 2048 <u>Minimum time increment between</u> Update progress of computation m Save input file when a form is sa Use line draw <u>character</u>	a points (year):	

11.22 TEST CASE 033-003

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-33-003 ID

Test Test the functionality of Set Pathways navigation in the left panel of GUI. **Summary**

Created CW 10/17/2019

By/Date

Test To Test the functionality of Set Pathways navigation in the left panel of GUI. **Objective**

Procedure 1) Launch the code and click Set Pathways in the left panel

- 2) The Set Pathways form should pop up and stay right by the left panel. By default, all the pathways should be on except Radon pathway.
- 3) Click all the press buttons one by one, the pathways should be turned off and the pathway icons should present an off marker
- 4) Click all the press buttons one by one again to turn on all the pathways. The off marker on the pathway icons should go away.
- 5) Clicking Radon pathway should not get any response at this time when no radionuclides are selected.
- 6) Repeat Steps 3-4 by pressing the pathway icons, rather than the press button.
- 7) Turn off all the pathways again except external pathway.
- 8) Click Close, and the pathway form should be closed.
- 9) Click Initial Concentrations form and select Ac-227.
- 10) Save the input to file Test011.rof and Run the code.
- 11) Open the input file Test011.rof in a text editor such asNotepad, and should see SELPATH = 1, indicating only external pathway is selected.
- 12) Open the file Summary.REP in the application folder using a text editor and look into the Summary of Pathway Selections section. All the pathways should be suppressed except that external gamma is active.
- 13) Open Test011.rof and add Ra-226 from the Initial Concentrations form, and turn on Radon pathway. Save the file and Run the code again.
- 14) Check TEST011.rof and the variable SELPATH should be 257.

15) Check Summary.REP and only external gamma and radon pathways should be active.

Required Data	None.
Expected Results	Pathway form should be opened and closed from the left panel navigation.
	Pathways can be turned on and off by pressing either the press buttons or the pathway icons.
	The selection of pathways should be correctly written into the input file and echoed in the report file.

11.23 TEST CASE 033-004

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-33-004 ID

Test Test the functionality of Modify Data navigation in the left panel of GUI. **Summary**

Created CW 10/17/2019

By/Date

Test To test the functionality of Modify Data navigation in the left panel of GUI.

Objective

- Procedure 1) Click Modify Data button from the left navigation panel. The Modify Data form should pop up and stay right next the left panel. Depending on the setup of last run, it should like one of the three formats as shown in Expected Results section, namely, Case 1, 2, and 3. The default is the left one.
 - 2) Open the form again. For Case 1, click "Hide Subforms" button, it should look like Case 2.
 - 3) Click "Show Subforms Vertically" in Case 2, the form should change back to Case 1.
 - 4) In either Case 1 or 2, clicking "Show Subforms Horizontally", the form should change to Case 3.
 - 5) In Case 3, clicking Hide Subforms should change the form to Case 2; and clicking Show Subforms Vertically should change the form to Case 1.
 - 6) Clicking Close in any Case should close the form.

Required	None.
Data	

Expected Results

5			

Modify Data			Modify Data		
Preliminary Inputs	Preliminary Inputs				
		Release Times			
Initial Concentrations	Initial Concentrations	Nuclide Specific Release	Distribution Coefficients	Deposition Velocities	Transfer Factors
Reporting Times	Reporting Times	Storage Times			
Site Layout	Site Layout				
Phys/Hydrological					
Atmospheric Transport	Physical and Hydrological	Primary Contamination	Agricultural Areas	Livestock Feed Areas	Dwelling Site
Groundwater Transport		Sediment Delivery Ratio			
Surface Water body	Atmospheric Transport				
Ingestion Rates	Water Use	Unsaturated Zones	Saturated Zone	Groundwater Transport	
Inhalation, Gamma					
Radon	Surface Water body				
C-14	Ingestion Rates	Plant Factors	Livestock Intakes	Livestock Feed Factors	
H-3	Inhalation, Gamma	Shape Factors	Occupancy		
Close	Radon		Carbon-14		H-3
			Mass fractions of C-12		
Show Subforms Vertically	Hide Sub	forms	Close		w Subforms √ertically
Show Subforms Horizontally					

Water Use
Unsaturated Zones
Saturated Zone
Groundwater Transport
Surface Water body
Ingestion Rates
Plant Factors
Livestock Intakes
Livestock Feed Factors
Inhalation, Gamma
Shape Factors
Occupancy
Radon
Carbon-14
Mass fractions of C-12
H-3
115
Close

Modify Data Hide Subforms

Show Subforms Horizontally Preliminary Inputs

Release Times Initial Concentrations Nuclide Specific Release Distribution Coefficients Deposition Velocities Transfer Factors

Reporting Times Storage Times Site Layout

Physical and Hydrological Primary Contamination Sediment Delivery Ratio Agricultural Areas Livestock Feed Areas Dwelling Site

Atmospheric Transport

11.24 TEST CASE 033-005

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-33-005 ID

Test Test the functionality of Iconic Navigator

Summary

Created CW 10/17/2019 By/Date

Test To test the functionality of Iconic Navigator **Objective**

Procedure 1) Launch the code.

- 2) Click Problem tab of Iconic Navigator.
 - a. Clicking File icon should bring up the window for selection of input file. Select an input file, and the file should be loaded to the main interface.
 - b. Clicking Title icon should bring up the Title & Radiological Data form
 - c. Clicking Dose Factors should bring up the DCF Editor window.
 - d. Clicking Input/Pathway should open the Inputs & Pathways tab of Iconic Navigator.
 - e. Clicking Sensitivity icon should turn on/off the Sensitivity Input Summary at the bottom left corner of the main interface.
 - f. Clicking Uncertainty Analysis button should bring up the Uncertainty and Probabilistic Analysis form.
 - g. Clicking Run button should run the code using the loaded input file.
 - h. Clicking Results should open the Results tab of the Iconic Navigator.
- 3) Clicking Input & Pathways Tab.
 - a. Clicking each icon should open one associated form. Then run the code.
- 4) Click Results tab.
 - a. Clicking Parent Dose Report button should open Summary.rep file. Clicking Deterministic Graphics icon should open the graphics Wresplot.exe with loaded data.
 - b. Clicking Progeny Dose Report icon should open DAUDOSE.REP file, Clicking Health Risk Report icon should open INTRISK.REP file.
 - c. Run the code with uncertainty analysis.

- d. Clicking Graphics under Uncertainty/Probabilistic Analysis frame should open forms Uncertainty and Probabilistic Analysis, Probabilistic/Uncertainty Outputs, and Probabilistic Temporal Plots.
- e. Clicking Dose and Risk Report icon should open MCSUMMAR.REP file.
- f. Clicking Input Report icon should open LHS.REP file.
- 5) Clicking Help tab and the REARD program website and contact information should present under this tab, as well as the function of F1 key for help.

Required None. Data

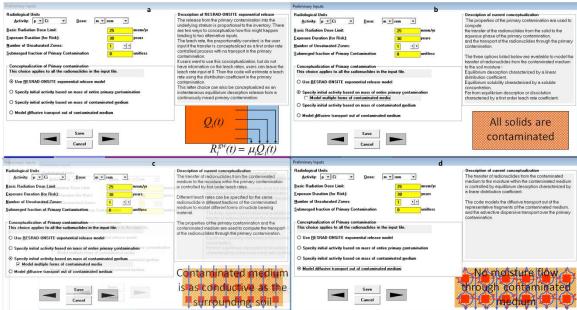
Expected The code should behave as described in each step. **Results**

11.25 TEST CASE 034-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-001
Test Summary	Test the functionality of Form Preliminary Inputs
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Form Preliminary Inputs.
Procedure	 On the left panel, click Modify Data -> Preliminary Inputs. The form should pop up with Figure a as default setting, including the units and values in textboxes. The background of each textbox should be in yellow if the values are default values; otherwise, in white. Change the unit to Bq. The unit in Forms Initial Concentrations and Transfer Factors should change accordingly. Changing the selection of Conceptualization frame from top to bottom in order, the form should look like Figure a, b, c and d, respectively. Selection of "Model multiple forms of contaminated media" under settings of either Figure b or c will change the other's setting. The Number of Unsaturated Zones should be able to be changed between 0 and 5. Once this value is change, need to check Form Unsaturated Zones to check if the number of unsaturated zone changed in that form accordingly. Submerged fraction of Primary Contamination should be able to changed 0-1; however, once its value is larger than 0, the Number of Unsaturated Zone should update to 0 automatically. Change the values in textboxes and the units, save the input to Test13.rof, then check whether the input file is correctly written. The variables in this form include BRDL, ED, and NS. SUBMERGEDF, PCOPTION, and MULTIFORM.
Required	None.

Data

Expected Radiological Units Activity: p - Ci Results



Preliminary Inputs

Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-34-002		
Test Summary	Test the functionality of Form Release Times		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Form Release Times.		
Procedure	 On the left panel, clicking Modify Data -> Release Times should open a pop-up window with caption "Times at which Release Properties are Specified (years)". Clicking "Insert New 1st time and shift down existing times and associated release data" 8 times. Every click should shift down the newly generated textbox by one row. The default of each generated textbox should be 0. Click "Delete 1st time and associated release data and shift up exiting data" for 8 times, all the newly generated textboxes should be deleted. Clicking "Add new xx-th time at which release changes" should generate a textbox corresponding to xx-th release time. Specifying a value to each box in an increasing order. Change the value of the top box to a negative value, an error message should pop-up. Similarly, changing the largest value to more than 100000 should also trigger an error message window. Change the third textbox value to a value less than the one in the second box, a warning message should show in the bottom-left box. Clicking Close. An error message should pop-up pointing out this error. Make sure the input to this form is correct, close the form. Check Form Nuclide Specific Release. The release time in the form should change accordingly. save the file to Test14.rof, and then check the values in the generated input file in a text editor. The variable to check is RELTIME(1) - (9). 		
Required Data	None.		
Expected Results	The behavior of the code should be the same as described in each step.		

11.27 TEST CASE 034-003

Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-34-003		
Test Summary	Test the functionality of Form Initial Concentrations		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Form Initial Concentrations.		
Procedure	 Open the Initial Concentrations window and visually check the format, fonts, spelling, and default setting. Check the unit is correct according to Form Preliminary Inputs. The upper right box should indicate the radionuclide database and cutoff half-life. Frame "Transfer Mechanism" should be available. Select Ac-227, then click button "Add Ac-227 21.77y", Ac-227 should be added to the left panel with a concentration of 100 unit. Highlight it and then change the Nuclide Concentration value to 50. Its concentration should update to 50 in the left panel. Clicking Delete "Ac-227" should remove it from the left panel. Select U-238 from right panel and add it. The radionuclides in the U-238 decay change with half-life larger than the cutoff halflife should be added to the left panel with U-238 having a concentration of 50 units and all others zero concentration. Close the form and save the project to Test15.rof. Check the variables NUCNAM and S. Their values should be identical to the input to the form. 		
Required Data	None.		
Expected Results	The behavior of the code should be the same as described in each step.		

11.28 TEST CASE 034-004

Required Data	None.						
F (1		Radionucide Specific Release	a		Radionuclide Specific Release	b	
Expected		Radionuclide U-238	÷ Element U		Radionuclide U-238	Element U	
Expected Results		Release to ground water	Transfer mechanism © First Order Rote Controlled Transfer © Equilibrium Description Transfer © Equilibrium Solubility Transfer			Transfer nechanism O Fiss Drober Rate Controlled Transfer @ Equilibrium Decouption Transfer O Equilibrium Solubility Transfer	
		т	ine at which release begins or changes (years) 0	10 100 1000 5000 Add Reat	n	me at which release begins or changes (years)	10 100 1000 5000 Add Next
			of radionuclide bearing material that is releaseble 1			of radionuclide bearing material that is releasable 1	
		Incremental Iractio	in of radionuclide bearing becomes releasable stepwise at time	0 0 0 0	Incremental fraction	n of radionuclide bearing becomes releasable stepwise at time	0 0 0 0
		Le	Leach rate (1/year) 0 linearly over time ach rate of izotope changes stepseize at time ③		Distribu	dion coefficient in primary contamination (cm?gl 30	
		Release from surface layer	Radionuclide becomes available for refease © In the same manner as for release to groundwater		Release from surface layer	Redionuclide becomes available for release ③ In the same manner as for release to groundwater	
			O Beginning at time zero			Beginning at time zero	
			Save Cancel			Save Cancel	
		Radionuclide Specific Release	c		(
		Radionuclide U-238	Element U				
		Release to ground water	Transfer mochanism O First Order Rate Controlled Transfer O Equilibrium Desception Transfer				

.

1

Save Cancel

ecomes available for release manner as for release to gro

-

Radionuclide to In the same Add Next Time

11.29 TEST CASE 034-005

Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-34-005		
Test Summary	Test the functionality of Distribution Coefficients form		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Distribution Coefficients form.		
Procedure	 With U-238 selected with default settings. Open Distribution Coefficients form and visually check the format, fonts, spelling, and default setting. The form should be available for inputs as shown in the Figure in Expected Results. When either of the first or second options in Conceptualization of Primary Contamination in Preliminary form is selected, the distribution coefficient input box for Contaminated Medium will be gray out. Clicking the value of Number of Unsaturated Zone should open the Preliminary Inputs form Change at least one value for each radionuclide, and save the project to Test17.rof. Check the following variables in the generated input file and their value should match the input, DCACTC, DCACTCM, DCACTDWE, DCACTSWB, DCACTSWS, DCACTU1, DCACTS, DCACTV1, DCACTV2, DCACTL1, DCACTL2. 		
Required Data	None.		
Expected Results	The behavior of the code should be the same as described in each step.		

Distribution Coefficients		
Radionuclide U-238		
Distribution coeffic	ient (cm?g) in:-	
Contaminated Medium: 50 <u>C</u> ontaminated Zone: 50 Unsaturated Zone <u>1</u> : 50	Suspended sediment in surface water body Bottom sediment in surface water body Fruit, grain, nonleafy fields Leafy vegetable fields Pasture, silage growing areas	50 50 50 50 50 50
S <u>a</u> turated Zone: 50 Number of Unsaturated Zones: se 1	Livestock feed grain fields Dwelling site	50 50
	Save Cancel	

11.30	TEST CASE 034-006		
Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-34-006		
Test Summary	Test the functionality of Deposition Velocities form		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Deposition Velocities form.		
Procedure	 Select U-238 with default settings. Open Deposition Velocity form and visually check the format, fonts, spelling, and default setting. Change at least one value for each radionuclide in the U-238 decay chain. Save the form and the project to Test18.rof. Check the variables DEPVEL, and DEPVELT in the generated file; they should match the input values in the interface. 		
Required Data	None.		
Expected Results	The behavior of the code should be the same as described in each step.		

11.31	TEST CASE 034-007		
Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-34-007		
Test Summary	Test the functionality of Transfer Factors form		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Transfer Factors form.		
Procedure	 Select U-238 with all default settings. Open Transfer Factors form, and visually check the format, fonts, spelling, and default setting. Change at least one value for each radionuclide, and save the form. Save the project to Test19.rof. Check the following variables' values; they should match the input. RTF, I_M, BIOFAC. 		
Required Data	None.		
Expected Results	The behavior of the code should be the same as described in each step.		

11.32 TEST CASE 034-008

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-008
Test Summary	Test the functionality of Reporting Times form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Reporting Times form.
Procedure	 Click Modify Data -> Reporting Times. Visually check the format, fonts, and spelling. It should have contents as shown in the figure, allowing up to 9 input times. Check the lower and upper bounds. Each value should be (0, 100000] Check Add and Remove buttons Clicking "Storage times" button should bring the form up. Save the form and the project to Test20.rof. Check the variable T(1)-(10) in the file; they should be identical to the input in GUI.

Required None. Data

Expected The behavior of the code should be the same as described in each step. **Results**

Reporti	ng Times					
Time	s at which outp	ut is reported (years):			
Ø	000	880	90	8		
1	10	100		1000	10000	10000
	Add	Storage time		R <u>e</u> move	1) 2) 3)	1 3 6
		Save			<u>4)</u> 5) 6) 7)	12 30 75 175
		Cancel			<u>8)</u> <u>9</u>)	420 970

11.33 TEST CASE 034-009

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-009
Test Summary	Test the functionality of Storage Times form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Storage Times form.
Procedure	 Click Modify Data -> Storage Times. Visually check the format, fonts, and spelling. Check the lower and upper bounds for each input box value. It should be no less than 0. Change two or more values. Save the form and the project to Test21.rof. Check the variable STOR_T(1)-(10) in the file; they should be identical to the input in GUI.
Required Data	None.

Expected The behavior of the code should be the same as described in each step. **Results**

Storage Times		
Surf <u>a</u> ce water:	1	days
W <u>e</u> ll water:	1	days
Fruits, Grain & Nonleafy vegetables:	14	days
Leafy vegetables:	1	days
Pasture and Silage	1	days
Livestock feed grain:	45	days
<u>M</u> eat:	20	days
Mjlk:	1	days
<u>F</u> ish:	7	days
<u>C</u> rustacea and mollusks:	7	days
Save Cancel		

11.34 TEST CASE 034-010

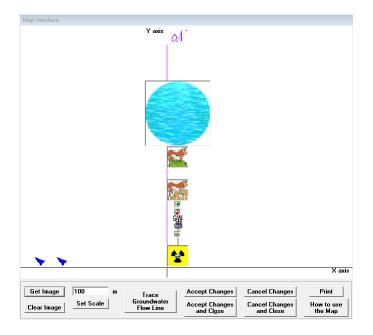
Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-010
Test Summary	Test the functionality of Site Layout form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Site Layout form.
Procedure	 Open Site Layout form and visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. Clicking Display Map should bring up the Map Interface window. Change the values for Bearing of X axis, X and Y dimensions, and at least one value on each row and column of the site coordinate table. Save the project to Test22.rof. Check the following variables in the file; they should be identical to the input in GUI. NXBEARING, SOURCEXY, AGRIXY, DWELLXY, SWXY.
Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.

Site Layout

Bearing of X axis (clockwise angle from X dimension of Primary Contamination Y dimension of Primary Contamination		190 1100 2100	degrees meters meters		
Location	Smaller X Coo	Larger ordinate	Smaller Y Coo	Larger ordinate	
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters
Leafy vegetables plot	34.375	65.625	268	300	meters
Pasture, Silage growing area	0	100	450	550	meters
Grain fields	0	100	300	400	meters
Dwelling site	34.375	65.625	134	166	meters
Surface- water body	-100	200	550	850	meters
		ny Map			
-		ncel			

11.35 TEST CASE 034-011

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-011
Test Summary	Test the functionality of Map Interface form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Map Interface form.
Procedure	 Open Map Interface form by clicking Modify Data -> Site Layout -> Display Map It should include the functions as shown in the figure. Check the following buttons: Print, How to use the Map, Accept/Cancel changes, Accept/Cancel Changes and Close. Move each icon in the map a little and the purple Y-axis line, then click Accept Changes and Close. The coordinate table in the Site Layout form should update accordingly. Click Get Image should direct to select an image file. Select the file HypotheticalSuburbanScenarioOutline.JPG under UserFiles folder. The image should load to the code. Click Clear Image should remove the file from the code. Change the scale value and click "Set Scale". The image should change accordingly. Click Trace Groundwater Flow Line, the widow should update with GW line. Clicking How to Trace a Flow Line button should open a file named GwFlowLinRO.pdf. Following the procedure in the file and check each button functions as designed.
Required Data	None.
Expected Results	The code should behave as described in each step.



11.36 TEST CASE 034-012

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-012
Test Summary	Test the functionality of Physical and Hydrological form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Physical and Hydrological form.
Procedure	 Open Physical and Hydrological form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should contain Site Properties input, as shown in the figure. Clicking each of the five buttons in Sub-area Properties section should bring up the corresponding forms. Change the precipitation value and rainfall and runoff factor, save the form, and save the project to Test24.rof. Check the variables PRECI and RAINEROS in the generated file. They should be identical to the input in GUI.
Required Data	None.
Expected Results	The code should behave as described in each step.

Physical and Hydro	logical		
Site properties	3		
Precipitatio <u>n</u> : Rainfall and ru	noff factor:	1 160	meters/year
Sub-area prop	erties		
	Primary <u>C</u> on	tamination	
	S <u>e</u> diment	Delivery	
	<u>A</u> gricultur	al areas	
	Livestock feed	growing areas]
	Offsite <u>D</u> w	elling site]
-	Sav Can		

11.37 TEST CASE 034-013

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-013
Test Summary	Test the functionality of Primary Contamination form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Primary Contamination form.
Procedure	 Open Primary Contamination form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should contain Site Properties input, as shown in the figure. Check the consistence of Area of Primary Contamination with the X and Y dimesons in Site Layout form. Check the consistence of Factor of primary contamination that is submerged with the Submerged fraction of Primary Contamination in Preliminary Input. Modify at least two values in each column, save the form, and then save the project to Test25.rof. Check the following variables in the generated input file. They should be the same as input in the GUI. AREA, LCZPAQ, DM, MLFD, DEPVEL_DUSTT, RESPFRACPC, DEPVEL_DUST, RI, EVAPTR, RUNOFF, SLPLENSTPPC, CRPMANGPC, CONVPRACPC, THICK0, TPCZ, VCZ, DENSCZ, ERODIBILITYCZ, FCCZ, BCZ, HCCZ, EPCZ, ALPHALCZ, SUBMERGEDDEPTH, COVER0, TPCV, VCV, DENSCV, ERODIBILITYCV, PH2OCV
Required Data	None.
Expected	The code should behave as described in each step.

Area of primary contamination.	-			10000	square
Length of contamination parall	el to aquifer flo	W:		100	meters
Depth of soil mixing layer:				.15	meters
Mass loading of all particulate:	s:			.0001	grams/
Deposition velocity of all partic	culates (to com	pute atmosphe	ric release):	.001	meters
Respirable particulates as a fra	action of total p	particulates		1	
Deposition velocity of respirab	le particulates	(to compute at	mospheric release):	.001	meters
Irrigation applied per year:				.2	meters
Evapotranspiration coefficient				.5	
Runoff coefficient:				.2	
Slope-length-steepness factor:				.4	
Cover and management factor:				.003	
Support practice factor:				1	
Fraction of primary contaminat	ion that is subm	nerged		0	
Soil layer ->		Contami	nated zone		
Location relative to water table	e ->	above	below		
Thickness:	0	2	meters		
Soil erodibility factor:	.4	.4	tons/acre		
-					
Dry bulk density:	1.5	1.5	grams/cm?		
Erosion rate:	1.147E-05	1.147E-05	grams/cm? <i>meters/year</i>		
Erosion rate: Total porosity:	1.147E-05 .4				
<i>Erosion rate:</i> Total porosity: Volumetric <u>w</u> ater content:	1.147E-05	1.147E-05 .4			
<i>Erosion rate:</i> Total porosity: Volumetric <u>w</u> ater content: Effective porosity:	1.147E-05 .4	.4 .4	meters/year		
Erosion rate: Total porosity: Volumetric water content: Effective porosity: Hydraulic conductivity:	1.147E-05 .4	<u>1.147E-05</u> .4 .4 10			
Erosion rate: Total porosity: Volumetric water content: Effective porosity: Hydraulic conductivity: Field capacity:	1.147E-05 .4	1.147E-05 .4 .0 .3	meters/year		
Erosion rate: Total porosity: Volumetric water content: Effective porosity: Hydraulic conductivity:	1.147E-05 .4	<u>1.147E-05</u> .4 .4 10	meters/year		

11.38 TEST CASE 034-014

Project	RESRAD-OFFSITE				
Test Case ID	RESOFF-TEST-34-014				
Test Summary	Test the functionality of Sediment Delivery Ratio form				
Created By/Date	CW 10/17/2019				
Test Objective	To test the functionality of Sediment Delivery Ratio form.				
Procedure	 Open Sediment Delivery Ratio form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should the input boxes, as shown in the figure. Check the lower and upper bounds, which should be 0 and 1, respectively. The summation of the values in this form should be 1. Make it more than one, and an error message should pop up. Check the values input in the form are consistent with the ones in Forms Dwelling Site, Agricultural Areas, Livestock Feed Areas, and Surface Water Body. Change three or more values, save the form, and then save the project to Test26.rof. Check the following variables in the generated input file; they should be identical to the input from GUI. SDR, SDROF(1)-(4) and SDRDELL 				
Required Data	None.				
Expected Posults	The code should behave as described in each step.				

action of eroded radionuclides deposited in the nonleafy vegetable plot	0
Fraction of eroded radionuclides deposited in the leafy vegetable plot	
action of eroded radionuclides deposited in the pasture	0
action of eroded radionuclides deposited in the feed grain plot	0
action of eroded radionuclides deposited in the surface water body	1

11.39 TEST CASE 034-015

Project	RESRAD-OFFSITE				
Test Case ID	RESOFF-TEST-34-015				
Test Summary	Test the functionality of Agricultural Areas form				
Created By/Date	CW 10/1/2019				
Test Objective	To test the functionality of Agricultural Areas form.				
Procedure	 Open Agricultural Areas form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Check the Area values; they should be grayed out in this form but match the inputs in Site Layout form. Check the Erosion rate and Total Porosity values; they should be grayed out in this form but match the ones in Primary Contamination form Check the Sediment delivery ratio values; they should be grayed out in this form but match the ones in Sediment Delivery Ratio form. Clicking the values in this form should bring up the Sediment Delivery Ratio form. Change at least three values in each column, save the form, and save the project to Test27.rof. Check the following variables in the generated file; they should be the same as inputs in GUI. AREAO(1) and (2), FAREA_PLANT(1) and (2), RIRRIG(1) and (2), EVAPTRN(1) and (2), RUNOF(1) and (2), DPTHMIXG(1) and (2), TMOF(1) and (2), EROSN(1) and (2), RHOB(1) and (2), CONVPRAC(1) and (2), TPOF(1) and (2). 				
Required Data	None.				
Expected	The ends should behave as described in each star				

Expected Results

ted The code should behave as described in each step. s

Agricultural Areas		
Сгоря	Fruit, grain, non-leafy	Leafy vegetables
Area (square meters):	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation applied per year (meters/year):	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil <u>Mixing</u> layer or Plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>P</u> orosity	.4	.4
Sediment from primary contamination delivery ratio	.3	.2
Save Cancel		

11.40 TEST CASE 034-016

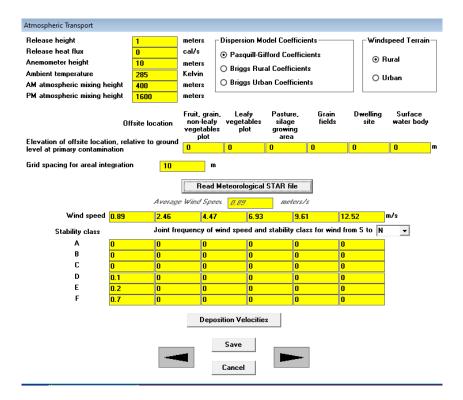
Project	RESRAD-OFFSITE			
Test Case ID	RESOFF-TEST-34-016			
Test Summary	Test the functionality of Livestock Feed Areas form			
Created By/Date	CW 10/17/2019			
Test Objective	To test the functionality of Livestock Feed Areas form.			
Procedure	 This form should contain the same input content as Agricultural Areas form but for Livestock Feed Area, including Pasture Silage and Grain Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAO(3) and (4), FAREA_PLANT(3) and (4), RIRRIG(3) and (4), EVAPTRN(3) and (4), RUNOF(3) and (4), DPTHMIXG(3) and (4), TMOF(3) and (4), EROSN(3) and (4), RHOB(3) and (4), ERODIBILITY(3) and (4), SLPLENSTP(3) and (4), CRPMANG(3) and (4), CONVPRAC(3) and (4), TPOF(3) and (4). 			
Required Data	None.			
Expected Results	The code should behave as described in each step.			

11.41 TEST CASE 034-017

Project	RESRAD-OFFSITE			
Test Case ID	RESOFF-TEST-34-017			
Test Summary	Test the functionality of Dwelling Site form			
Created By/Date	CW 10/17/2019			
Test Objective	To test the functionality of Dwelling Site form.			
Procedure	 This form should contain the same input content as Agricultural Areas form but for Offsite Dwelling Area Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAODWELL, , RIRRIGDWELL, EVAPTRNDWELL, RUNOFDWELL, DPTHMIXGDWELL, TMOFDWELL, EROSNDWELL, RHOBDWELL, ERODIBILITYDWELL, SLPLENSTPDWELL, CRPMANGDWELL, CONVPRACDWELL, TPOFDWELL. 			
Required Data	None.			
Expected Results	The code should behave as described in each step.			

11.42 TEST CASE 034-018

Project	RESRAD-OFFSITE				
Test Case ID	RESOFF-TEST-34-018				
Test Summary	Test the functionality of Atmospheric Transport form				
Created By/Date	CW 10/17/2019				
Test Objective	To test the functionality of Atmospheric Transport form.				
Procedure	 Open Atmospheric Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Clicking Read Meteorological STAR file should allow to select a STAR file from the available list installed in Application folder\Metfiles. Loading of a selected STAR file should update the table. Clicking Deposition Velocities should bring up the Deposition Velocities form. Change at least one value in each input area, save the form, and save the project to Test30.rof. Check the following variables in the generated input file; they should be the same as the inputs from GUI. AIRRELHT, HEATFLX, ANH, TABK, AMIX, PMIX, AGRIELEV, DWELLELEV, SWELEV, WIND, WINDSPEED, DFREQ, ATGRID 				
Required Data	None.				
Expected Results	The code should behave as described in each step.				



11.43 TEST CASE 034-019

Project	RESRAD-OFFSITE				
Test Case ID	RESOFF-TEST-34-019				
Test Summary	Test the functionality of Water Use form				
Created By/Date	CW 10/17/2019				
Test Objective	To test the functionality of Water Use form.				
Procedure	 Open Water User form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Check the Area of Plot; which should be grayed out and consistent with the inputs in Site Layout form. Check the Fraction of water values. The summation of two columns should be 1. Changes at least two values in each column, save the form, and save the project to Test31.rof. Check the following variables in the generated file; they should be the same as inputs in the GUI. DWI, FDWI, FSWD, FWWD, HHW, FSWHH, FWWHH, LWI, FSWLV, FWWLV, FSWIR, FWWIR, FSWIRDWELL, FWWIRDWELL, NDWI, NLWI, UW 				
Required Data	None.				
Expected Results	The code should behave as described in each step.				

Water Use					
Description of Usage:- Water for ,			Fraction of	water from	Number of individuals to
101,	Quantity		Surface body	₩ell	compute well water needs
Consumption per person	510	Liters/year	0	1	
Use indoors of dwelling per person	225	Liters/day	0	1	4
Beef cattle per animal	50	Liters/day	0	1	2
Dairy cows per animal	160	Liters/day	0	1	2
Irrigation applied per year:-					
Fruit, grain, non-leafy vegetables	.2	meters/year	0	1	1000
Leafy vegetables	.2	meters/year	0	1	1000
Pasture, Silage	.2	meters/year	0	1	10000
Livestock feed Grain	.2	meters/year	0	1	10000
Offsite Dwelling site	.2	meters/year	0	1	1000
Well pumping rate: 5100 cubic meters/year Well pumping rate needed to support specified Water use: 5084.17 cubic meters/year					
Save					
Cancel					

11.44 TEST CASE 034-020

Project	RESRAD-OFFSITE			
Test Case ID	RESOFF-TEST-34-020			
Test Summary	Test the functionality of Unsaturated Zones form			
Created By/Date	CW 10/17/2019			
Test Objective	To test the functionality of Unsaturated Zones form.			
Procedure	 Open Unsaturated Zones form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Clicking the Number of Unsaturated Zones should bring up the Preliminary Inputs form Modify at least two values for each unsaturated zone, save the form, and the save the project to Test32.rof. Check the following variables in the generated file; they should be the same as inputs in GUI. H, DENSUZ, TPUZ, EPUZ, FCUZ, HCUZ, BUZ, ALPHALU 			
Required Data	None.			
F				

Expected Results The code should behave as described in each step.

Unsaturated Zone Hydro	logy	
Number of Unsaturated Zones: set in preliminary inputs form		
Unsatur	ated Zone Numl	ber: 1:
Thickness (meters)		4
Dry Bulk Density (grams/cm?		1.5
Total Porosity		.4
Effective Porosity		.2
Field Capacity		.3
Hydraulic Conductivity	y (meters/year)	10
b Parameter		5.3
Longitudinal Dispersiv	rity (meters)	.1
	Save	
	Cancel	

11.45 TEST CASE 034-021

Project	RESRAD-OFFSITE				
Test Case ID	RESOFF-TEST-34-021				
Test Summary	Test the functionality of Saturated Zone form				
Created By/Date	CW 10/17/2019				
Test Objective	To test the functionality of Saturated Zone form.				
Procedure	 Open Saturated Zone form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Modify at least two values for each unsaturated zone, save the form, and the save the project to Test33.rof. Check the following variables in the generated file; they should be the same as inputs in GUI. DPTHAQ, DENSAQ, TPSZ, EPSZ, HCSZ, HGW, DWIBWT, ALPHALOW, ALPHATW, ALPHAVW, HGSW, DPTHAQSW, ALPHALOSW, ALPHATSW, ALPHAVSW 				
Required Data	None.				
Expected Results	The code should behave as described in each step.				

Saturated Zone Hydrology

Thickness of saturated zone:		100		meters	
Dry <u>B</u> ulk Density of saturated zone:		1.5		grams/	/cm?
<u>I</u> otal porosity of saturated zone:		.4			
Effective porosity of saturated zone:		.2			
Hydraulic Conductivity of saturated zone:		100		meters	/year
	to s	vell		urface erbody	
Hydraulic <u>G</u> radient of saturated zone:	.02		.02		
Depth of aquifer contributing:	10		5		meters below water table
Longitudinal Dispersivity of saturated zone:	3		10		meters
<u>H</u> orizontal lateral Dispersivity of saturated zone:	.4		1		meters
Vertical lateral Dispersivity of saturated zone:	.02		.06		meters
	Save Cancel				
_					

11.46 IESI CASE 034-022	11.46	TEST CASE 034-02	2
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Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-022
Test Summary	Test the functionality of Groundwater Transport form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Groundwater Transport form.
Procedure	 Open Groundwater Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Clicking the three buttons should bring up the forms of Water Use, Unsaturated Zones, and Saturated Zone Check the options for subzone dispersion; they should respond to selection Change at least three values, save the form, and then save the project to Test34.rof Check the following variables in the generated file; they should be the same as inputs in GUI. OFFLPAQW, OFFLPAQS, OFFLNAQW, OFFLNAQSN, OFFLNAQSF, EPS, NPCM, NPCMF, NPCZ, NPCZF, NSPCZ, NSPCZF, NPSS, NPSSF, NAQS, NAQSF
Required Data	None.
Expected Results	The code should behave as described in each step.

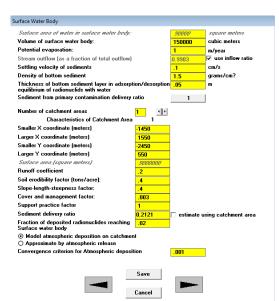
Groundwater	r Transport				
Sub Scre	ens Wate <u>r</u> Use p	arameters			
	Unsaturated Zone Properties Saturated Zone Properties				
Distance in	the direction parallel to aquifer flow fro	om downgradient edge of	contaminatio	on to	
	<u>w</u> ell:		100	meters	
	<u>s</u> urface wa	ter body:	450	meters	
Distance in	the direction perpendicular to aquifer f	low from center of contan	nination to		
	w <u>e</u> ll:		0	meters	
	<u>r</u> ight edge	of surface water body:	-150	meters	
	<u>l</u> eft edge o	f surface water body:	150	meters	
Convergen	ce criterion (fractional accuracy desired	I):	.001		
Number of	sub zones (to model dipsersion of proge	eny produced in transit):			
Main sub	zones in primary contamination		1		
Main sub	zones in submerged primary contaminat	ion	1		
Main sub	zones in each partially saturated zone		1		
Main sub	zones in saturated zone		1		
⊙ nuclide transfo	e specific retardation in all sub zones, lo ormation	ongitudinal dispersion in a	II but the su	b zone of	
0 longitu transfo	idinal dispersion in all sub zones, nuclid ormation, parent retardation in zone of t	le specific retardation in a ransformation	II but the su	lb zone of	
👝 lonaitu	idinal dispersion in all sub zones, nuclid	le specific retardation in a	ll but the su	lb zone of	

O longitudinal dispersion in all sub zones, nuclide specific retardation in all but the sub zone transformation, progeny retardation in zone of transformation

	Save	
_	Cancel	

	11.47	TEST	CASE	034-023
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Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-023
Test Summary	Test the functionality of Surface Water Body form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Surface Water Body form.
Procedure	 Open Surface Water Body form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Check the Surface area of water body, which should be consistent with the inputs in Site Layout form Check the Sediment Delivery ration button, which should be consistent with the input in Sediment Delivery Ration form. Clicking it should bring up the Sediment Delivery Ratio form. Check the Number of catchment areas. The left and right arrow button should allow delete or add one catchment with default settings Validate the catchment are using the coordinates Modify at least three values in each column, save the form, and then save the project to Test35.rof Check the following variables in the generated file; they should be the same as the inputs in GUI. ALAKE, VLAKE, EVAPOT, FSTMFLOW, FSTMFLOWIN, VSETTLE, RHOBSED, THICKSED, SDR, NCATCH, CATCHXY, AREACA, RUNOFFCA, ERODIBILITYCA, SLPLENSTPCA, CRPMANGCA, CONVPRACCA, SDRCA, SDRACOR, DDRCA, COMPUTEDEP, CONVCRITATM
Required Data	None.
Expected Results	The code should behave as described in each step.



11.48 TEST CASE 034-	-024
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Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-024
Test Summary	Test the functionality of Ingestion Rates form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Ingestion Rates form.
Procedure	 Open Ingestion Rates form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Check the Drinking Water Consumption rate, which should be consistent with the input in Water Use form. Modification on either one should change the other one automatically. Check the Drinking water fraction from affected area, which should be consistent with the inputs from Water Use form. Clicking of this button should bring up the Water Use form. Check the three buttons. Clicking them should bring up forms of Plant Factors, Livestock Factors, and Livestock Feed Factors. Modify at least two values in each column, save the form, and then save the project to Test36.rof. Check the following variables in the generated file; they should be the same as inputs in GUI. DFI,DVI, DMI, SOIL, FFISH, FVEG, FMEMI
Required Data	None.
Expected	The code should behave as described in each step.

Ingestion Rates			
	Consumptio rate	n	Fraction from affected area
<u>D</u> rinking water	510	Liters/year	1
<u>F</u> ish	5.4	kg/year	.5
<u>C</u> rustacea and mollusks	.9	kg/year	.5
Fruit, grain, non-leafy vegetables	160	kg/year	.5
Leafy <u>v</u> egetables	14	kg/year	.5
M <u>e</u> at	63	kg/year	1
Mjik	92	Liters/year	1
<u>S</u> oil (incidental)	36.5	grams/year	
Plant Factors			
Livestock Feed Factors			
Save			
	Cancel		

11.49 TEST CASE 034-025

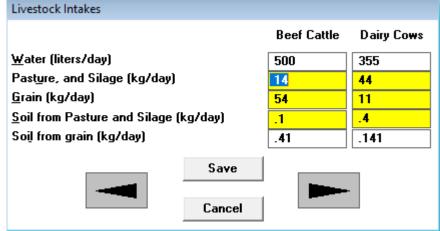
Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-025
Test Summary	Test the functionality of Plant Factors form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Plant Factors form.
Procedure	 Open Plant Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the figure has. Modify at least two values in each column, save the form, and then save the project to Test37.rof. Check the following variables in the generated file; they should be the same as inputs in GUI. YIELD, GROWTIME, FOLI_F, RWEATHER, FINTCEPT, DROOT
Required Data	None.
Expected	The code should behave as described in each step.

Expected Results

Plant Factors			
Crops		Fruit, grain, non-leafy	Leafy vegetables
Wet weight crop yield (kg/m?		.7	1.5
Duration of <u>G</u> rowing season (years)		.17	.25
Foliage to Food <u>Transfer</u> coefficient		.1	1
<u>₩</u> eathering Removal constant (1/year)		20	20
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot Depth (meters)		1.2	.9
	Save		
	Cancel		

11.50 TEST CASE 034-026

Project	RESRAD-OFFSITE	
Test Case ID	RESOFF-TEST-34-026	
Test Summary	Test the functionality of Livestock Intakes form	
Created By/Date	CW 10/17/2019	
Test Objective	To test the functionality of Livestock Intakes form.	
Procedure	1) Follow the same procedure as testing of Plant Factors form, except checking the following variables, LWI, LFI, LSI.	
Required Data	None.	
Expected Results	The code should behave as described in each step.	
	Livestock Intakes	



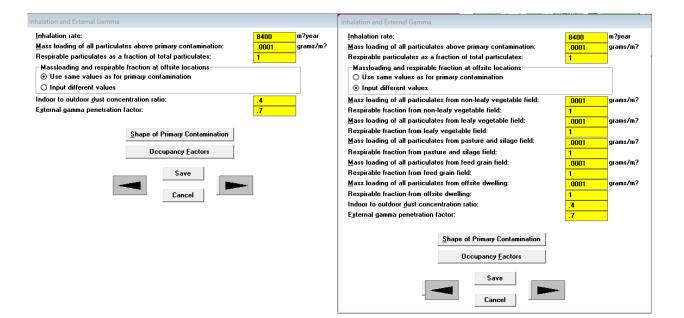
11.51 TEST CASE 034-027

Project	RESRAD-OFFSITE	
Test Case ID	RESOFF-TEST-34-027	
Test Summary	Test the functionality of Livestock Feed Factors form	
Created By/Date	CW 10/17/2019	
Test Objective	To test the functionality of Livestock Feed Factors form.	
Procedure	 Follow the same procedure as testing of Plant Factors form, except checking the following variables, YIELD(3), YIELD(4), GROWTIME(3), GROWTIME(4), FOLI_F(3), FOLI_F(4), RWEATHER(3), RWEATHER(4), FINTCEPT(3,2), FINTCEPT(4,2), FINTCEPT(3,1), FINTCEPT(4,1), DROOT(3), DROOT(4) 	
Required Data	None.	
Expected	The code should behave as described in each step.	

Сгорз	Pasture, Silage	Grain
Wet weight crop yield (kg/m?	1.1	.7
Duration of <u>G</u> rowing season (years)	.08	.17
Foliage to Food <u>Transfer</u> coefficient	1	.1
Weathering Removal constant (1/year)	20	20
Foliar interception factor for irrigation	.25	.25
Foliar interception factor for dust	.25	.25
<u>R</u> oot Depth (meters)	.9	1.2
Sav	e	

11.52 TEST CASE 034-028

Project	RESRAD-OFFSITE	
Test Case ID	RESOFF-TEST-34-028	
Test Summary	Test the functionality of Inhalation, Gamma form	
Created By/Date	CW 10/17/2019	
Test Objective	To test the functionality of Inhalation, Gamma form.	
Procedure	 Open Inhalation, Gamma form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the left figure has. Selection of Input different values under Massloading and respirable fraction at offsite locations should bring more input boxes, as shown in the right figure. Clicking the two buttons should bring up the forms of Shape Factors and Occupancy. With Input different values selected, modify at least three inputs, save the form, and then save the project to Test40.rof. Check the following variables in the input file; they should be the same as the inputs in GUI. INHALR, SAMEMLRF, MLTOTOF, RESPFRACOF, MLTOTDWELL, RESPFRACDWELL, SHF3, SHF1 	
Required Data	None.	
Expected	The code should behave as described in each step.	



11.53 TEST CASE 034-029	11.53	TEST CASE 034-029
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Project	RESRAD-OFFSITE	
Test Case ID	RESOFF-TEST-34-029	
Test Summary	Test the functionality of Shape Factors form	
Created By/Date	CW 10/17/2019	
Test Objective	To test the functionality of Shape Factors form.	
Procedure	 Open Shape Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the figure has. Select Onsite tab on the right panel. Select Circular for Shape of the primary contamination, a circle should appear in the center. Click "Calculate Radii and Fractions", and the code should calculate and list the results in the table in right panel. Click Clear. The left panel should become blank. Select Polygonal for Shape of primary contamination. Generate a polygon on the left panel using mouse. The button "Calculate Radii and Fractions" should be available should become available upon a polygon is generated. Click it and the results should be listed in the table. Select Offsite tab on the right panel, and repeat Steps 4-6. Save the form, and then save the project to Test41.rof. Check the variable RAD_SHAPE in the generated input file; its value should be same as the calculated ones in the GUI. 	
Data		
Expected Bosults	The code should behave as described in each step.	

Expecte Results

External Radiation Shape and Area Factors				
	Current X: 245		Onsite	Offsite
	Current Y: 33	Dw	- elling Location	X: 625
	Line Length: meters	Dw	elling Location	Y: 625
	Area: 10000 m?			
	Drawing Instructions		alculate <u>R</u> adii	and Fractions
	Use the left mouse button to change		Radius: (m)	Fraction:
	the dwelling location and to calculate the Radii and Fractions.	1	6.583333	1
		2	13.16667	1
		3	19.75	.9
		4	26.33333	1
	Key board Instructions Key in the dwelling location.	5	32.91667	.9
	Then press the Calculate Radii and	<u>6</u>	39.5	1
	Fractions button.	Z	46.08333	.9
		<u>8</u>	52.66667	1
		<u>9</u>	59.25	.54
		10	65.83334	.24
Shape of the plan of the primary contamination:	Save	11	72.41666	.072
○ <u>C</u> ircular		12	79	0
Coordinates of the verticies of polygon: \underline{X} (m): \underline{Y} (m):	Cancel		🔲 Userinpu	ut fractions
	xt Vertex			
	ete Polygo <u>n</u> Ciear <u>S</u> cale:	12	50 meters	

11.54 TEST CASE 034-030

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-030
Test Summary	Test the functionality of Occupancy form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Occupancy form.
Procedure	 Select Ac-227 in the Initial Concentrations form. Open Occupancy form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the figure has. Modify at least three values, save the form, and then save the project as Test42.rof. Check the following variables in the generated file; they should be the same as the inputs in GUI. FIND, FOTD, FINDDWELL, FOTDDWELL, OCCUPANCY(1) -(4) Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.
Required Data	None.
Expected Results	The code should behave as described in each step.

Occupancy		
Fraction of Time spen (whether cultivated o		CONTAMINATION
<u>I</u> ndoors		0
Out <u>d</u> oors		0
Fraction of Time spen	t in OFFSITE D	WELLING SITE
<u>I</u> ndoors		.5
Out <u>d</u> oors		.1
Fraction of Time spen	t in FARMED AI	REAS
Frui <u>t,</u> grain, and No	onleafy fields	.1
Leafy vegetable fie	elds	.1
Pasture and silage	fields	.1
Livestock grain fie	lds	.1
	Save	
		Run
	Cancel	

11.55 TEST CASE 034-031

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-002
Test Summary	Test the functionality of Radon form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Radon form.
Procedure	 Open Radon form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the figure has. All the input boxes in this form should be grayed out unless a radon parent Rn-222 or Rn-220 is present in the contamination radionuclide list. Close the form. Select U-238 from the Initial Concentrations form and then turn on Radon pathway. Open Radon form again; it should be available for modification now. Modify at least three values, save the form, and then the project to Test43.rof. Check the following variables in the generated file; they should be the same as the inputs in GUI. DIFCV, DIFCZ, DIFOS(1), DIFOS(2), DIFOS(3), DIFOS(4), DIFOS(5), DIFFL, FLOOR1, DENSFL, TPFL, PH2OFL, DMFL, HMIX, HRM, REXG, FAI, EMANA(1), EMANA(2) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.
Required Data	None.
Expected	The code should behave as described in each step.

Results

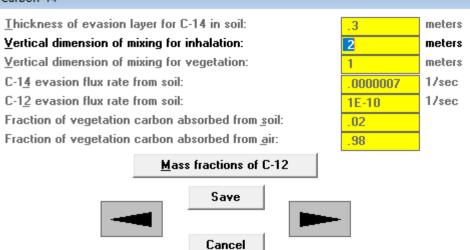
Radon		
Effective radon diffusion coefficient of Cover:	.000002	m?s
Effective radon diffusion coefficient of Contaminated zone:	.000002	m?s
Effective radon diffusion coefficient of Floor:	3.E-7	m?s
Thickness of floor and foundation:	.15	meters
Density of floor and foundation:	2.4	g/cm?
Total porosity of floor and foundation:	.1	
Volumetric water content of floor and foundation:	.03	
Depth of Foundation below ground level:	-1	meters
Vertical dimension of mixing:	2	meters
Building room height:	2.5	meters
Building air exchange rate:	.5	1/hr
Building indoor area factor:	0	1
Rn-222 emanation coefficient:	.25	1
Rn-22 <u>0</u> emanation coefficient:	.15	ĺ
Effective radon diffusion coefficient of nonleafy veg field:	.000002	m?s
Effective radon diffusion coefficient of leafy vegetable field:	.000002	m?s
Effective radon diffusion coefficient of pasture:	.000002	m?s
Effective radon diffusion coefficient of livestock grain field:	.000002	m?s
Effective radon diffusion coefficient of offsite dwelling site:	.000002	m?s
Save Run Cancel		-

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11.56 TEST CASE 034-032

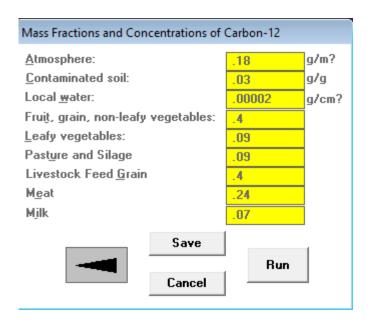
Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-032
Test Summary	Test the functionality of Carbon-14 form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Carbon-14 form.
Procedure	 Open Carbon-14 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the figure has. All the input boxes in this form should be grayed out unless C-14 is present in the contamination radionuclide list. Select C-14 from the Initial Concentrations form. Open Carbon-14 form again; it should be available for modification now. Clicking Mass fractions of C-12 should bring up Mass fractions of C-12 form. Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test44.rof. Check the following variables in the generated file; they should be the same as the inputs in GUI. DMC, HMIXV, C14EVSN, C12EVSN, CAIR, CSOIL
Required Data	None.
Expected Results	The code should behave as described in each step.

Carbon-14



11.57	TEST CASE 034-033
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Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-34-033
Test Summary	Test the functionality of Mass fraction of C-12 form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Mass fraction of C-12 form.
Procedure	 Open Mass fraction of C-12 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. It should have the same input boxes as the figure has. Select C-12 from the Initial Concentrations form. Open Mass fraction of C-12 form again. Save the form, and then the project to Test45.rof. Check the following variables in the generated file; they should be the same as the inputs in GUI. C12AIR, C12CZ, C12WTR, C12PLANT(1), C12PLANT(2), C12PLANT(3), C12PLANT(4), C12MEAT_MILK(1), C12MEAT_MILK(2) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.
Required Data	None.
Expected Results	The code should behave as described in each step.



11.58 TEST CASE 034-034	
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Project	RESRAD-OFFSITE
IIOjeet	
Test Case ID	RESOFF-TEST-34-034
Test Summary	Test the functionality of H-3 form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of H-3 form.
Procedure	 Select H-3 from the Initial Concentrations form. Open H-3 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. It should have the same input boxes as the figure has. Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test46.rof. Check the following variables in the generated file; they should be the same as the inputs in GUI. HUMID, H2OPLANT(1), H2OPLANT(2), H2OPLANT(3), H2OPLANT(4), H2OMEAT_MILK(1), H2OMEAT_MILK(2), HMX Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.
Required Data	None.
Expected Results	The code should behave as described in each step.

Results

.6 .88 2	meters
.6	
.8	
.8	1
.8	
.8	
8	grams/m?
	.8 .8 .8

11.59 TEST CASE 035-001

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-35-001 ID

Test Test if sub-menus File->New and Save work correctly **Summary**

Created CW 10/17/2019

By/Date

Test To test GUI menu File|New/Save

Objective

Procedure 1) Make sure the application path in .ini file points to the application folder

- 2) Launch the code. Remember the main window caption, say Site1.ROF" for example.
- 3) Click File -> New. A new window with caption "Title & Radiological Data" should pop up.
- Change the Title text box to: test menu File -> New/Save, then click "Close" button. The pop-up windows should be closed.
- 5) Click Set Pathways button on the left navigation panel, then check if all the pathways except Radon are on. If any is off, this test is failed.
- 6) Click Modify Data button from the left navigation panel, open the following forms in order and check if all the text box background is in yellow. If not, this test is failed.
 - I. Preliminary Inputs
 - II. Release Times
 - III. Initial Concentrations (check if the values in the top box is 100 pCi/g contaminated zone).
 - IV. Reporting times
 - V. Storage times
 - VI. Site Layout
 - VII. Physical and Hydrological
 - VIII. Primary contamination
 - IX. Sediment Delivery Ratio
 - X. Agricultural areas
 - XI. Livestock areas
 - XII. Dwelling site

- XIII. Atmospheric transport
- XIV. Water use
- XV. Unsaturated zones
- XVI. Saturated zones
- XVII. Groundwater Transport
- XVIII. Surface water transport
- XIX. Surface water body
- XX. Ingestion rates
- XXI. Plant factors
- XXII. Livestock intakes
- XXIII. Livestock feed factors
- XXIV. Inhalation, gamma
- XXV. Shape factors
- XXVI. Occupancy
- XXVII. Radon
- XXVIII. Carbon-14
 - XXIX. Mass fraction of C-12
 - XXX. H-3
- 7) Click File -> Save
- 8) Go to UserFiles folder under the application folder and open Site1.ROF file.
- 9) Check if files "Site1.ROF" and "Site1.CHN" are created
- 10) Open "Site1.ROF" and check if Variable Title = "test menu File -> New/Save"
- 11) IF so, this test is passed, otherwise, failed.
- 12) Repeat Steps 1-5 using icon "New" from tool bar.
- 13) Click icon "Save" from tool bar, and then Steps 8-10.
- 14) Repeat Steps 12 using keyboard Ctrl + S rather than tool bar, and then Step 13.

Required Data	None.
Expected	A new project can be generated from File New, tool bar icon, and hotkey, and all the initial values

Results are default values.

The generated input can be saved from File|Save, tool bar icon, and hotkey Ctrl + S, with correct values.

11.60 TEST CASE 035-002

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-35-002s ID

Test Test if submenus File->Open and Save As work correctly **Summary**

Created CW 10/17/2019

By/Date

Test To test menu File|Open/Save as. **Objective**

Procedure 1) Launch the code

- Click File -> Open. A new window should pop up, requesting user to select which file to open. The default file location should be the folder where the input file was read to run the code last time.
- 3) Go to the QAFiles folder and select the file with name ending with "US.ROF", and click Open.
- 4) The main interface should update after loading the input file. Check if the caption of the window is the same as the input file name.
- 5) Click Modify Data from left navigation panel and then Initial Concentration button, and check if the unit is conventional unit in the pop-up window. If not, this test is failed.
- 6) Click File -> Save as. A new window should pop out and the default path in the address box should be the QAFiles. If not, this test is failed. Change to UserFiles folder
- 7) Type "Test002" in the File name box and click Save. A file named Test002.rof should be saved in the UserFiles folder.
- 8) Go to UserFiles folder and compare file Test002.rof with the original file. They should be identical. If not, this test is failed.
- 9) Repeat Steps 1-8 using Open icon in Tool bar.
- 10) Repeat Steps 1-8 using keys Ctrl + O.
- 11) Copy the QAFiles folder to a USB drive and repeat Steps 1-8.

Required QAFiles folder in the installation. **Data**

11.61 TEST CASE 035-003

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-35-003 ID

Test Test if the submenu File-> Title works correctly. **Summary**

Created CW 10/17/2019

By/Date

Test To test menu File|Title.

Objective

Procedure 1) Launch the code.

- 2) Click File -> New. A new window with caption "Title & Radiological Data" should pop up.
- 3) Change the Title text box to: test menu Title, then click "Close" button. The pop-up windows should be closed.
- 4) Click File -> Save as, change the file address to UserFiles under the application folder, and type "Test003" in the File name box in the pop-up window.
- 5) Open "Test003.ROF" and check if Variable Title = "test menu Title"
- 6) IF so, this test is passed, otherwise, failed.
- 7) Repeat Steps 1-6 using hotkey Ctrl + T.

Required	None
Data	

Expected The project tile should be able to be changed and saved correctly into the input file. **Results**

11.62 TEST CASE 035-004

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-35-004 ID

Test Test if the DCF Editor can be called successfully from the menu of GUI. **Summary**

Created CW 10/17/2019

By/Date

TestTo test DCF Editor from GUIObjective

Procedure 1) Launch the code

- 2) Click File -> DCF Editor. The DCF Editor interface should pop up.
- 3) Close the DCF Editor.
- 4) Click Modify Data from the left navigation panel and then Initial Concentration.
- 5) Select "Ac-227" in the pop-up Initial Concentration window.
- 6) Click File->Run
- 7) Repeat Step 2 and check if the DCF Editor pops up correctly.

Required None. Data

Expected The DCF Editor should be called from the GUI menu at the beginning phase of using code and in any phase of running the code.

11.63 TEST CASE 035-005

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-35-005 ID

Test Test the menu Help works appropriately. **Summary**

Created CW 10/17/2019

By/Date

Test To test menu Help. Objective

Procedure 1) Launch the code.

- 2) Click Help-> Context Sensitive Help, the RESRAD-OFFSITE Help file should pop up.
- 3) Click "Ambient Temperature", "Darcy Velocity", and "Wind Speed", respectively, from the left panel under Tab Contents. The associated content should accordingly present on the right panel after each click.
- 4) Close RESRAD-OFFSITE Help file by clicking mark X on the top right corner of the window.
- 5) Press F1 at the main interface, the RESRAD-OFFSITE Help file should pop up. Repeat Steps 3 and 4.
- 6) Click Change Title from left navigation panel, put the cursor in Cut-off half life box in the pop-up Title & Radiological Data window, and then Press F1, the help file should pop up with the specific page "Half life limit for principle radionuclides" page open. Close the help file.
- Click Modify Data -> Primary Contamination, and put the cursor in the Box Depth of soil mixing layer. Pressing F1 should open the Help file with Page "Depth of Soil Mixing Layer" open.
- Click Modify Data -> Occupancy, and then put the cursor in Box Indoors on the top of the pop-out Occupancy window. Pressing F1 should open the Help file with page "Fraction of Time Spent Indoors Open Primary Contamination" open.
- From the main interface, click Help -> User's Guide. A PDF file named UsersGuild.pdf should pop out. Close it.
- 10)Repeat Step 9 by pressing F3.
- 11)Click Help -> User's Technical Manual. A PDF file named UsersManuel.pdf should pop out. Close it.

12)Repeat Step 11 by pressing F4.

13)From the main interface, click Help -> About RESRAD-OFFSITE. The About RESRAD-OFFSITE should pop up.

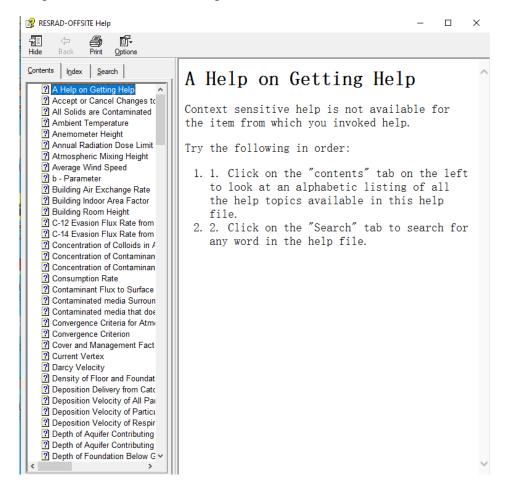
14)Close all the windows.

Required None Data

Expected The GUI should be able to open the Help file from menu and open a specific help page by pressResults F1 with the cursor focusing on a particular variable input box.

The GUI should be able open User's Guide and User's Manual file from help menu or by pressing F3/F4 key at any window.

Help menu should be able to open About RESRAD-OFFSITE window.



11.64 TEST CASE 035-006

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-35-006 ID

Test Test the functionality of Pathways menu. **Summary**

Created CW 10/17/2019

By/Date

Test To Test the functionality of Pathways menu.

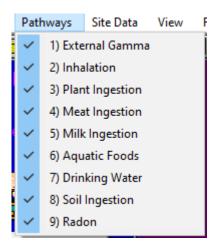
Objective

Procedure 1) Launch the code and clicking Set Pathways form the left panel. By default, all the pathways should be on except Radon pathway.

- 2) Select U-238 from Initial Concentrations form.
- 3) Click Pathways from the menu
- 4) Click all the press buttons one by one, the check marker in front of nine pathways should go away and the pathway icons should present an off marker in the Set pathways form.
- 5) Click all the press buttons one by one again to turn on all the pathways. The check marker in front of nine pathways in Pathways menu should appear again and the off marker on the pathway icons in the Set pathways form should go away.
- 6) Turn off all the pathways again except external pathway.
- 7) Save the input to file Test47.rof.
- 8) Open the input file Test47.rof from notepad, and should see SELPATH = 1, indicating only external pathway is selected.
- 9) Open project Test47.rof, and turn on Radon pathway. Save the file and Save the project again.
- 10) Check TEST011.rof and the variable SELPATH should be 257.

Required Data	None.
Expected Results	Pathway form should be opened and closed from the menu.
Kesuits	Pathways can be turned on and off by pressing either the press buttons or the pathway icons.

The selection of pathways should be correctly written into the input file and echoed in the report file.



11.65 TEST CASE 035-007

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-35-007
Test Summary	Test the functionality of Site Data menu
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Site Data menu.
Procedure	 Launch the code and click Site Data menu. It should look like the attached figure. Visually check the format, fonts, and spelling. Clicking the submenus one by one should open the corresponding form.
Required Data	None.
Expected Results	The code should behave as described in each step.

Site Data	View	Form Options	Data Transfe		
A) P	reliminary	/ Inputs			
B) Initial Concentrations					
C) F	C) Reporting Times				
D) P	hysical ar	nd Hydrological			
E) A	tmospher	ic Transport			
F) G	roundwat	er Transport			
G) li	ngestion F	Rates			
H) I	nhalation	and External Gam	ma		
I) Ra	don				
J) C	arbon-14				
К) Т	ritium (H-	3)			
L) S	torage Tin	nes			
M) I	Primary Co	ontamination			
N) /	Agricultura	al Areas			
O) L	ivestock F	Feed Area			
P) D	welling Si	te			
Q) (Insaturate	ed Zones			
R) S	aturated Z	Ione			
	/ater Use				
	urface Wa	-			
U) L	ivestock l	ntakes			
V) P	lant Facto	ors			
		Feed Factors			
	ccupancy)				
· · · ·		ions of C-12			
	ite Layout				
		elivery Ratio			
2) R	elease Tin	nes			

11.66	TEST CASE 035-008		
Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-35-008		
Test Summary	Test the functionality of View menu		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of View menu.		
Procedure	 Launch the code and click View menu. It should look like the attached figure. Visually check the format, fonts, and spelling. Select U-238 and run the code. Clicking Message Log should open OUTPUT.FIL file from Viewer. Clicking Deterministic Graphics should open the graphics from WRESPLOT.EXE Clicking Uncertainty/Probabilistic Graphics should bring up the Uncertainty and Probabilistic Analysis interactive window. Clicking Iconic Navigator toggle Iconic Navigator window on the upper right corner of the main interface, and clicking it again should turn it on. Clicking Pathway Bar should toggle the tool bar between on and off. Clicking Sensitivity Input Summary should toggle the sensitivity variable list at the bottom left corner of the main interface between on and off. Clicking Uncertainty/Probabilistic Interface should toggle the Uncertainty and Probabilistic Analysis interactive window between on and off. Clicking Uncertainty/Probabilistic Interface should toggle the Uncertainty and Probabilistic Analysis interactive window between on and off. Clicking Uncertainty/Probabilistic Interface should toggle the Uncertainty and Probabilistic Analysis interactive window between on and off. Clicking Soil Strata Graphic should toggle the Soil Strata form between on and off. Clicking Soil Strata Graphic should toggle the Soil Strata form between on and off Turning on Variable information will display the variable name, default value, and range of allowable value at the bottom of the main interface. Turn it on by clicking the submenu, and then open the Surface Water Body form. Put the cursor on Area of surface water body. 		

At the bottom of the windows should display the following information "Variable name: VLAKE Default: 150000 Range: 1 to 1E34"

Required None. Data

The code should behave as described in each step. Expected

Results

Viev	 Form Options Data Transfer 	Help
	Text Output	>
1	Message Log	Ctrl+E
	Deterministic Graphics	
	Uncertainty/Probabilistic Graphics	
~	Iconic Navigator	
~	Tool Bar	
	Pathway Bar	Ctrl+P
~	Sensitivity Input Summary	Ctrl+F9
	Uncertainty/Probabilistic Interface	Ctrl+F8
	Map Interface	
	Soil Strata Graphic	
~	Button Prompts	
~	Variable Information	Ctrl+I

11.67	TEST CASE 035-009		
Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-35-009		
Test Summary	Test the functionality of Text Output menu		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Text Output menu.		
Procedure	 Launch the code and click View menu. It should look like the attached figure. Visually check the format, fonts, and spelling. Select U-238 and run the code. Clicking menu View -> Text Output -> Parent Dose Report should open Summary.rep by Viewer. Clicking View -> Text Output -> Risk Report should open INTRISK.REP by Viewer. Clicking View -> Text Output -> Progeny Dose Report should open DAUDOSE.REP by Viewer. Set up a parameter for uncertainty analysis and then run the code. Clicking View -> Text Output -> Uncertainty/Probabilistic Dose and Risk Report should open MCSUMMAR.REP by Viewer. Generate area factors from File Generate area factors. Clicking View -> Text Output -> Area Factors Report should open AREAFACTORTEXT.REP by Viewer. 		
Required Data	None.		
Expected	The code should behave as described in each step.		

Expected Results

View	v Form Options Data Transfer	Help	
	Text Output	>	Parent Dose Report
	Message Log	Ctrl+E	Risk Report
	Deterministic Graphics Uncertainty/Probabilistic Graphics		Progeny Dose Report Uncertainty/Probabilistic Dose and Risk Report
*	Iconic Navigator Tool Bar Pathway Bar	Ctrl+P	Uncertainty/Probabilistic Inputs Report Linear Regression Report Area Factors Report
~	Sensitivity Input Summary	Ctrl+F9	
	Uncertainty/Probabilistic Interface	Ctrl+F8	
	Map Interface		
	Soil Strata Graphic		
	Button Prompts		
~	Variable Information	Ctrl+I	

11.68 TEST CASE 035-010

Project	RESRAD-OFFSITE		
Test Case ID	RESOFF-TEST-35-010		
Test Summary	Test the functionality of Form Options menu		
Created By/Date	CW 10/17/2019		
Test Objective	To test the functionality of Form Options menu.		
Procedure	 Launch the code and click Form Options menu. It should look like the attached figure. Visually check the format, fonts, and spelling. Open Initial Concentration form and select Ac-227, then click Form Options -> Save Current Form. The form should be closed. Open the form again and check if Ac-227 is selected with concentration of 100 pCi/g. From Initial Concentration from, click Nuclide Specific Release button and the form should pop up. Change the value of "Specify the First Order Leach Rate Constant" from 0 to 10, then click Form Option -> Cancel Current Form button. The Radionuclide Specific Release form should be closed. Open it and check if the value of "Specify the First Order Leach Rate Constant" is 0, rather than 10. Change the value 0 in Step 3 to 10, then save and close the Radionuclide Specific Release form. Open the form again, the value should be 10, rather than 0. Clicking Form Option -> Cancel Current Form button should close this form. Open it and check the value gain; it should be 10 rather than 0. Restore the value to 0 by pressing F6 on the text box and click Save to close the Radionuclide Specific Release form. At this time, the Initial Concentration should still be open. Clicking Form Option -> Cancel Current Form button should pop up a warning window with message "Changes to the Initial Concentration form cannot be canceled. Changes have to be reserved manually." Click Ok and close the pop-up windowm. Open Distribution Coefficients form, put cursor focus on the Contaminated zone text box with default value of 20, then click Form Options Sensitivity Analysis (Single Parameter) menu, the Set Sensitivity Analysis Range window should pop up. Click Cancel to close the form. 		

- 8) Open Distribution Coefficients form, put the cursor on the Unsaturated Zone 1 text box, and click Form Options|Uncertainty/Probabilistic Analysis menu. Uncertainty and Probabilistic Analysis window should pop up. Click Ok to close the window.
- 9) Open Physical and Hydrological form, put cursor on Precipitation text box, and the click Form Options|Uncertainty/Probabilistic Analysis menu. Uncertainty and Probabilistic Analysis window should pop up again with one more variable present on the left panel. Click OK to close the form.
- 10) Change the value of the Unsaturated Zone 1 text box to 10, and its background color should change to white. Click Form Options Form|Default, the default value (20) should replace the current value. Clicking Form Options Form|Lower Bound should change the value to its minimum allowable value and clicking Form Options Form|Upper Bound should change the value to its maximum allowable value.
- 11) Repeat Steps 1-10 using hot-keys listed on the right of the submenus.

Required	None.	
Data		

Expected The code should behave as described in each step.

Results

Form Options	Data Transfer Help	
Save Curre	ent Form	Ctrl+K
Cancel Cu	rrent Form	Ctrl+U
Sensitivity	Analysis (Single Parameter)	F9
Uncertaint	y/Probabilistic Analysis	F8
Multiparar	meter Sensitivity Analysis	Shift+F8
Lower Bou	ind	F5
Default		F6
Upper Bou	ind	F7

11.69	TEST CASE 035-011	
Project	RESRAD-OFFSITE	
Test Case ID	RESOFF-TEST-35-011	
Test Summary	Test the functionality of Data Transfer menu.	
Created By/Date	CW 10/17/2019	
Test Objective	To test the functionality of Data Transfer menu.	
Procedure	 Launch the code and save the project to Test55.rof. Clicking Data Transfer Generate Template files menu should bring up the Formatted Data Transfer form, as shown in the left figure. Click Generate files button and give a name Test55-1.rof on the pop-up Save as window. Close the Formatted Data Transfer form. Compare Test55.rof and Test55-1.rof. They should be identical. Clicking Data Transfer Read Template files should bring up the Formatted Data Transfer form with Read files button available for clicking. Clicking Read files and select Test55-1.rof. A message window with warning message should popup. Click OK and then close the Formatted Data Transfer form. Test55-1.rof should be loaded. 	
Required Data	None.	

Expected Results The code should behave as described in each step.

Formatted Data Transfer

Click on the command buttons below to change the specifications of the template file to **b** generated :

ICRP 38 transformation database	30 days cutoff half life
RESRAD-ONSITE exponentia	al release conceptualization
pCi	Specify radionuclides at site
<u>G</u> enerate files	se <u>R</u> ead files

The file dialogue box will be displayed where you can specify the name for the files to be generated.
 Three files will be saved, each with the specified root name.

a. The first is a RESRAD-OFFSITE input file, with extension ROF, containing all the data currently specified in the interface.

b. The second is a comma seprarated text file, with extension NID.CSV, containing most of the radionuclide independent data currently specified in the interface.

c. The third is a comma seprarated text file, with extension NDP.CSV, containing some of the radionuclide dependent data currently specified in the interface.

Edit only the third column, titled 'value', of the radionuclide independent template file and the numerical data in the radionuclide dependent template file.

1. Do not alter any of the other data in the radionuclide independent data file.

2. Do not alter the names of the radionuclides nor the titles of the columns in the radionuclide dependent data file.

3. Do the following if you need to change the list of radionuclides after changing some of the data in the radionuclide dependent data file,

a. Read the template file that you have modified back into this interface.

b. Use the Select radionuclides command to make the necessary changes to the list of radionuclides and save the template files again.

c. Modify the new template file.

11.70 TEST CASE 035-012

Project **RESRAD-OFFSITE Test Case** RESOFF-TEST-35-012 ID Test Test the GUI's input functionality from control level. **Summary** Created CW 10/17/2019 **By/Date** Test To test the GUI's input functionality from control level. Objective **Procedure** 1) Run the code and open the forms to be tested. 2) Check the overall layout and spelling of the form. 3) For each control (frame, text box, label.), check the following if applicable a. Spelling and legibility b. Alignment, size, and dimensions are appropriate. c. Whether the default values are loaded before any modification d. Whether the background of textbox is in yellow when default value is present and white when it is nondefault value. e. Check key F5, F6, F7 can restore the value to its minimum, default, and maximum f. Check its error checking function i. input a very small value (e.g., a negative value). An error message should present upon saving/closing the form with three options: change the currently input value to the lower bound of the variable, change to default value, and reentering the value. ii. input a very large number (e.g., 1e100 or 1.5 for fractions). An error message should present upon saving/closing the form with three options: change the current input value to the upper bound of the variable, change to default value, and reenter the value. g. Check if help works for this control. Put the cursor on the control and press F1 key, the help file should pop up, opening to the content for the specified variable. h. Check if the unit is consistent with the setting in Preliminary Input 4) Each control should respond correctly to actions.

Required None. Data **Expected** The code should behave as described in each step. **Results**

11.71 TEST CASE 036-001

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-36-001
Test Summary	Test the Help file works appropriately.
Created By/Date	CW 10/17/2019
Test Objective	To test Help file.
Procedure	 Launch the code and open the Help file from the main interface. It should have Contents, Index, and Search elements. It should include help information for parameters as shown in the figure. Click "Contaminant Flux to Surface Water Body" and then click two places on the right panel where the text shows a hyperlink. The help file page associated with the text should open. Click Search tab on the left panel, the type "precipitation" in the search bar and press Enter, then topics including the searching word should be listed in lower left panel. Clicking one should bring its content to the right panel.
Required Data	None
Expected	The Help file should have all the required content and functions.

Results

A Help on Getting Help Accept or Cancel Changes to Map Interface All Solids are Contaminated Ambient Temperature Anemometer Height Annual Radiation Dose Limit Atmospheric Mixing Height Rerage Wind Speed 🛯 b - Parameter Building Air Exchange Rate Building Indoor Area Factor Building Room Height C-12 Evasion Flux Rate from Soil C-14 Evasion Flux Rate from Soil Concentration of Colloids in Aquifer Concentration of Contaminants in Surface Water Concentration of Contaminants in Well Water Consumption Rate R Contaminant Flux to Surface Water Body Contaminated media Surrounded by Clean soil Contaminated media that does not Conduct Moisture Surrounded by Clean soil Convergence Criteria for Atmospheric Deposition Convergence Criterion 2 Cover and Management Factor Current Vertex 2 Darcy Velocity 2 Density of Floor and Foundation P Deposition Delivery from Catchment P Deposition Velocity of All Particulates Peposition Velocity of Particulates to Compute Atmospheric Release Peposition Velocity of Respirable Particulates Popth of Aquifer Contributing to the Surface Water Body 2 Depth of Aquifer Contributing to Well 2 Depth of Foundation Below Ground Level Depth of Soil Mixing Laver 2 Diffusion Coefficient of Radionuclide Pimensions of Contaminated Medium Direction of Ground Water Flow 2 Direction of X-Axis Disperse Vertically or Not 2 Dispersion Coefficient of Contaminant in Ground Water Transport 2 Dispersion Model Coefficients 2 Distance, Parallel to Aquifer Flow, from Contamination to Surface Water Body Distance. Parallel to Aquifer Flow, from Contamination to Well 2 Distance, Perpendicular to Aguifer Flow, from Contamination to the Left Edge of the Surface Water Body Distance, Perpendicular to Aquifer Flow, from Contamination to the Right Edge of the Surface Water Body 2 Distance, Perpendicular to Aquifer Flow, from Contamination to Well Participation Coefficient 2 Distribution Coefficient of Colloids 2 Distribution Coefficient of Nuclides on Colloids 2 Dose Conversion and Slope Factors 2 Dose Conversion Factor Library 2 Drv Bulk Density ? Dwelling Location Refective Diffusion Coefficient of the Radionuclide in the Contaminated Medium Effective Porosity P Effective Radon Diffusion Coefficient Receptor Location 2 Equilibrium Desorption Transfer 2 Equilibrium Dissolution Transfer

2 Evapotranspiration Coefficient 2 Exposure Duration 2 Exposure Pathways 2 External Gamma Penetration Factor Field Capacity First Order Rate Controlled Transfer Poliage-to-Food Transfer Coefficient Poliar Interception Factor for Dust Poliar Interception Factor for Irrigation Praction of Agricultural Area Directly Over Primary Contamination Praction of Food from the Contaminated Area Praction of Radionuclide Bearing Material that is Releasable Praction of Time Spent in Farmed Areas Praction of Time Spent Indoors in Offsite Dwelling Praction of Time Spent Indoors On Primary Contamination Praction of Time Spent Outdoors in Offsite Dwelling Site Praction of Time Spent Outdoors On Primary Contamination Praction of Vegetation Carbon Absorbed from Air Fraction of Vegetation Carbon Absorbed from Soil 2 Get Image of Map for Map Interface 2 Grid Spacing for Atmospheric Transport Half Life Limit for Principal Radionuclides Parizontal Lateral Dispersivity of Saturated Zone P Humidity in Air ? Hvdraulic Conductivity ? Hvdraulic Gradient Indoor Dust Filtration Factor Infiltration Infiltration Rate, Hydraulic Conductivity Check R Mass Fraction of Stable Carbon in Plant Inhalation Dose Conversion Factor for Carbon-14 Inhalation Rate Inhalation Slope Factor for Carbon-14 2 Intake of Grain, Silage or Pasture by Livestock Intake of Soil with Grain, Silage or Paster by Livestock Irrigation Applied Per Year I Joint Frequency of Wind Speed and Stability Class 2 Land-Based Offsite Receptor Locations 2 Launch Dose and Slope Factor Editor 2 Leach Rate Constant 2 Leach Rate Coefficient 2 Length of Growing Season 2 Length of Primary Contamination (in Direction Parallel to Aquifer Flow) Location of Dose, Slope and Transfer Factor Database I Longitudinal Dispersivity in the Saturated Zone 2 Longitudinal Dispersivity in the Unsaturated Zone Map Interface for Site Lavout Mass Fraction of Stable Carbon in Meat Mass Fraction of Stable Carbon in Milk Mass Eraction of Water in Meat Mass Eraction of Water in Milk 2 Mass Fraction of Water in Plant Mass Loading for Inhalation 2 Mass Loading of All Particulates Mass Loading at Offsite Locations Same as at Primary Contamination 2 Set Scale 2 Mass of Primary Contamination Mass and Volume of Contaminated Medium Minimum Time Increment

2 Modeling Nuclide-Specif Retardation or Dispersion Modeling the Effects of Colloids In the Transport of the Contaminants 2 Modeling Transport of Progeny Produced in Transit 2 Modifying the Joint Frequency Data that Was Read in From a STAR File 2 Model Multiple Forms of Contaminated Media 2 Nuclide Concentration Nuclides in Database List of Nuclides Present at the Site. List of 2 Number of Catchments 2 Number of Iterations for Equilibrium Solubility Transfer 2 Number of Livestock Consuming Water INumber of Main Sub Zones in Each Partially Saturated Zone INumber of Main Sub Zones in a groundwater transport zone R Number of Minor Subzones in Last Main Subzone 2 Number of Individuals Consuming Water Number of Time Points Number of Unsaturated Zones Occupancy Onsite Vertical Dimension of Mixing Pore Water Velocity Porosity, Total 2 Potential Evaporation from the Surface Water Body Precipitation Primary Contamination Radiological Activity Radiological Dose Radiological Transformation Database Radionuclide Bearing Material Becomes Releasable Temporally Radionuclide, Properties of Radionuclides become available for surface releases Radon Dose and Slope Factors Radon Emanation Coefficient Rainfall Erosion Index 2 Rate of (Ground Water) Transport of Contaminant Read Meteorological STAR File Recharge Through and Ground Water Flow Under Primary Contamination Check Release Heat Flux Release Height Report Viewer ? Reporting Times Respirable Particulates as a Fraction of Total Particulates RESRAD-ONSITE Exponential Release Model Retardation Factor Retardation Factor Flag Root Depth Rsizing an Icon in the Map Interface ? Runoff Coefficient 2 Save Input File when a Form is Saved ? Sector Sediment Delivery from Catchment ? Sediment Delivery Ratio Selecting the Dose Factor Library Selecting the Slope Factor Library ? Sensitivity Analysis Settling Velocity of Sediment Shape and Dimensions of the Plan of the Primary Contamination for Direct Exposure Shape and Location Factor of Primary Contamination from Each Dwelling Location

Shape of the Plan of the Primary Contamination ? SI (Metric) Prefixes ? Slope Factor Library Slope-Length-Steepness Factor 2 Soil Erodibility Factor ? Soil Ingestion Rate Soluble Concentration Spacing of Time Points Specifying the Location of the Dwellings Recifying the Shape of the Primary Contamination 3 Stable Carbon Concentration in Atmosphere 3 Stable Carbon Concentration in Contaminated Soil 3 Stable Carbon Concentration in Local Water Storage Times Stream outflow Fraction 3 Submerged Fraction of Primary Contamination Support Practice Factor Surface Water Body Thickness of Bottom Sediment Thickness of Evasion Layer of C-14 in Soil Thickness of Floor and Foundation Thickness of Primary Contamination and of Cover Thickness of Saturated Zone Thickness of the Unsaturated Zone Time at Which Radionuclides First Become Releasable ? Time Horizon Times at Which Release Properties Change ? Title 2 Total Porosity of Floor and Foundation ? Transfer Factor Library Transfer Factor, Intake to Animal Product Transfer Factor, Soil to Plant Transfer Factor, Water to Aquatic Food ? Transfer Mechanism 2 Update Time Interval of Progress of Computation Message 2 Use Line Draw Characters Vertical Later Dispersivity of Saturated Zone Volume of Surface Water Body Volumetric Water Content 2 Volumetric Water Content of Contaminated Medium Volumetric Water Content of Floor and Foundation Water for Household Purposes Water for Use by Beef Cattle 2 Water for Use by Dairy Cows Water from Surface Water Body ? Water from Well ? Water Intake 2 Weathering Removal Constant ? Well Location Well Pumping Rate Well Pumping Rate Needed to Support Specified Water Use ? Wet Weight Crop Yield ? Wind Speed Wind Speed Terrain

11.72 TEST CASE 037

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-037 ID

Test Tests OFFSITE's DCF data Summary

Created DJL 11/26/2019 By/Date

Test Tests OFFSITE's DCF Data

Objective

Procedure

1. Spot check based on PM scope request

- 2. Verify by comparing data in manual, input form, input echo in results
- 3. ICRP60/ICRP72 External: Table A.2-3
- 4. Further verification details are in the "Data Verification/DCF Verification" V&V folder.

Required
DataNAExpected
ResultsUnderlined steps in above procedure

11.73 **TEST CASE 038**

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-038 ID

Test Tests OFFSITE's Slope factor data Summary

Created DJL 11/26/2019 By/Date

Test Tests OFFSITE's Slope Factor Data Objective

Procedure

- 1. Spot check based on PM scope request
 - 2. Verify by comparing data in manual, input form, input echo in results
 - 3. Further verification details are in the "Data Verification/slope factor Verification" V&V folder.

Required Data	NA
Expected Results	Underlined steps in above procedure

11.74 **TEST CASE 039**

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-039 ID

Test Tests OFFSITE's Transfer factor data Summary

Created DJL 11/26/2019 By/Date

Test Tests OFFSITE's Transfer factor Data Objective

Procedure

- 1. Spot check based on PM scope request
- 2. Verify by comparing data in manual, input form, input echo in results
- 3. Further verification details are in the "Data Verification/Transfer factor Verification" V&V folder.

Required NA Data

11.75 **TEST CASE 040**

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-040 ID

Test Tests OFFSITE's Nuclide decay and ingrowth data Summary

Created DJL 11/26/2019 By/Date

Test Tests OFFSITE's Nuclide decay and ingrowth Data Objective

Procedure

- 1. Spot check based on PM scope request
- 2. <u>Verify by comparing data in the .CHN file in the UsersFiles with Table A.1-1 in User's</u> Manual
- 3. Further verification details are in the "Data Verification/Nuclide decay and ingrowth Verification" V&V folder.

Required NA Data

11.76 TEST CASE 041

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-41 ID

Test Tests OFFSITE's external radiation model Summary

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's to external radiation model
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'external-pathway'
Required Data	EXTERNAL-1.ROF, EXTERNAL-2.ROF,
Expected Results	Compare with Table 1 of "Verification of External Model and External Exposure Pathway Dose.docx" in

 $R:\QA_Files\OFFSITE\V\&V\external-pathway\$

11.77 TEST CASE 042

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-042 ID

Test Tests OFFSITE's default uncertainty distribution data Summary

Created DJL 11/26/2019

By/Date

Test Tests default uncertainty distribution data

Objective

Procedure

- 1. Spot check based on PM scope request
- 2. <u>Verify by comparing data in probabilistic input form and Appendix C of "Default</u> <u>Parameter Values and Distribution in RESRAD-ONSITE V7.2, RESRAD-BUILD V3.5,</u> <u>and RESRAD-OFFSITE V4.0 Computer Codes</u>
- 3. Further verification details are in the "Data Verification/parameter distribution comparison" V&V folder.

Required NA Data

11.78 **TEST CASE 044**

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-044 ID

Test Tests OFFSITE's validation of user's email for download Summary

Created DJL 11/26/2019

By/Date

Test Tests OFFSITE's validation of user's email for download Objective

Procedure

- 1. Go through download registration process on website.
- 2. Verify receipt of email for access to download
- 3. <u>Verify email link allows access</u>
- 4. Verify download

Required NA Data

Expected Underlined steps in above procedure

Results

11.79 TEST CASE 047

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-047 ID

Test Tests OFFSITE's Area factor tool Summary

Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's area factor tool

Procedure

- 1. perform an area factors run with a very narrow range (or a point range if that is possible) of dimensions.
- 2. Check that the area factors are calculated using the dose from the critical location.
- 3. Manually input the values for the critical run and verify that the dose matches the dose from the area factors run.

Required	NA
Data	

Expected Area factor from tool is the ratio of the peak dose from the limited and full contaminated area. **Results**

11.80 TEST CASE 048

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-048

Test Tests OFFSITE's generation of template files tool Summary

Created	DJL 11/26/2019 BASED ON EG suggestion
By/Date	

Test Tests OFFSITE's generation of template files tool **Objective**

Procedure

- 1. generate the data transfer template files, make copies of these files for later use
 - 2. open them in excel
 - 3. multiply each input by some constant, not too large a constant to avoid exceeding the upper bound.
 - a. can do this by copying an expression and then copying back the value of the expression.
 - 4. read the modified template file.
 - 5. do a few <u>spot checks of inputs</u> in the forms; automate the checking of all the inputs as in the steps below
 - 6. generate another set of template files.
 - 7. compare with the copies of the template files in 1 and <u>verify that they are in the ratio of the constant used in 3.</u>
 - 8. divide by the factor used in 3.
 - 9. read the modified template file.
 - 10. Chain through all the input forms to verify that the inputs are back at their defaults.

Required	NA
Data	

11.81 TEST CASE 049

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-049 ID

Test Tests OFFSITE's pathway option tool Summary

Created	DJL 11/26/2019 BASED ON EG suggestion
By/Date	

Test Tests OFFSITE's pathway option tool

Objective

Procedure

- 1. create an input file with only one exposure pathway active.
 - 2. Chain through all the input forms to verify the enabled / disabled status of the inputs in the forms.
 - 3. Run the file and <u>check the input echo</u>.
 - 4. Repeat for each exposure pathway.

Required NA Data

11.82 TEST CASE 050

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-050 ID

Test Tests OFFSITE's transformation database option tool Summary

Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's transformation database option tool
Procedure	1. create an input file under one choice of transformation data

change all the radionuclide specific properties (release properties, distribution coefficients, transfer factors, deposition velocities).

- 3. switch to the other transformation data.
- 4. <u>verify that the radionuclide specific properties that were input in 2 are still there</u>. Can use the data transfer feature do this more easily.

Required NA Data

Expected Underlined steps in above procedure.

Results

11.83 TEST CASE 051

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-051

ID

Test Tests OFFSITE's transformation DCF database option tool Summary

Created	DJL 11/26/2019 BASED ON EG suggestion
By/Date	

TestTests OFFSITE's transformation DCF database option toolObjective

Procedure

- 1. Select one of the transformation data choices.
 - 2. Verify the choices of libraries available for the internal dose library and the risk library.
 - 3. Repeat for the other choice of transformation data.
 - 4. Repeat the check after creating a user library under each of the transformation data choices.

Required	NA
Data	

11.84 TEST CASE 052

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-052 ID

Test Tests OFFSITE's transformation DCF database option tool Summary

Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's transformation DCF database option tool
Procedure	1. Use the example in Appendix E.4, but after verifying the calculations described there.
Required	NA

Data

11.85 TEST CASE 053

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-053 ID

Test Tests OFFSITE's source conceptualization options tool Summary

Created	DJL 11/26/2019 BASED ON EG suggestion
By/Date	

TestTests OFFSITE's source conceptualization options toolObjective

- **Procedure** 1. Create an input file under each of the 4 main conceptualizations and the two sub conceptualizations.
 - 2. <u>Verify that the appropriate release options are shown</u> in the source form and or the release properties form.

Required		NA			
Data					
F (TT 1	1.	1	

11.86 TEST CASE 054-001

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-054-001 ID

Test Tests OFFSITE C14 concentration in primary contamination Summary

Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE C14 concentration in primary contamination
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	CARBON-14.ROF
Expected Results	Compare the primary contamination concentrations with c14.xlsx in V&V folder on 'special radionuclides'

11.87 TEST CASE 054-002

Project	RESRAD-OFFSITE
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Test Case RESOFF-TEST-054-002 ID

Test Tests OFFSITE C14 plant concentrations Summary

Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE C14 plant concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	CARBON-14.ROF
Expected Results	Compare the plant concentrations with c14.xlsx in V&V folder on 'special radionuclides'

11.88 TEST CASE 054-003

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-054-003 ID

Test Tests OFFSITE C14 meat and milk concentrations Summary

Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE C14 meat and milk concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	CARBON-14.ROF
Expected Results	Compare the meat and milk concentrations with c14.xlsx in V&V folder on 'special radionuclides'

11.89 TEST CASE 054-004

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-054-004 ID

Test Tests OFFSITE H3 concentration in primary contamination Summary

Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE H3 concentration in primary contamination
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	HYDROGEN-3.ROF
Expected Results	Compare the primary contamination concentrations with H3.xlsx in V&V folder on 'special radionuclides'

11.90 TEST CASE 054-005

Project F	RESRAD-OFFSITE
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Test Case RESOFF-TEST-054-005 ID

Test Tests OFFSITE H3 plant concentrations Summary

Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE H3 plant concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	HYDROGEN-3.ROF
Expected Results	Compare the plant concentrations with h3.xlsx in V&V folder on 'special radionuclides'

11.91 TEST CASE 054-006

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-054-006 ID

Test Tests OFFSITE H3 meat and milk concentrations Summary

Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE H3 meat and milk concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	HYDROGEN-3.ROF
Expected Results	Compare the meat and milk concentrations with $\mathrm{H3.xlsx}$ in V&V folder on 'special radionuclides'

11.92 TEST CASE 111

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-111 ID

Test Tests OFFSITE Activated Metal Case I: new source term Summary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term; delay 500 years
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	ACTIVATED METAL-500_1000 COSTANT.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M3.2-11

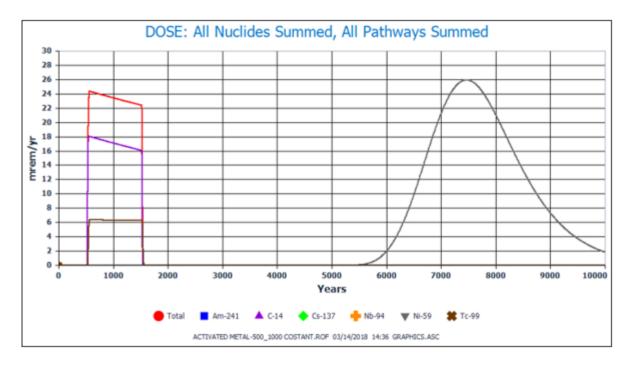


Figure M3-2 Potential Radiation Dose Associated with Disposal of Activated Metals – Delayed Releases for 500 years

11.93 TEST CASE 112

Project RESRAD-OFFSITE

Test CaseCompilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docxRESOFF-IDTEST-112

Test Tests OFFSITE Activated Metal Case II : new source term Summary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term; delay 1000 years
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	ACTIVATED METAL-1000_10000 COSTANT.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figgues M4.1-10

11.94 TEST CASE 113

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx-TEST-113 **ID**

Test Tests OFFSITE Activated Metal Case III : increasing corrosion rate Summary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term; increasing corrosion rate
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	ACTIVATED METAL-500_1000 INCREASE.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M5.2-11

11.95 TEST CASE 114

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx-TEST-114 **ID**

TestTests OFFSITE Activated Metal Case IV : TRU WasteSummary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	OTHER WASTE-KD=0_500-V2_DT2.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M6.2-7

11.96 TEST CASE 115

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

TestTests OFFSITE Activated Metal Case V : Grouted TRU WasteSummary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	OTHER WASTE-KD=CEMENT_500_DT2-DUST-REVISED.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M7.2-7

11.97 TEST CASE 116

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

 Test
 Tests OFFSITE Activated Metal Case VI : Grouted TRU Waste

 Summary
 Summary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	OTHER WASTE-KD=0_500_DT1-DIF-DUST-REVISED.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M8.2-7

11.98 TEST CASE 117

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

 Test
 Tests OFFSITE Activated Metal Case VII : Grouted TRU Waste w diffusion

 Summary
 Summary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	SELAED SOURCES-TRENCH-LEACH_300-800-V2.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M9.2-3

11.99 TEST CASE 118

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

TestTests OFFSITE Activated Metal Case VII : Grouted TRU Waste w solubility-controlled releaseSummary

Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	SELAED SOURCES-TRENCH-SOLUBILITY_300-800-V2.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M10.2-12

11.100 TEST CASE 401

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

Test Tests OFFSITE Plant concentrations
Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE plant concentrations;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 1-4 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.101 TEST CASE 402

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

Test Tests OFFSITE Meat and Milk concentrations Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Meat & milk concentrations;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 5-6 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.102 TEST CASE 403

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

TestTests OFFSITE Aquatic Foods concentrationsSummary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE aquatic food concentrations;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 7-8 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.103 TEST CASE 404

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

Test Tests OFFSITE Plant ingestion dose Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE plant pathway dose;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 9 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.104 TEST CASE 405

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

Test Tests OFFSITE Meat and Milk Pathway Doses Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Meat and Milk Pathway Doses;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 10 & 11 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.105 TEST CASE 406

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

Test Tests OFFSITE Aquatic Pathway Doses Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Aquatic Pathway Doses;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figure 12 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.106 TEST CASE 407

Project RESRAD-OFFSITE

Test Case Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx **ID**

Test Tests OFFSITE Drinking Water Pathway Doses Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Drinking Water Pathway Doses;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figure 13 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in

11.107 TEST CASE 411

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-411 ID

TestTests OFFSITE's Offsite soil concentration in leafy vegetable agricultural fieldSummary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in leafy vegetable agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test1.rof
Expected	Compare with Figure 1 of "Verification of Accumulation at offsite location.docx" in
Results	$R: \ QA_Files \ V\&V \ accumulation-at-offsite-testing$

11.108 TEST CASE 412

Test Case RESOFF-TEST-412 ID

TestTests OFFSITE's Offsite soil concentration in pasture agricultural fieldSummary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test Offsite soil concentration in pasture agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test2.rof
Expected	Compare with Figure 2 of "Verification of Accumulation at offsite location.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\accumulation-at-offsite-testing$

11.109 TEST CASE 413

Test Case RESOFF-TEST-413 ID

TestTests OFFSITE's Offsite soil concentration in grain agricultural fieldSummary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in grain agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test3.rof
Expected	Compare with Figures 3 of "Verification of Accumulation at offsite location.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\accumulation-at-offsite-testing$

11.110 TEST CASE 414

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-414 ID

TestTests OFFSITE's Offsite soil concentration in Non-leafy vegetable agricultural fieldSummary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test4.rof
Expected	Compare with Figure 4 of "Verification of Accumulation at offsite location.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\accumulation-at-offsite-testing$

11.111 TEST CASE 415

Test Case RESOFF-TEST-415 ID

TestTests OFFSITE's Offsite soil concentration in non-leafy vegetable agricultural field contributed bySummaryerosion

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field contributed by erosion;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-Test4-erosion-only.rof.rof
Expected	Compare with Figures 5 of "Verification of Accumulation at offsite location.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\accumulation-at-offsite-testing$

11.112 TEST CASE 416

Test Case RESOFF-TEST-416 ID

TestTests OFFSITE's Offsite soil concentration in non-leafy vegetable agricultural field contributed by
air deposition

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field contributed by air deposition;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-Test4-air-dep-only.rof.rof
Expected	Compare with Figure 6 of "Verification of Accumulation at offsite location.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\accumulation-at-offsite-testing$

11.113 TEST CASE 417

Test Case RESOFF-TEST-417 ID

TestTests OFFSITE's Offsite soil concentration in non-leafy vegetable agricultural field contributed bySummarysurface water irrigation

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field contributed by surface water irrigation;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-Test4-surface-water-only.rof.rof
Expected	Compare with Figures 7 of "Verification of Accumulation at offsite location.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\accumulation-at-offsite-testing$

11.114 TEST CASE 421

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-421 ID

TestTests OFFSITE's Offsite air concentration (Briggs rural, no deposition, with plume rise)Summary

Created By/Date	DJL 11/24/2019 based on SK Verification
Test Objective	Test features of OFFSITE air concentration (Briggs rural, no deposition, with plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN1.rof
Expected Results	Compare with Table 2 of "Verification of Atmospheric Transport Model.docx" in
ixesuits	

11.115 TEST CASE 422

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-422 ID

TestTests OFFSITE's Offsite air concentration (PG, dry deposition, with plume rise)Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry deposition, with plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN2.rof
Expected Results	Compare with Table 2 of "Verification of Atmospheric Transport Model.docx" in

11.116 TEST CASE 423

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-423 ID

TestTests OFFSITE's Offsite air concentration (PG, dry & wet deposition, with plume rise)Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry & wet deposition, with plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN3.rof
Expected Results	Compare with Table 2 of "Verification of Atmospheric Transport Model.docx" in

11.117 TEST CASE 424

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-424 ID

TestTests OFFSITE's Offsite air concentration (PG, no deposition, no plume rise)Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, no deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN4.rof
Expected Results	Compare with Table 3 of "Verification of Atmospheric Transport Model.docx" in

11.118 TEST CASE 425

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-425 ID

TestTests OFFSITE's Offsite air concentration (PG, dry deposition, no plume rise)Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN5.rof
Expected Results	Compare with Table 3 of "Verification of Atmospheric Transport Model.docx" in

11.119 TEST CASE 426

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-426 ID

TestTests OFFSITE's Offsite air concentration (PG, dry & wet deposition, no plume rise)Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry and wet deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN6.rof
Expected Results	Compare with Table 3 of "Verification of Atmospheric Transport Model.docx" in

11.120 TEST CASE 427

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-427 ID

TestTests OFFSITE's Offsite air concentration (PG, wet deposition, no plume rise)Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, wet deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN7.rof
Expected Results	Compare with Table 4 of "Verification of Atmospheric Transport Model.docx" in

11.121 TEST CASE 428

Project	RESRAD-OFFSITE
Test Case ID	RESOFF-TEST-428
Test Summary	Tests OFFSITE's Offsite air depletion
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air depletion
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air- dispersion-model-testing'
Required Data	AIR DISPERSION RUN5.rof
Expected	Compare with Table 5 & 6 of "Verification of Atmospheric Transport Model.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\air-dispersion-model-testing$

11.122 TEST CASE 431

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-431 ID

TestTests OFFSITE's Offsite surface water body accumulation with cover Tc-99Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation with cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-TC99-TEST1.rof
Expected	Compare with Figure 1 of "Verification of Surface Water Model.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\surface-water-model-testing$

11.123 TEST CASE 432

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-432 ID

TestTests OFFSITE's Offsite surface water body accumulation no cover Tc-99Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation no cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-TC99-TEST2.rof
Expected	Compare with figure 2 of "Verification of Surface Water Model.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\surface-water-model-testing$

11.124 TEST CASE 433

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-433 ID

TestTests OFFSITE's Offsite surface water body accumulation with cover, U-234Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation no cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-U234-TEST1.rof
Expected	Compare with figure 3 of "Verification of Surface Water Model.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\surface-water-model-testing$

11.125 TEST CASE 434

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-434 ID

TestTests OFFSITE's Offsite surface water body accumulation no cover, U-234Summary

Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation no cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-U234-TEST2.rof
Expected	Compare with figure 4 of "Verification of Surface Water Model.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\surface\-water\-model\-testing$

11.126 TEST CASE 435

Test Case RESOFF-TEST-435 ID

Test Tests OFFSITE's release to air Summary

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's release to air
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'air release'
Required Data	AIR RELEASE COMP CASE1.ROF, AIR RELEASE COMP CASE2.ROF
Expected	Compare with figure 1 & 2 of "Verification of Air Release from surface layer.docx" in
Results	$R:_QA_Files\OFFSITE\V\&V\Air\ release\$

11.127 TEST CASE 436

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Test Case RESOFF-TEST-436 ID

Test Tests OFFSITE's release to erosion Summary

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's release to erosion
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'erosion release'
Required Data	EROSION RELEASE COMP CASE1.ROF, EROSION RELEASE COMP CASE2.ROF
Expected	Compare with figure 1 & 2 of "Verification of Erosion Release from surface layer.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\Erosion\ release\$

11.128 TEST CASE 437

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-437 ID

Test Tests OFFSITE's external radiation model Summary

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's to external radiation model
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'external-pathway'
Required Data	EXTERNAL-1.ROF, EXTERNAL-2.ROF,
Expected Results	Compare with Table 1 of "Verification of External Model and External Exposure Pathway Dose.docx" in

 $R:\QA_Files\OFFSITE\V\&V\external-pathway\$

11.129 TEST CASE 438

Test Case RESOFF-TEST-438 ID

Test Tests OFFSITE's external radiation model Summary

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's external radiation model
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'external-pathway'
Required Data	EXTERNAL-3.ROF, EXTERNAL-4.ROF
Expected Results	Compare with Figures 1-4 of "Verification of External Model and External Exposure Pathway Dose.docx" in

 $R:\QA_Files\OFFSITE\V\&V\external-pathway\$

11.130 TEST CASE 439

Test Case RESOFF-TEST-439 ID

Test Tests OFFSITE's Particulate inhalation **Summary**

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's Particulate inhalation
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'particulate inhalation pathway'
Required Data	INHALATION-1.ROF, INHALATION-2.ROF, INHALATION-3.ROF, INHALATION-4.ROF
Expected Results	Compare with figure 1-8 of "Verification of Particulate Inhalation Pathway Dose.docx" in

 $R:\QA_Files\OFFSITE\V\&V\Particulate\ Inhalation\ Pathway$

11.131 TEST CASE 440

Test Case RESOFF-TEST-440 ID

Test Tests OFFSITE's Soil ingestion Summary

Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's Soil ingestion
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'soil ingestion pathway'
Required Data	SOIL-INGESTION-1.ROF, SOIL-INGESTION-2.ROF, SOIL-INGESTION-3.ROF, SOIL-INGESTION-4.ROF
Expected	Compare with figure 1-8 of "Verification of Soil Ingestion Pathway Dose.docx" in
Results	$R:\QA_Files\OFFSITE\V\&V\Soil\ ingestion\ pathway$

11.132 TEST CASE 441

Test Case RESOFF-TEST-441 ID

Test Tests OFFSITE's groundwater transport model Kd=0
Summary

Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=0
Procedure	Copy AQFLUXIN.dat from the \KD0\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 0.rof
Expected	Compare results from WTFLUXIN.DAT with spreadsheet 'unsaturated 0.xlsx' in
Results	R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.133 TEST CASE 442

Test Case RESOFF-TEST-442 ID

Test Tests OFFSITE's groundwater transport model Kd=1 Summary

Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=1
Procedure	Copy AQFLUXIN.dat from the \KD1\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 1.rof
Expected	Compare results from WTFLUXIN.DAT with spreadsheet unsaturated 1.xlsx in
Results	$R:\QA_Files\OFFSITE\V\&V\Groundwater\ transport\flux\ input$

11.134 TEST CASE 443

Test Case RESOFF-TEST-443 ID

TestTests OFFSITE's groundwater transport model Kd=10Summary

Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=10
Procedure	Copy AQFLUXIN.dat from the \KD10\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 10.rof
Expected	Compare results from WTFLUXIN.DAT with spreadsheet unsaturated 10.xlsx in
Results	R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.135 TEST CASE 444

Project F	RESRAD-OFFSITE
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Test Case RESOFF-TEST-444 ID

Test Tests OFFSITE's groundwater transport model Kd=100
Summary

Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=100
Procedure	Copy AQFLUXIN.dat from the \KD10\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 100.rof
Expected	Compare results from WTFLUXIN.DAT with spreadsheet unsaturated 100.xlsx in
Results	R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.136 TEST CASE 445

Test Case RESOFF-TEST-445 ID

Test Tests OFFSITE's groundwater transport model Kd=0 Summary

Created By/Date	DJL 01/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=0
Procedure	Copy AQFLUXIN.dat from the \SKD0\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\ pulse input over part of the transport zone\'
Required Data	SATURATED FLUXIN KD 0.rof
Expected	Compare results from GWtoSWBFLUX.DAT with spreadsheet 'saturated 0.xlsx' in
Results	$R:\QA_Files\OFFSITE\V\&V\Groundwater\ transport\pulse\ input\ over\ part\ of\ the\ transport\ zone\Vector and Vector and$

11.137 TEST CASE 446

Test Case RESOFF-TEST-446 ID

Test Tests OFFSITE's groundwater transport model Kd=1 Summary

Created By/Date	DJL 01/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=1
Procedure	Copy AQFLUXIN.dat from the \SKD1\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\ pulse input over part of the transport zone\'
Required Data	SATURATED FLUXIN KD 1.rof
Expected	Compare results from GWtoSWBFLUX.DAT with spreadsheet unsaturated 1.xlsx in
Results	$R:\QA_Files\OFFSITE\V\&V\Groundwater\ transport\ pulse\ input\ over\ part\ of\ the\ transport\ zone\Vector and Vector an$

11.138 TEST CASE 447

Project RESRAD-OFFSITE

Test Case RESOFF-TEST-447 ID

TestTests OFFSITE's groundwater transport model Kd=10Summary

Created By/Date	DJL 01/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=10
Procedure	Copy AQFLUXIN.dat from the \SKD10\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\ pulse input over part of the transport zone\'
Required Data	SATURATED FLUXIN KD 10.rof
Expected Results	Compare results from GWtoSWBFLUX.DAT with spreadsheet unsaturated 10.xlsx in
Results	$\label{eq:response} R:\QA_Files\OFFSITE\V\&V\Groundwater\ transport\ pulse\ input\ over\ part\ of\ the\ transport\ zone\'$

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APPENDIX 12: TESTERS' REPORTS

The reports written by those who performed the release testing for each of the tests defined in the previous section, while performing each test or soon after, are gathered in this section. These reports are similar to field notes or laboratory notes and are therefore not edited.

12.1 TEST CASE 001 TESTER'S REPORT

Documented in Results_ Test Case 001.msg of 2/14/2020 3:09 PM

Results: Test Case 001

LePoire, David J.

Thu 2/14/2020 3:09 PM

From Microsoft Windows support page: <u>https://support.microsoft.com/en-us/help/13853/windows-lifecycle-fact-sheet</u>

The two currently supported Windows Operating Systems are Windows 10 and Windows 8.1: (Windows 7 extended supported ended Jan 14, 2020)

Windows 10 version history	Date of availability	End of service for Home, Pro, Pro Education, and Pro for Workstations editions	End of service for Enterprise and Education editions
Windows 10, version 1909	November 12, 2019	May 11, 2021	May 10, 2022**
Windows 10, version 1903	May 21, 2019	December 8, 2020	December 8, 2020
Windows 10, version 1809	November 13, 2018	May 12, 2020	May 11, 2021**
Windows 10, version 1803	April 30, 2018	November 12, 2019	November 10, 2020
Windows 10, version 1709	October 17, 2017	April 9, 2019	April 14, 2020
Windows 10, version 1703	April 5, 2017*	October 9, 2018	October 8, 2019
Windows 10, version 1607	August 2, 2016	April 10, 2018	April 9, 2019
Windows 10, version 1511	November 10, 2015	October 10, 2017	October 10, 2017
Windows 10, released July 2015 (version 1507)	July 29, 2015	May 9, 2017	May 9, 2017
* Windows 10, version 170	3 for Enterprise, Education,	and IOT Enterprise edition	s were released on April 11,

Windows 8.1 and 7

Prior releases of the Windows operating system are governed by the Fixed Lifecycle Policy. This policy comprises two phases: mainstream support and extended support. See Microsoft Business, Developer and Desktop Operating Systems Policy for more details.

Client operating systems	End of mainstream support	End of extended support
Windows 8.1	January 9, 2018	January 10, 2023
Windows 7, service pack 1*	January 13, 2015	January 14, 2020

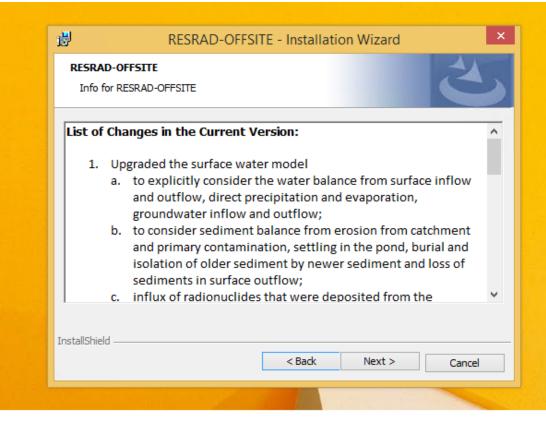
* Support for Windows 7 RTM without service packs ended on April 9, 2013.

Prior versions of Windows, including Windows 8.1, have limited support when running on new processors and chipsets from manufacturers like Intel, AMD, NVidia, and Qualcomm. For more information, see Microsoft Lifecycle Policy. A device may not be able to run prior versions of Windows if the device hardware is incompatible, lacks current drivers, or is otherwise outside the original equipment manufacturer's (OEM) support period.

Installing on VM Win 8:

RESRAD-OFFSITE - InstallShield Wizard		
	Preparing to Install	
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	Cancel	



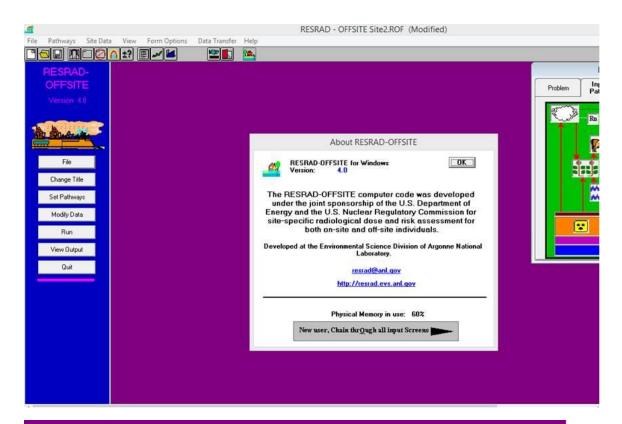


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E.	Installation Wizard Completed
	The Installation Wizard has successfully installed RESRAD-OFFSITE. Click Finish to exit the wizard.
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-	Show the readme file
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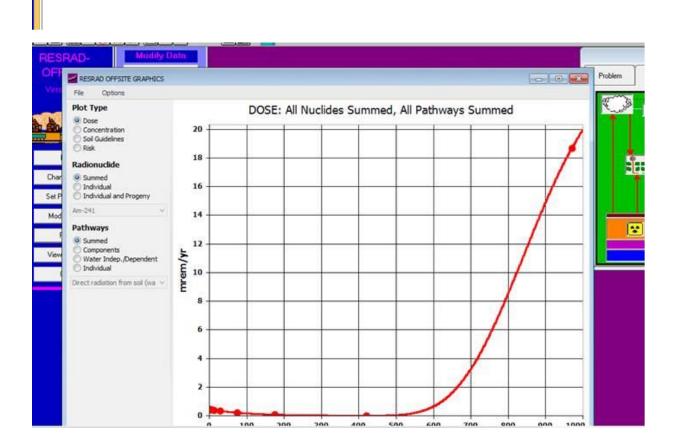
_ _ _ Programs and Features ↑ 🔤 → Control Panel → Programs → Programs and Features • () ~ ¢ Search Programs and Features 🔎 Control Panel Home Uninstall or change a program View installed updates To uninstall a program, select it from the list and then click Uninstall, Change, or Repair. 🚱 Turn Windows features on or off == - 🔞 Organize 💌 Uninstall Publisher Name Installed On 🚣 Adobe Acrobat Reader DC Adobe Systems Incorporated 2/13/2020 IBM BigFix Client IBM Corp. 6/27/2018 WcAfee Agent 10/25/2017 McAfee, Inc. McAfee VirusScan Enterprise McAfee, Inc. 1/27/2020 Second Se 2/14/2020 Argonne National Laboratory < > RESRAD Argonne National Laboratory Product version: 4.0.3.0 Help link: C:\RESRAD_Family\OFFSITE\4.0\Readm... - ser to

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Part I: Mixture Sums and Single Radionuclide Guidelines				
Dose Conversion Factor (and Related) Parameter Summary	2			
Site-Specific Parameter Summary	5			
Summary of Pathway Selections	35			
Contaminated Zone and Total Dose Summary	36			
Total Dose Components				
Time = 0.0002+00	37			
Time = 1.000E+00	38			
Time = 3.000E+00	39			
Time = 6.000E+00	40			
Time = 1.200E+01	41			
Time = 3.000E+01	42			
Time = 7.500E+01	43			
Time = 1.750E+02	44			
Time = 4.200E+02	45			
Time = 9.700E+02	46			
Dose/Source Ratios Summed Over All Pathways	47			
Single Radionuclide Soil Guidelines	47			
Dose Per Nuclide Summed Over All Pathways	48			
Soil Concentration Per Nuclide	48			
Run Time Information	49			



On VM Win10

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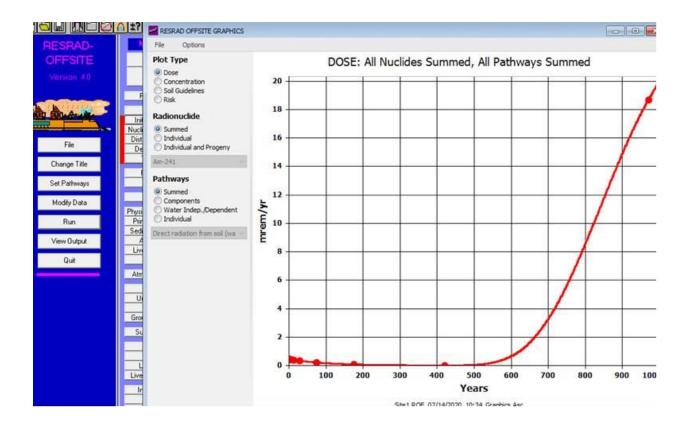
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Hide Subforms Show Subforms Horizontally Preliminary Inputs Release Times Initial Concentrations Nuclide Specific Release Distribution Coefficients		
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Site Layout Physical and Hydrological Primary Contamination Sediment Delivery Ratio	Waiting for 1seconds Elapsed calculation time 4. Seconds	
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RESRAD - OFFSITE Site1.ROF (Unmodified)

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Set Pathways	Contaminated Zone and Total Dose Summary
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Run	Time = 6.000E+00
	Time = 1.200E+01
View Output	Time = 3.000±+01
	Time = 7.500E+01
Quit	Time = 1.750E+02
	Time = 9.7003+02
	Dose/Source Ratios Summed Over All Pathways
	Single Radionuclide Soil Guidelines
	Dose Per Nuclide Summed Over All Pathways
	Soil Concentration Per Nuclide
	Run Time Information



12.2 TEST CASE 002 TESTER'S REPORT

Documented in Test-002_report.docx of 2/20/2020 6:32 AM

Test Case 002 Report

By cheng wang 2/13/2020

Objective: To test OFFSITE Nuclide Decay and Ingrowth

Conclusion: the code worked as expected.

Procedure:

1. Copy input files to the folder

 $C: \label{eq:charge} C: \lab$

2. Run the input file.

3. Export the concentration for U-238, U-234, Th-230, Ra-226, Pb-210, Po-210 to the folder.

4. Put all the results in file "test-001_comp.xlsx" and compare with the expected results.

As shown in test-001_comp.xlsx, the results matched with the expected results, except the concentrations of Pb-210 and Po-210 at time 1 year. The discrepancies are acceptable.

Year	Pb-210 from	Pb-210 hand-	Po-210 form	Po-210 hand-
	code	calculated	code	calculated
1	1.38E-15	1.40E-15	4.13E-16	4.01E-16

12.3 TEST CASE 003-001 TESTER'S REPORT

Documented in Test-003-001_report.docx of 2/19/2020 3:16 PM

Test Case 003-001 report

By cheng wang 2/13/2020

Objective:

Conclusion: the code worked as expected.

Procedure:

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\003-001

2. Run the input file.

3. Copy file "CZTHICK3.DAT" to the testing folder, rearrange the data to file "CZTHICK3.xlsx", and compare the results with the expected ones.

12.4 TEST CASE 003-002 TESTER'S REPORT

Documented in Test-003-002_report.docx of 2/19/2020 3:16 PM

Test Case 003-002 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE Source Term Mixing Concentration

Conclusion: the code worked as expected

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\003-002

2. Run the input file.

3. Copy file "CZTHICK3.DAT" to the testing folder, rearrange the data to file "CZTHICK3.xlsx", and compare the results with the expected ones.

12.5 TEST CASE 003-003 TESTER'S REPORT

Documented in Test-003-003_report.docx of 2/19/2020 3:24 PM

Test Case 003-003 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE Source Term Mixing Concentration

Conclusion: the code worked as expected

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\003-003

2. Run the input file.

3. Copy file "CZTHICK3.DAT" to the testing folder, rearrange the data to file "CZTHICK3.xlsx", and compare the results with the expected ones.

12.6 TEST CASE 005 TESTER'S REPORT

Documented in Test-005_report.docx of 2/27/2020 9:13 AM

Test Case 005 report

By cheng wang 2/13/2020; corrected the Objective on 2/26/2020

Objective: Test OFFSITE Source Term leaching

Conclusion: the code worked as expected

Suggest to remove Table 2.16 from the Expected Results section because the revised results in V&V folder is used now.

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\005

2. Run the input file.

3. Copy file "AQFLUXIN.DAT" to the testing folder, rearrange the data to file "AQFLUXIN.xlsx", and compare the results with the expected release to groundwater in file "Revised Verification for U238.xls" tab "release"

The results calculated by code matched with the expected results, except the minor discrepancies on the values for Pb-210 and Po-210 at year1.

			Pb-210 by hand-	Po-210 by hand-
Year	Pb-210 by code	Po-210 by code	calculation	calculation
1	6.87E-08	2.01E-07	6.94E-08	1.81E-07

12.7 TEST CASE 020-001 TESTER'S REPORT

Documented in Test-020-001_report.docx of 2/19/2020 7:25 PM

Test Case 020-001 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE gaseous and particulate C-14 pathways

Conclusion: the code worked as expected

Need to modify the input file; change the initial concentration from 100 Bq/g to 1 Bq/g (according to file "20-001 inhalation of carbon 14.docx" in V&V\Special radionuclides\ folder)

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-001

2. Run the input file.

3. Export "Dose: C-14, Inhalation" data to file "C-14_inh.csv" using Wresplot.

4. Export data from "C-14_inh.csv" to file "C-14_inh.xlsx". Copy hand-calculated results from file "C14 inhalation.xlsx" tab "gas and particulates" to "C-14_inh.xlsx", and compare them.

12.8 TEST CASE 020-002 TESTER'S REPORT

Documented in Test-020-002_report.docx of 2/20/2020 8:19 AM

Test Case 020-002 report

By cheng wang 2/13/2020

Objective: To tess OFFSITE tritium inhalation pathways

Conclusion: the code worked as expected

Procedure

1. Copy the input file to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-002

2. Run the input file.

3. Export "Dose: H-3, Inhalation" data to file "H-3_inh.csv" using Wresplot.

4. Export data from "H-3_inh.csv" to file "H-3_inh.xlsx". Copy hand-calculated results from file "H3 inhalation.xlsx" tab "gas no particulates" to "H-3_inh.xlsx", and compare them.

12.9 TEST CASE 020-003 TESTER'S REPORT

Documented in Test-020-003_report.docx of 2/19/2020 8:08 PM

Test Case 020-003 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE Rn-222 inhalation pathways

Conclusion: the code worked as expected

Procedure

1. Copy the input file to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-003

2. Run the input file.

3. Export "Dose: All Nuclides Summed, Radon (Waterborne)" data to file "Rn-222_water.csv" using Wresplot.

4. Export data from "Rn-222_water.csv" to file "Rn-222_water.xlsx". Copy hand-calculated results from file "Rn 222 household water.xlsx" tab "RnProgenyDose" to "Rn-222_water.xlsx", and compare them.

12.10 TEST CASE 020-004 TESTER'S REPORT

Documented in Test-020-004_report.docx of 2/20/2020 5:00 AM

Test Case 020-004 report

By cheng wang 2/13/2020

Objective: Test OFFSITE Rn-220 inhalation pathways

Conclusion: the code worked as expected

Procedure

1. Copy the input file to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-004

2. Run the input file.

3. Export "Dose: All Nuclides Summed, Radon (Waterborne)" data to file "Rn-220_water.csv" using Wresplot.

4. Export data from "Rn-220_water.csv" to file "Rn-220_water.xlsx". Copy hand-calculated results from file "Rn 220 household water.xlsx" tab "RnProgenyDose" to "Rn-220_water.xlsx", and compare them.

12.11 TEST CASE 027-001 TESTER'S REPORT

Documented in Results-Test-27-1.docx of 2/26/2020 4:09 PM

Results for Test Case 27-1

Test performed as described. Went through the report files and found all elements and formatting worked as described in the test case. The three report files (summary.rep, intrisk.rep, and daudose.rep) are also saved.

12.12 TEST CASE 027-002 TESTER'S REPORT

Documented in Results-Test-27-2.docx of 2/17/2020 8:00 AM

Results for Test Case 27-2

Step 1 Open RESRAD-OFFSITE Version 4.0

Step 2 Click on "Modify Data" command button in DOS Emulator

Step 3 Select "Initial Concentrations" Form

Step 4 Add Ac-227 in "Initial Concentrations" Form

Step5 Close the form and save file as Test 27-2.rof

Step 6 Click on "Run" command button in DOS Emulator

Step 7 The report Viewer pops up and opens SUMMARY.REP file.

Step 8 Clicked on File menu and checked its functions (Save, Save All, Printer Setup, Print, Adjust Font, Make New MyFonts.Dat, View Another File, and Exit Viewer). Screenshots for some are below

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oil Concentration Per Nuclide	46					
In Time Information	47					

Figure 1 Printer Setup Screenshot

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	Print Cancel

Figure Print Screenshot

Clicking on "Adjust Font" changed the font size to 7(see screenshot below)

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Dose Conversion Factor (and Related) Parameter Summary	2		
Site-Specific Parameter Summary	4		
Summary of Pathway Selections	33		
Contaminated Zone and Total Dose Summary	34		
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Time = 3.0002+01	40		
Time = 7.5002+01	41		
Time = 1.750E+02	42		
Time = 4.200E+02	43		
Time = 9.700E+02	44		
Dose/Source Ratios Summed Over All Pathways	45		
Single Radionuclide Soil Guidelines	45		
	46		
Dose Per Nuclide Summed Over All Pathways			
Dose Per Nuclide Summed Over All Pathways	46		

Clicking on "Make New MyFonts.Dat" changed the font size to 7.4(see screenshot below)

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Part I: Mixture Sums and Single Radionuclide Guidelines				
Oose Conversion Factor (and Related) Parameter Summary	2			
Site-Specific Parameter Summary	4			
Summary of Pathway Selections	33			
Contaminated Zone and Total Dose Summary	34			
Total Dose Components				
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Time = 6.0002+00	38			
Time = 1.2002+01	39			
Time = 3.0002+01	40			
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Time = 1.7502+02 Time = 4.2002+02	42 43			
Time = 9.700 ± 02	43			
Oose/Source Ratios Summed Over All Pathways	45			
Single Radionuclide Soil Guidelines	45			
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SUMMARY.REP C:\ Current_External_DCF.txt DAUDOSE.REP UNTRISK.REP WESSAGE_FIL NObataNuclides.txt UABUSE_FIL ReadMe.txt SUMMARY.REP				
SUMMARY.REP C.1 Current_External_DCF.txt DAUDOSE.REP C.1 INTRISK.REP C.1 MESSAGE.FIL C.1 Metriles NoDataNuclides.txt output.fil ReadMe.txt SUMMARY.REP UserFiles				
SUMMARY.REP C:\ Current_External_DCF.txt DAUDOSE.REP UNTRISK.REP WESSAGE_FIL NObataNuclides.txt UABUSE_FIL ReadMe.txt SUMMARY.REP				
SUMMARY.REP C.1 Current_External_DCF.txt DAUDOSE.REP C.1 INTRISK.REP C.1 MESSAGE.FIL C.1 Metriles NoDataNuclides.txt output.fil ReadMe.txt SUMMARY.REP UserFiles				
SUMMARY.REP				
SUMMARY.REP Current_External_DCF.txt DAUD05E.REP INTRISK.REP MESSAGE_FIL NODataNuclides.txt output_fil ReadMe_txt SUMMARY.REP UniqueNuc.txt VARIAB0F-distribution.inf.txt Djsk_Drives:				

Figure View Another File Screenshot Exit Viewer closes the file.

Step 9 Edit menu enabled to select all and copy of the present page

Step10 Help menu opened the help file for the code with Report Viewer topic page opened (see screenshot below)

RESRAD-OFFSITE Help

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1

Contents Index Search Mass of Primary Contaminati A ? Mass and Volume of Contam Minimum Time Increment ? Model Atmospheric Depositic Modeling an Onsite Exposure Modeling Nuclide-Specif Reta Modeling the Effects of Colloi Modeling Transport of Proger Rodifying the Joint Frequence 2 Model Multiple Forms of Con Nuclide Concentration Nuclides in Database, List of Nuclides Present at the Site, Number of Catchments Number of Iterations for Equil Rumber of Livestock Consum Number of Main Sub Zones ir Number of Main Sub Zones ir Number of Minor Subzones in Rumber of Individuals Consur Number of Time Points Number of Unsaturated Zone: Occupancy Onsite Vertical Dimension of Pore Water Velocity Porosity, Total Potential Evaporation from th Precipitation Primary Contamination Radiological Activity Radiological Dose Radiological Transformation [Radionuclide Bearing Materia Radionuclide, Properties of Radionuclides become availa Radon Dose and Slope Facto Radon Emanation Coefficient Rainfall Erosion Index Rate of (Ground Water) Trans Read Meteorological STAR F Recharge Through and Grour ? Release Heat Flux Release Height ? Report Viewer Reporting Times

Report Viewer

The report viewer is designed to allow easy viewing, printing and saving of reports generated by the model. The viewer supports full Windows printing and clipboard features.

Displaying the viewer: The viewer is displayed at the end of each run. It can also be displayed using the menu (View, Text Output, and then any of the available choices), the first button on the third cluster o the toolbar, the DOS Emulator (View Output button and then the command button corresponding to the desired report), or the Navigator (Results tab and click on the command button corresponding to the desired report).

Viewing different parts of the report: Enter a page number in the "Page" box to view a specific page of the report. Use the scroll bars to scroll through the page, or tab the cursor into the text of the report and use the cursor control keys. The "Next Page" and "Previous Page" command buttons as well as the "Page Up" and "Page Down" keys can be used to move to the next or previous page.

Saving Report Files: Every time a calculation is run, the previous reports and graphics files are overwritten. The results can be saved under different names, which allow their retrieval later. All the textual reports can be saved by clicking on File followed by Save All under the Report Viewer main menu. If the input filename is xxxx.rof, the reports will be saved in the user files directory as xxxx.yyy, where the extension yyy identifies the report as follows:

- par = parent dose report.
- pro = progeny dose report.
- rsk = cancer risk report.
- · prb = uncertainty and probabilistic dose and risk report.
- smp = uncertainty-probabilistic input report.
- reg = output-input regression report.
- af = area factor report.

Viewing report from an earlier run: To view a previously saved report first launch the viewer, then click on the File menu of the report viewer's main menu and followed by View another File (Ctrl f). Point to the subdirectory where the input files are located. Select the file that you want to view. The saved files have the same root name as the input file. Threecharacter extensions identify the five types of report files.

Copying Selections: The "Copy" option of the "Edit" menu allows the highlighted text to be copied to the Windows clipboard for pasting into other applications. The "Copy" option of the "Edit" menu will allow the highlighted text to be copied to the Windows clipboard for

Step 11 Checked Tool bar icons.

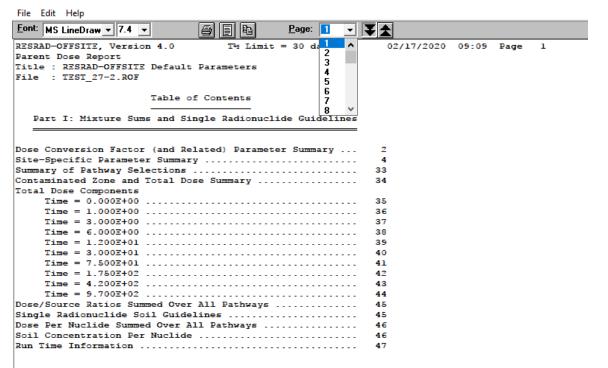
The page up/down worked.

Step 12 Put the cursor on the page number box, type 3, and the press Enter key, and Page 3 (see screenshot below).

File E	dit Help			
	MS LineDraw ▼ 7.4 ▼ 🗿 🗐 📴 Page: 3 ▼ ¥ 🛧			
	· · · · · · · · · · · · · · · · · · ·	17/2020 09:0	9 Page 3	
	t Dose Report			
	: RESRAD-OFFSITE Default Parameters			
File	: TEST_27-2.ROF			
	Dose Conversion Factor (and Related) Parameter	S		
	Current Library: RESRAD Default Trans		(Indea)	
	Default Library: RESRAD Default Trans:			
	bilder Hordry. Aband bilder Hund.			
		Current	1	Parameter
Menu	Parameter	Value	Default	Name
TF	Soil to plant transfer factors:			
	Soil to plant transfer factors: Ac-227+D , plant/soil concentration ratio, dimensionless	2.5002-03	2.500E-03	RTF(1,1)
TF TF TF	-	2.500Z-03 2.500Z-03		
TF	Ac-227+D, plant/soil concentration ratio, dimensionless	2.500E-03		RTF(1,2)
TF TF TF	Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless	2.500Z-03 2.500Z-03	2.500E-03	RTF(1,2) RTF(1,3)
TF TF TF TF	Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless	2.500Z-03 2.500Z-03	2.500E-03 2.500E-03	RTF(1,2) RTF(1,3)
TF TF	Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless	2.500E-03 2.500E-03 2.500E-03	2.500E-03 2.500E-03	RTF(1,2) RTF(1,3) RTF(1,4)
TF TF TF TF TF	<pre>Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless intake to meat/milk transfer factors:</pre>	2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.000 <u>2</u> -05	2.500Z-03 2.500Z-03 2.500Z-03	RTF(1,2) RTF(1,3) RTF(1,4) I_M(1,1)
TF TF TF TF TF TF	<pre>Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless intake to meat/milk transfer factors: Ac-227+D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)</pre>	2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.000 <u>2</u> -05	2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.000 <u>2</u> -05	RTF(1,2) RTF(1,3) RTF(1,4) I_M(1,1)
TF TF TF TF TF TF	<pre>Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless Ac-227+D, plant/soil concentration ratio, dimensionless intake to meat/milk transfer factors: Ac-227+D, beef/livestock-intake ratio, (pCi/kg)/(pCi/d) Ac-227+D, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	2.5002-03 2.5002-03 2.5002-03 2.5002-03 2.0002-05 2.0002-05	2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.500 <u>2</u> -03 2.000 <u>2</u> -05	RTF(1,2) RTF(1,3) RTF(1,4) IM(1,1) IM(1,2)

Step 13 Clicked the dropdown arrow of page number, a list of pages appeared (see screenshot below)

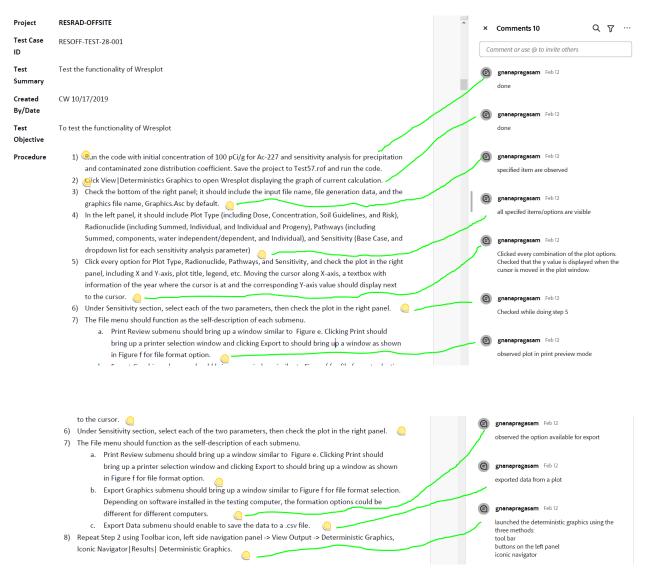
View - SUMMARY.REP



Step 14 Used Toolbar icon->View>Test Output>Parent Dose Report, Left side navigation panel -> View Output -> Parent Dose Report, Iconic Navigator>Results|>Parent Dose Report. All opened "SUMMARY.REP."

12.13 TEST CASE 028-001 TESTER'S REPORT

Documented in RESOFF-TEST-001 Test Cases ekg.pdf of 2/12/2020 3:21 PM



12.14 TEST CASE 029-001 TESTER'S REPORT

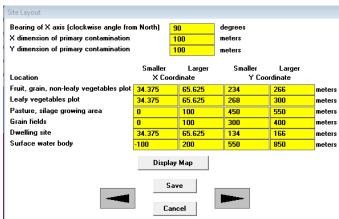
Documented in Results-Test-29-1.docx of 2/17/2020 8:302 AM

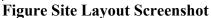
Results for Test Case 29-1

Step 1 Open RESRAD-OFFSITE Version 4.0

Step 2 Click Modify Data on the Left Navigation Panel

Step 3 Click on Site Layout. The Site Layout Looks as in the Screenshot below





Step 4 Click on Display Map (The Map of the site as in the Screenshot below)

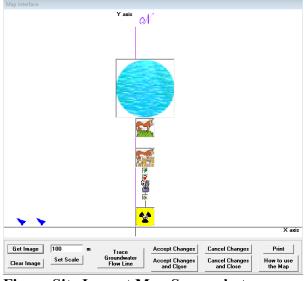


Figure Site Layout Map Screenshot

Step 5 Click File on the left Navigation Panel - File Options Window opens

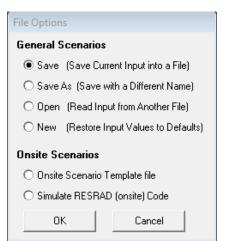


Figure File Options Window Screenshot

Step 6 Check Onsite Scenario Template file button and click OK, A new window with caption (see Screenshot below) opens

Onsite Scenario Primary Contamination		
X dimension of primary contamination	100	meters
Y dimension of primary contamination	100	meters
These dimensions are used to initialize the locati agricultural/farmed lands, the well and the surfac		
Save		

Figure Onsite Scenario Primary Contamination Window Screenshot

Step 7 Click Save

Step 8 Click Site Layout (see Screenshot below)

Bearing of X axis (clockwise angle from X dimension of primary contamination Y dimension of primary contamination		90 100 100	degrees meters meters		
	Smaller	Larger	Smaller	Larger	
Location		rdinate		ordinate	_
Fruit, grain, non-leafy vegetables plot		54.545	-120	100	meters
Leafy vegetables plot	45.455	50	-120	100	meters
Pasture, silage growing area	54.545	100	-120	100	meters
Grain fields	0	45.455	-120	100	meters
Dwelling site	34.189	65.811	34.189	65.811	meters
Surface water body	-100	200	100	400	meters
		y Map ive			

Figure Site Layout Screenshot (Note change in the Site Layout)

Step 9 Click on Display Map (see Screenshot below)

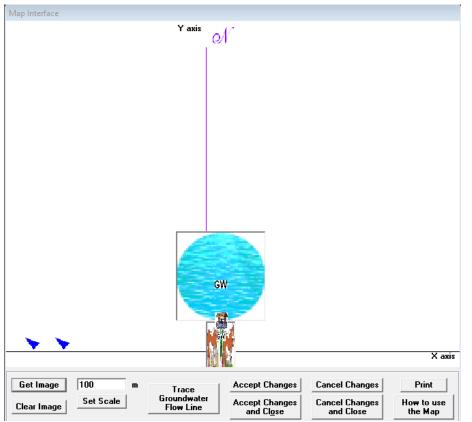


Figure Site Layout Map Screenshot – Note change in the Site Layout Map

12.15 TEST CASE 029-002 TESTER'S REPORT

Documented in Test Case 31-1-JJCheng.docx of 2/17/2020 9:02 AM

Results for Test Case 29-2

Step 1 Open RESRAD-OFFSITE Version 4.0

Step 2 Click File on the Left Navigation Panel-File Options Window opens

File Options				
General Scenarios				
 Save (Save Current Input into a File) 				
○ Save As (Save with a Different Name)				
Open (Read Input from Another File)				
O New (Restore Input Values to Defaults)				
Onsite Scenarios				
🔿 Onsite Scenario Template file				
O Simulate RESRAD (onsite) Code				
OK Cancel				

Figure File Options Window Screenshot

Step 3 Check Simulate RESRAD (onsite) Code button and click OK, A new window with caption (see Screenshot below) opens

Title & Radiological Data	NSITE code			
Location of dose, slope and transf	er factor database:	C:\RESRAD_FAM	ILY\DCF\3.1	
Radionuclide transformations base		© ICRP 107	ICRP 38	
ICRP 60 based external, inhalatior External exposure dose library	ICRP 60	e conversion factors		Ŧ
Internal exposure dose library	ICRP 72 (Adult)			-
Slope factor (risk) library	FGR 13 Morbidity	1		• •
Transfer factor library	RESRAD Default	Transfer factors		-
		-	than the cut-off 209 s or risk factors: 8	
Calculation Time points				
<u>Number of points:</u> 204 <u>Minimum time increment betwee</u>		1/1	 Linear spacing Log spacing 	
Update progress of computation	message every:	1. •	Geconds	
Save input file when a form is :	saved			
Use line draw character				

Figure Title & Radiological Data Window Screenshot

Step 4 Click Close

Step 5 Click Modify Data on the Left Navigation Panel

Step 6 Click Site Layout (see Screenshot below)

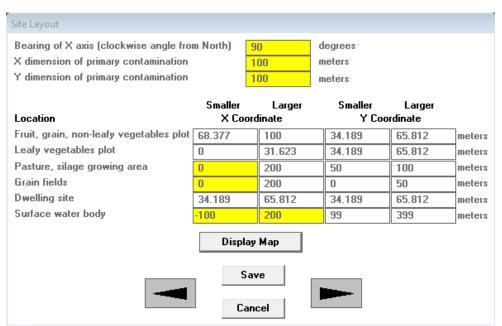


Figure Site Layout Screenshot



lap Interface	Y axis			
	Y axis	V		
	GV	V		
		2		
* *		17 - F		Хах
California 100		4 10	Canad Channel	Brint
Cat Casta	Trace Groundwater	Accept Changes to Primary Contamination	Cancel Changes	Print How to use
Clear Image	Flow Line	and Close	Cancel Changes and Close	the Map

Figure Site Layout Map Screenshot

Step 8 Compare Site Layout and Site Layout Map screenshots with the screenshots in the RESRAD-OFFSITE Test Cases file.

12.16 TEST CASE 030-001 TESTER'S REPORT

Documented in Test Case 30-1.msg of 2/14/2020 11:40 AM

Test Case 30-1

LePoire, David J.

Thu 2/20/2020 11:40 AM

Summary: Went through exercising the DCF editor. Successfully created new library and connected it to input and used it.

1-3) Default setting:

🚑 R	RESRAD DCF Editor Version 3.1		×
File	Help		
	Welcome to th	e RESRAD Dose Conversion Factor (DCF) Editor	
		Version 3.1 — March 24, 2016	
[Transformation chain database		
۲	Library Options	Base External Exposure dose factors	
4	🔿 View a Default Library (Read Only)	Base Inhalation and Ingestion dose factors	
6	Create a new DCF library	DCFPAK3.02 (Adult)	
0	C Edit an existing DCF library	Base values for slope (risk factors) DCFPAK3.02 Morbidity	
0	Make a copy of an existing DCF library	Type the name of the new DCF library	
0	C Rename an existing DCF library	Library Description	
E	xit Program		Create Library

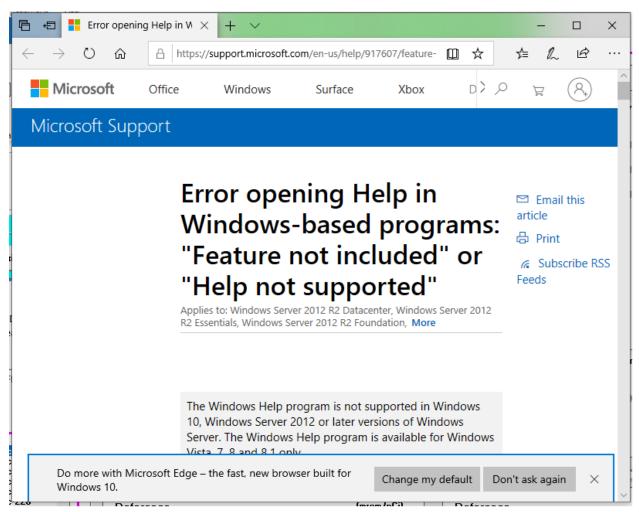
4) ICRP-38 setting:

RESRAD DCF Editor Version 3.1			×
File Help			
Welcome to the	RESRAD Dose Conversion Factor (D	CF) Editor	pi
	Version 3.1 — March 24, 2016		
C ICRP107 ○ ICRP107 ○ ICRP38			
Library Options	Base External Exposure dose factors		
🔿 Yiew a Default Library (Read Only)	FGR 12	•	
Tien a berdak Elbidiy (ireda eniy)	Base Inhalation and Ingestion dose fac	tors	
Create a new DCF library	FGR 11	•	
C Edit an existing DCF library	Base values for slope (risk factors) FGR 13 Morbidity	T	
C Make a copy of an existing DCF library	Type the name of the new DCF library		
C Rename an existing DCF library	Library Description		
		^	Create
Exit Program			Library

5-9) Default viewing: Went through tabs and radionuclides Cs-137 and Zr-97. (Note: Zr-91 in not in the database. The test problem should be changed to refer to Zr-87 instead of Zr-91, as was done in step 10).

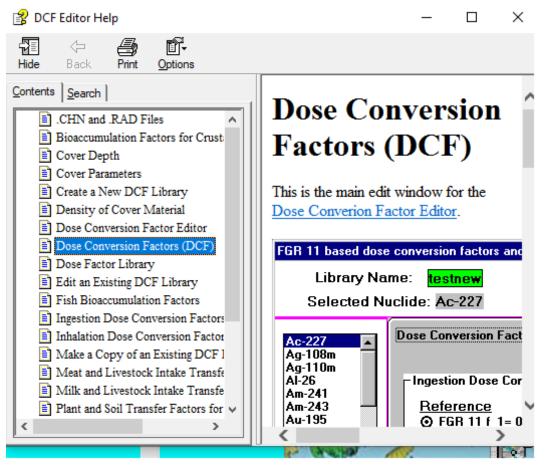
Selected N	ne: DCFPAK3.02, DCFPAK3.02 (Ac uclide: <mark>Ac-223</mark>	Jult), and DCFPAK3.02 Morb	pidity	Dose Factors Help
-223	Dose Conversion Factors	Slope Factors	Radon	Transfer Factors
226	Ingestion Dose Conversion Factors		Inhalation Dose Conversion Fact	
228	Reference	(mrem/pCi)	Reference	(mrem/pCi)
231 232	Ø Half-life < 10 min., 0 used at run tit	me <mark>-2</mark>	Half-life < 10 min., 0 used at	run time -2
233 100m				
101 102				
102m				
103 104				
104m 105				
105m 106				
106m 108				
108m 109m				
110 110m				
111 111m	External Dose Conversion Factors, Volu			
112 113	Reference	(mrem/yr)/(pCi/g)	External Dose Conversion Factor	s. Surface
113m 114	Default DCFPAK3.02	0.07771	Reference	-, (mrem/yr)/(pCi/cm
115 ~			© Default DCFPAK3.02	0.01891
			S DOGUN DOTTANG.02	0.01831
other Library				

11) Help from DCF editor did not work:



12-14) Repeated above for DOE STD and FGR 11

16-17) Help works from the main screen:



Edit mode test:

Library Name: Test DCF Editor Dose Factors Help Selected Nuclide: Ac-227 Dose Factors Help				
1c-223	Dose Conversion Factors	Slope Factors	Radon	Transfer Factors
c-226	☐ Ingestion Dose Conversion Factors —		Inhalation Dose Conversion Factors	
xc-228 xc-230	Reference	(mrem/pCi)	Reference	(mrem/pCi)
10-231 10-232	O DCFPAK3.02 (Adult), f_1 = 0.00	5, <mark>0.0011914</mark>	OCFPAK3.02 (Adult) Class =	F 0.576
xc-233 xg-100m			O DCFPAK3.02 (Adult) Class =	M 0.2694
vg-101 vg-102				
.g-102m			O DCFPAK3.02 (Adult) Class = 1	S 0.2045
ig-103 ig-104	⊙ test	^ 0		
ig-104m ig-105		\vee		
.g-105m .g-106				
.g-106m .g-108				
ig-108m ig-109m				
ig-110 ig-110m			0	^
.g-111 .g-111m	External Dose Conversion Factors, V			\checkmark
.g-112 .g-113	Reference	(mrem/yr)/(pCi/g)	-External Dose Conversion Factors	, Surface
.g-113m .g-114	O Default DCFPAK3.02	0.0002615	Reference	(mrem/yr)/(pCi/cm^2
ig-115 Y	⊙ test	0	Default DCFPAK3.02	0.0002767
Another Library			0	
- and an end of any	Adjustment Parameters			

See new library in list

Title & Radiological Data					
Title: RESRAD-OFFSITE Default Parameters					
Location of dose, slope and transfer factor database: C:\RESRAD_FAMILY\DCF\3.1					
Radionuclide transformations based on ICRP 107 ICRP 38 					
ICRP 60 based external, inhalation, and ingestion dose conversion factors					
External exposure dose library	Test DCF Editor				
Internal exposure dose library	Test DCF Editor				
Slope factor (risk) library	DCFPAK3.02 Morbidity				
Transfer factor library	RESRAD Default Transfer factors				
Cut-off half life: 30 days Number of nuclides in the database with half life greater than the cut-off 225 Number of nuclides lacking dose conversion factors or risk factors: 6					
Calculation Time points					
Number of points: 2048 Image: Second se					
Update progress of computation message every:					
Save input file when a form is saved					
✓ Use line draw character Close					

New DCF data was used:

RESRAD-OFFSITE, Version 4.0 T4 Limit = 30 days Parent Dose Report Title : RESRAD-OFFSITE Default Parameters File : Site6.ROF

02/20/2020 13:32 Page 2

Dose Conversion Factor (and Related) Parameter Summary Current Library: Test DCF Editor Default Library: DCFPAK3.02

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
DCSF	Ac-227 (Source: Test DCF Editor)	0.000 <u>2+00</u>	2.615E-04	DCFEXT(1)
DCSF	At-219 (Source: DCFPAK3.02)	0.0002+00	0.0002+00	DCFEXT(2)
DCSF	Bi-211 (Source: DCFPAK3.02)	2.410E-01	2.410E-01	DCFEXT (3)
DCSF	Bi-215 (Source: DCFPAK3.02)	1.369E+00	1.369E+00	DCFEXT (4)
DCSF	Fr-223 (Source: DCFPAK3.02)	1.758E-01	1.758E-01	DCFEXT (5)
DCSF	Pb-211 (Source: DCFPAK3.02)	3.6802-01	3.680E-01	DCFEXT (6)
DCSF	Po-211 (Source: DCFPAK3.02)	4.707E-02	4.707E-02	DCFEXT(7)
DCSF	Po-215 (Source: DCFPAK3.02)	9.452E-04	9.452E-04	DCFEXT(8)
DCSF	Ra-223 (Source: DCFPAK3.02)	5.791E-01	5.791E-01	DCFEXT(9)
DCSF	Rn-219 (Source: DCFPAK3.02)	2.970E-01	2.970E-01	DCFEXT(10)
DCSF	Th-227 (Source: DCFPAK3.02)	5.641E-01	5.641E-01	DCFEXT(11)
DCSF	T1-207 (Source: DCFPAK3.02)	2.3912-02	2.391E-02	DCFEXT(12)
		Ì		ĺ

Current Library: Test DCF Editor Default Library: DCFPAK3.02 (Adult)

		Current		Parameter
Menu	Parameter	Value	Default	Name
DCSF	Dose conversion factors for inhalation, mrem/pCi:			
DCSF	Ac-227+D	6.459E-01	6.459E-01	DCF2(1)
DCSF	Dose conversion factors for ingestion, mrem/pCi:			
DCSF	Ac-227+D	4.151E-04	1.606E-03	DCF3(1)
	•		•	•

12.17 TEST CASE 031-001 TESTER'S REPORT

Documented in Test Case 31-1-JJCheng.docx of 2/14/2020 9:49 PM

Test Case 31-1 – Test the functionality of sensitivity analysis (single parameter)

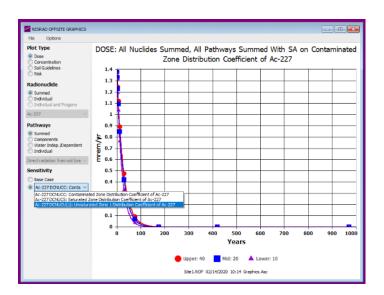
- Launched RESRAD-OFFSITE, used the default template, chose Ac-227 as the radionuclide of concern, entered an initial soil concentration of 100 pCi/g.
- Set Kd of the contaminated zone (in the radionuclide specific release input screen), unsaturated zone (in the distribution coefficient input screen), and saturated zone (in the distribution coefficient input screen) for sensitivity analysis via the menu bar option [Form Options-Sensitivity Analysis (single parameter)], tool bar option (the rainbow button), and hot key (F9) option, respectively, and set an analysis range of 2, 5, and 2.5, respectively.

Set Sensitivity Analysis Range	Set Sensitivity Analysis Range	Set Sensitivity Analysis Range	
Variable Description:	Variable Description:	Variable Description:	
Distribution coef. of Ac-227 in primary contamination	Distribution coef. of Ac-227 in unsaturated zone 1	Distribution coef. of Ac-227 in saturated zone	
Variable Name: DCACTC(Ac-227) Multiply and Divide the variable's deterministic value by: 1.5 0 2 3 5 0 10 0 K Cancel No Analysis	Variable Name: DCACTU11(Ac-227) Multiply and Divide the variable's deterministic value by: 1.5 2 3 0 5 10 <u>DK</u> <u>Cancel</u> No Analysis	Variable Name: DCACTS (Ac-227) Multiply and Divide the variable's deterministic value by: 1.5 2 3 5 0 2.5 0 <u>DCACTS (Ac-227)</u> Lower Value: 8 Base Value: 20 Upper Value: 50 <u>5</u> 0 <u>2</u> <u>DCA</u> <u>Cancel</u> <u>No Analysis</u>	

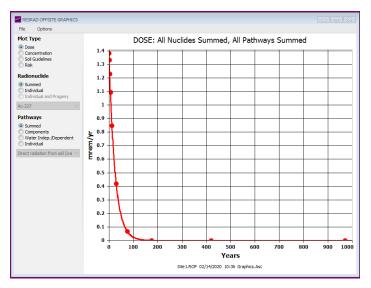
• Saw the settings appeared at the sensitivity analysis information bar at the bottom of the main interface



• Run calculations. Opened the Deterministic Graphics viewer. The sensitivity analysis options were available in the options selection panel. The graphic viewer displayed the sensitivity analysis results based on the selection.



• Cancelled each sensitivity analysis by clicking the "no analysis" tab in the Set Sensitivity Analysis Range window. All sensitivity analyses were cancelled successfully, verified by 0 variable listed in the sensitivity analysis summary bar at the bottom of the main interface, and no sensitivity analysis options in the Deterministic Graphics viewer after running the code.



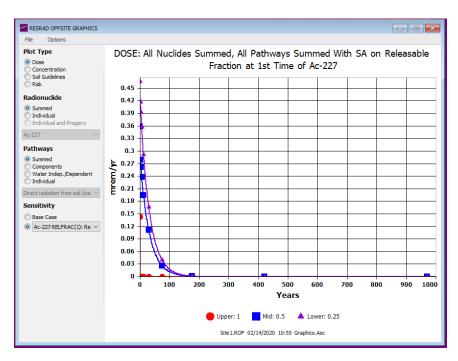
• Chose the Equilibrium Desorption Transfer as the release mechanism for Ac-227. Chose the cumulative releasable fraction at time 0 (default value is 1) for sensitivity analysis, and set a range value of 2. The code successfully provided warning against the selected range. Cancelled the sensitivity analysis.

Radionuclide Specific Release	Set Sensitivity Analysis Range
Radionuclide Ac-227 🛓 Element Ac	Variable Description: Cumulative fraction of Ac-227 bearing material that is releasable at time 1
Release to ground water O First Order Rate Controlled Transfer	Variable Name: RELFRAC(1_Ac-227)
 Equilibrium Desorption Transfer Equilibrium Solubility Transfer 	Multiply and Divide the variable's deterministic value
Time at which release begins or changes (years) 0 Add Next Cumulative fraction of radionuclide bearing material that is releasable 1	by: 0 <u>1.5</u> 0 <u>2</u> 0 2
Incremental fraction of radionuclide bearing becomes releasable stepwise at time	0 3 ■ V Upper Value: 2 0 5 0 0 10 0
Distribution coefficient in primary contamination (cm²/g) 20	<u>Q</u> K <u>C</u> ancel <u>N</u> o Analysis
Message The selected sensitivity range will exceed the allowable maximum value. Do you wish to reset the sensitivity range to the maximum level or cancel the sensitivity analysis.	
<u>R</u> eset <u>C</u> ancel	

• Changed the cumulative releasable fraction at time 0 to 0.5, and reselected it for sensitivity analysis with a range of 2. Ran the code.

Distribution coefficient in primary contamination (cm²/g) 20	
Incernental fraction of radionuclide bearing becomes releasable steppers at the O	
Cumulative fraction of radionuclide bearing material that is releasable .5	
Time at which release begins or changes (years) 0 Add N Time	4
C Equilibrium Solubility Transfer	
 Equilibrium Desorption Transfer 	
Release to ground water O First Order Rate Controlled Transfer	
_	
Radionuclide Ac-227 🐥 Element Ac	1 Variables RELFRAC(1,Ac-227) */ 2
Radionuclide Specific Release	

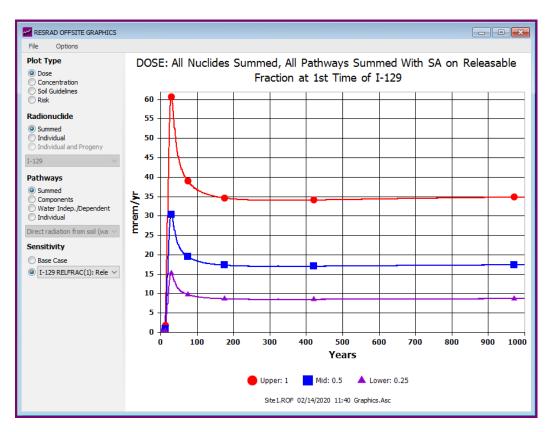
• Opened the Deterministic Graphics Viewer. The sensitivity analysis results were displayed as shown below. The results make sense because the external radiation pathway is the dominant pathway and half-life of Ac-227 is short, 21.772 years.



• Deleted Ac-227 and chose I-129 (half-life 1.57e7 years). Kept the Equilibrium Desorption Transfer as the release mechanism. Changed the Kd in primary contamination to 1000 cm3/g and the cumulative releasable fraction to 0.5 at time 0. Set sensitivity analysis for the releasable fraction with a range of 2. Ran the code.

	· · · · · · · · · · · · · · · · · · ·
Radionuclide Specific Release	Set Sensitivity Analysis Range
Radionuclide I-129 🚊 Element I	Variable Description: Fraction of I-129 bearing material that is releasable at release time 1 at time 0 years
Release to ground water Transfer mechanism ○ First Order Rate Controlled Transfer ○ Equilibrium Desorption Transfer ○ Equilibrium Solubility Transfer Time at which release begins or changes (years) 0 Cumulative fraction of radionuclide bearing material that is releasable 5	Variable Name: RELFRAC(1,1-129) Multiply and Divide the variable's deterministic value by: 0 1.5 0 2 0 3 1 Lower Value: .25 Base Value: .5 Upper Value: 1
Incremental fraction of radionuclide bearing becomes releasable stepwise at time	O <u>5</u> O 10
Distribution coefficient in primary contamination (cm²/g) 1000	<u>DK</u> <u>Cancel</u> <u>No</u> Analysis

• Opened the Deterministic Graphics Viewer. The sensitivity analysis results were displayed as shown below. The results make sense because the water-dependent pathways (milk, drinking water, and meat) are the dominant pathways, Kd of the primary contamination is large (1000 cm3/g) and I-129 is long-lived.



• The code is equipped with all the sensitivity analysis functions required for selecting one parameter at a time.

12.18 TEST CASE 031-002 TESTER'S REPORT

Documented in Test Case 31-2-JJCheng.docx of 2/14/2020 12:25 PM

Test Case 31-2 – Test the functionality of setting multiparamter sensitivity analysis

- Used default input template. Chose Ac-227 as radionuclide of concern with an initial concentration of 100 pCi/g.
- Selected Kd of the contaminated zone, unsaturated zone, and saturated zone for uncertainty analysis with a uniform sensitivity range by clicking Shift-F8. Chose Uniform distribution and set the range to be +-25%, +-50%, and +-99%, respectively. Saved the input file.

Uncertainty and Probabilistic Analysis						
Step by step analysis	Related inputs	Post run regression				
Sample specifications Param	eter distributions	Input rank correlations	Output specifications			
Variable Description Kd of Ac-227 in Contaminated Kd of Ac-227 in Unsaturated zone Kd of Ac-227 in Saturated zone	Statistics of uncert Kd of Ac-227 in Sa Distribution UNI					
		Max Uniform sensitivity C + - 0.1% about C + - 5% about de C + - 10% about d	deterministic value eterministic value leterministic value leterministic value leterministic value			
	Previous parameter Next parameter <u>R</u> emove parame	Update Paramete	er stats and distribution Restore Parameter stats and distribution			
Sort alphabetically before run	Sort alphabetically before run Suppress uncertainty analysis this session <u>OK</u>					

• In the generated input file (Site2.rof), the total number of observation was shown as 300 (NUM_SMPS=300) for three input parameters (NUMVAR=3).

```
SITE2 - Notepad
File Edit Format View Help
DEPVEL = .001,
DEPVELT = .001,
NSENA = 0,
NUM_SAMPS = 300, NUMVAR = 3, NUMRELVAR = 0,
SELPATH = 255,
NAIFLXT = 0,
NAQFLXT = 0,
NSFST = 0,
NSWFLXT = 0,
NSWCONC = 0,
NWWCONC = 0 ,
STARFILEREAD = 0,
STARFILELOCATION = ' ',
SAVEGTDATA = 0,
&END
```

• Opened the generated LHS input file (Site2.lhs) with Notepad, and noticed the recordings of the three Kd parameters for uncertainty analysis with the selected distribution function and range of distributions, the number of observation (default 100), and the number of repetition (3).

```
SITE2 - Notepad
File Edit Format View Help
TITLE - RESRAD-OFFSITE Default Parameters
RANDOM SEED 1000
NVAR 3
NOBS 100
NREPS 3
UNIFORM
                       DCACTC(1)
                                               Kd of Ac-227 in Contaminated zone
15
         25
                                          .25
                  Sensitivity 20
                                                   0
0
         none
                                                              1F+34
UNIFORM
                       DCACTU1(1)
                                               Kd of Ac-227 in Unsaturated zone 1
10
         30
                   Sensitivity
                                                             1E+34
                               20
                                                    0
0
         none
                                          .5
UNTFORM
                                               Kd of Ac-227 in Saturated zone
                       DCACTS(1)
.1999998 39.8
                                                    0
                                                              1E+34
0
                   Sensitivity 20
                                          .99
         none
OUTPUT CORR DATA
```

- If the code were ran, an uncertainty analysis with the above settings would be performed.
- The function of setting multiparameter sensitivity analysis was imeplemented successfully.

12.19 TEST CASE 032-001 TESTER'S REPORT

Documented in Test-032-001_report.docx of 2/20/2020 6:44 AM

Test-032-001 Report

By cheng wang 2/17/2020

Objective: To test the functionality of setting Uncertainty/Probabilistic Analysis Conclusion: the code worked as expected.

Procedure:

- 1. Followed the procedure described in test case
- 2. The generated files were saved in the folder 032-001
- 3. The screenshots were presented as follows. They matched the expected results.

Figure a

Uncertainty and Probabilistic Analysis						
Step by step analysis	Related inputs	Post run regression				
Sample specifications Par	ameter distributions	Input rank correlations	Output specifications			
Variable Description Kd of Ac-227 in Unsaturated zone	Statistics of unce Kd of Ac-227 in U	rtain or probabilistic paramete nsaturated zone 1	er			
	Distribution TRUNCATED LOGNORMAL-N					
		Mean (Mu) of underlying i riation (Sigma) of underlying i Lo w er qu Upper qu	normal <mark>3.22 Jantile .001</mark>			
	Previous parameter Next parameter	Update Paramet	er stats and distribution			
	<u>R</u> emove param	eter Help	Restore Parameter stats and distribution			
Sort alphabetically before run Suppress uncertainty analysis this session						

Figure b

Uncertainty and Probabilistic Ar	nalysis				
Step by step analysis	Related inputs	Post run regression			
Sample specifications	Parameter distributions	Input rank correlations	Output specifications		
Variable Description Kd of Ac-227 in Unsaturated Precipitation	Precipitation	rtain or probabilistic paramete			
			iimum <mark>.99</mark> simum <mark>1.01</mark>		
	holder distribut the distribution	ault distribution for this v ion will be deleted when is modified. Please ent I click the "Update Para mmand.	the file is saved unle: er the appropriate		
	Previous paramete Next parameter	Update Paramete	er stats and distribution		
	<u>R</u> emove parame	eter Help	Restore Parameter stats and distribution		
Sort alphabetically before run Suppress uncertainty analysis this session					

Figure c

Uncertainty and Probabilistic Ana	alysis				
Step by step analysis	Related inputs	Post run regression]		
Sample specifications	Parameter distributions	Input rank correlations	Output specifications		
Variable Description Kd of Ac-227 in Unsaturated Precipitation	zone Precipitation	ain or probabilistic paramete	er		
			nimum 0 Mode 1 ximum 2		
	Previous paramete Next parameter <u>R</u> emove parame	Update Paramet	er stats and distribution Restore Parameter stats and distribution		
Sort alphabetically before run Suppress uncertainty analysis this session OK					

Figure c-1

NUM_SAMPS = 300, NUMVAR = 2, NUMRELVAR = 0,

Figure d

🔚 TEST53.LHS 🔀								
1	TITLE - RE	TITLE - RESRAD-OFFSITE Default Parameters						
2	RANDOM SEED 1000							
3	NVAR 2	NVAR 2						
4	NOBS 100							
5	NREPS 3	NREPS 3						
6	TRUNCATED LOGNORMAL-N DCACTU1(1)			TU1 (1)		Kd of Ac-227 i	n Unsatura	ted zone 1
7	6.72	3.22	.001	.999				
8	0 :	none	TRUNCATED	LOGNORMAL-N	6.72	3.22	.001	.999
9	TRIANGULAR		PREC:	IP		Precipitation		
10	0	1	2					
11	0	10	user defin	ned				
12	OUTPUT COR	R DATA						
13								

12.20 TEST CASE 033-001 TESTER'S REPORT

Documented in Test-033-001_report.docx of 2/20/2020 9:05 AM

Test-033-001 report

By cheng wang 2/17/2020

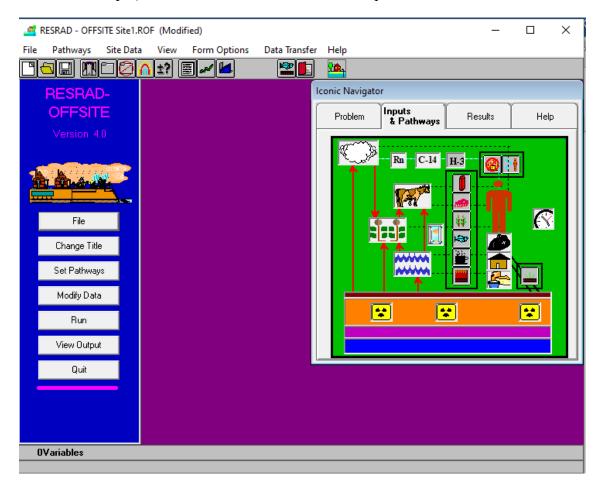
Objective: Test the File navigation function from the left panel of GUI.

Conclusion: the code worked as expected.

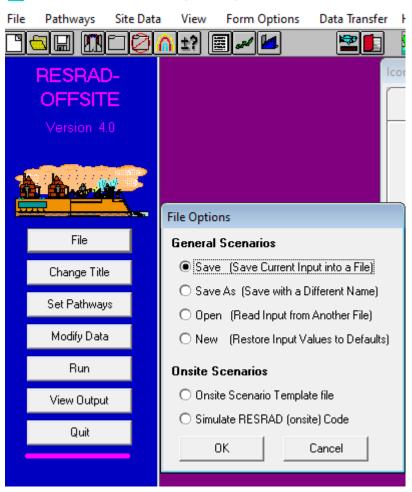
Suggest to modify the description of Test Case 035-001 which is use as Step 3) in this test case: remove "Reporting times" and "Surface water transport" from the bullet list in Step 6). "Reporting times" form was not designed to have yellow background, and there is no Surface Water Transport form.

Procedure:

1.Followed Step 1) in Test Case 033-001; worked as expected.



2. Followed Step 2): worked as expected

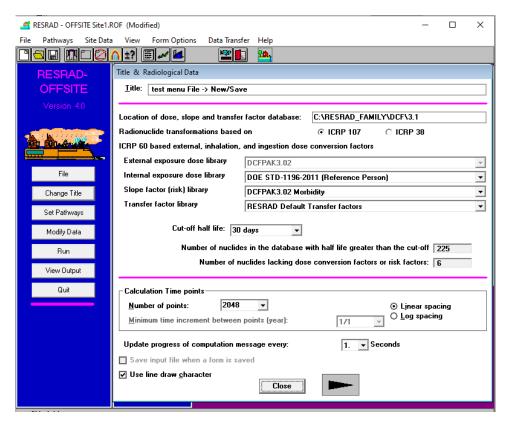


RESRAD - OFFSITE Site1.ROF (Modified)

3 (a). Followed Step 3) in test case description for testing "New" button; worked as expected except the following two issues:

only the background of text boxes in Reporting times for are not in yellow. Reporting times are not model calculation parameters. Suggest removing this form in the bullet list of this step in the test case description.

There is no Surface Water Transport form; suggest remove this bullet from the list of this step in the test case description



at RESRAD - OFFSITE Site1.ROF (Modified)



Preliminary Inputs Radiological units Description of RESRAD-ONSITE exponential release Activity: 🔹 🖌 🛛 -Dose: m 🔻 rem The release from the primary contamination into the underlying stratum is proportional to the inventory. There Basic radiation dose limit: mrem/yr are two ways to conceptualize how this might happen 25 leading to two alternative inputs. Exposure duration (for risk): 30 vears The leach rate, the proportionality constant, is the user Number of unsaturated zones: • F input if the transfer is conceptualized as a first order rate 1 controlled process with no transport in the primary Submerged fraction of primary Contamination 0 unitless contamination. If users want to use this conceptualization, but do not Conceptualization of primary contamination have information on the leach rates, users can leave the This choice applies to all the radionuclides in the input file. leach rate input at 0. Then the code will estimate a leach rate using the distribution coefficient in the primary O Use <u>BESRAD-ONSITE</u> exponential release model contamination. This latter choice can also be conceptualized as an O Specify initial activity based on mass of entire primary contamination instantaneous equilibrium desorption release from a continuously mixed primary contamination. O Specify initial activity based on mass of contaminated medium O Model diffusive transport out of contaminated medium $Q_i(t)$ Save Cancel $R_i^{gw}(t) = \mu_i Q_i(t)$ Times at which Release Properties are Specifed (years) 1st time at which release begins Insert new 1st time and shift down existing Delete 2nd time and associated release data 2nd time at which release changes times and associated release data and shift up existing data 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes 9th time at which release changes Add new 2nd time at which release changes Number of times at which the release properties are specified Times are in ascending order. Close Initial Concentrations Nuclide Concentration: Bg/g contaminated 100 List of ICRP107 Nuclides with half life greater than 30 days zone List of Nuclides Present a the Site Ag-105 Ag-108m Ag-110m AĪ-26 Am-241 Am-242m Add Ac-227 21.772y Am-243 No DCEs Ar-37 Ar-39 No DCFs Delete Ar-42 No DCFs As-73 Au-195 Nuclide Specific Release Ba-133 Be-10 Be-7 **Distribution Coefficients** Bi-207 Deposition Velocities Bi-208 Bi-210m Bk-247 Transfer Factors Bk-249 C-14 All <u>N</u>uclide Factors Ca-41 Ca-45 Cd-109 Turn on Radon Pathway Cd-113 Close

Storage Times		
Surf <u>a</u> ce water:	1	days
W <u>e</u> ll water:	1	days
Fruits, grain & nonleafy vegetables:	14	days
Leafy vegetables:	1	days
Pasture and silage	1	days
Livestock feed grain:	45	days
<u>M</u> eat:	20	days
Mjlk:	1	days
<u>F</u> ish:	7	days
<u>C</u> rustacea and mollusks:	7	days
Save Cancel		

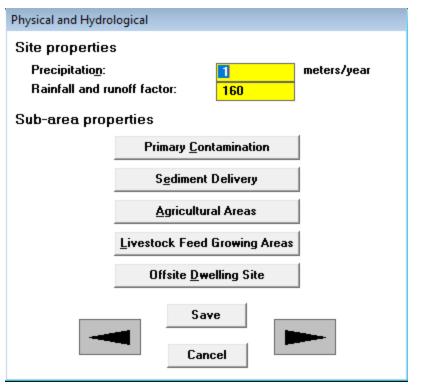
Site Layout

Bearing of X axis (clockwise angle from North)	90	degrees
X dimension of primary contamination	100	meters
Y dimension of primary contamination	100	meters

Location	Smaller X Cool	Larger rdinate	Smaller Y Co	Larger ordinate	
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters
Leafy vegetables plot	34.375	65.625	268	300	meters
Pasture, silage growing area	0	100	450	550	meters
Grain fields	0	100	300	400	meters
Dwelling site	34.375	65.625	134	166	meters
Surface water body	-100	200	550	850	meters

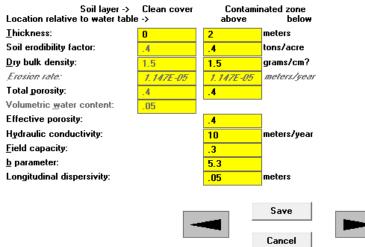
Display Map

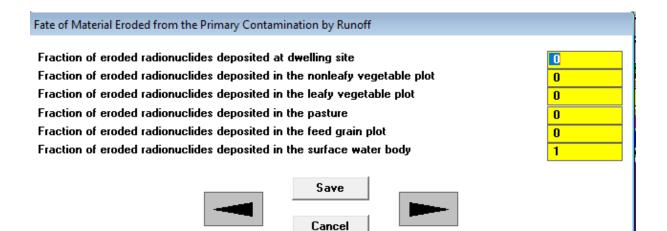




Primary Contamination

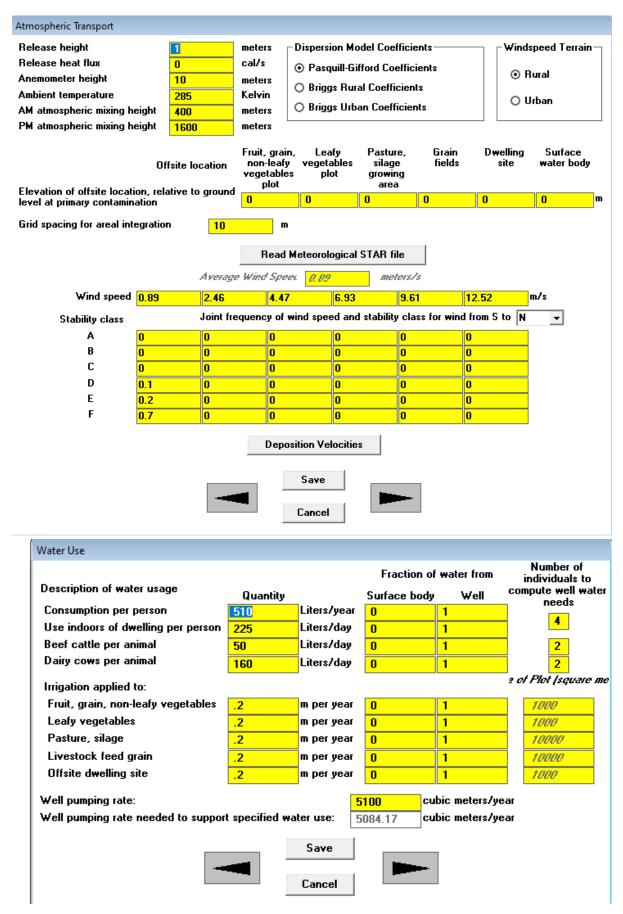
Area of primary contamination:	10000	square meters
Length of contamination parallel to aquifer flow:	100	meters
Depth of soil <u>m</u> ixing layer:	.15	meters
Mass loading of all particulates:	.0001	grams/m?
Deposition velocity of all particulates (to compute atmospheric release):	.001	meters/s
Respirable particulates as a fraction of total particulates	1	
Deposition velocity of respirable particulates (to compute atmospheric release):	.001	meters/s
Irrigation applied per year:	.2	meters in a year
Evapotranspiration coefficient:	.5	
R <u>u</u> noff coefficient:	.2	
Slope-length-steepness factor:	.4	
Cover and management factor:	.003	
Support practice factor:	1	
Fraction of primary contamination that is submerged	0	





Agricultural Areas Crops	Fruit, grain, non-leafy	Leafy vegetables
Area (square meters):	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

Livestock Feed Growing Areas			
Elvestock reed blowing Areas	_	Pasturo	Grain
	Crops	Pasture, silage	urain
Area (square meters):		10000	10000
Fraction of area directly over prima	iry contamination:	0	0
Irrigation (m) applied per year:		.2	.2
<u>Evapotranspiration coefficient:</u>		.5	.5
<u>R</u> unoff coefficient:		.2	.2
Depth of soil <u>mixing</u> layer or plow la	ayer (meters):	.15	.15
Volumetric <u>w</u> ater content:		.3	.3
Erosion rate (meters/year):		1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm?	<u>?:</u>	1.5	1.5
Soil erodibility factor (tons/acre):		.4	.4
Slope-length-steepness factor:		.4	.4
Cover and management factor:		.003	.003
Support practice factor:		1	1
Total porosity		.4	.4
Sediment from primary contamination	on delivery ratio	0	0
	C		
	Save		
	CI		
	Cancel		
Offsite Dwelling Area			
	Building	Offsite	
Area (square meters):	location	dwelling	
Zarea foguare meteroj.			
		1000	
Irrigation (m) applied per vear:		1000	
Irrigation (m) applied per year: Evapotranspiration coefficient:		1000 .2	
Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient:		1000 .2 .5	
Evapotranspiration coefficient:	ayer (meters):	1000 .2 .5 .2	
<u>Evapotranspiration coefficient:</u> <u>R</u> unoff coefficient:	ayer (meters):	1000 .2 .5	
<u>Evapotranspiration coefficient:</u> <u>Runoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u>	ayer (meters):	1000 .2 .5 .2 .15	
<u>Evapotranspiration coefficient:</u> <u>Runoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>w</u> ater content:		1000 .2 .5 .2 .15 .3	
<u>Evapotranspiration coefficient:</u> <u>Runoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year)</u> :		1000 .2 .5 .2 .15 .3 0	
<u>Evapotranspiration coefficient:</u> <u>Runoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year)</u> : <u>D</u> ry bulk density of soil (grams/cm?		1000 .2 .5 .2 .15 .3 0 1.5	
<u>Evapotranspiration coefficient:</u> <u>Runoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year)</u> : <u>Dry bulk density of soil (grams/cm?</u> Soil erodibility factor (tons/acre):		1000 .2 .5 .2 .15 .3 0 1.5 0	
<u>Evapotranspiration coefficient:</u> <u>Bunoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year):</u> <u>Dry bulk density of soil (grams/cm?</u> Soil erodibility factor (tons/acre): Slope-length-steepness factor:		1000 .2 .5 .2 .15 .3 0 1.5 0 .4	
<u>Evapotranspiration coefficient:</u> <u>Runoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year):</u> <u>D</u> ry bulk density of soil (grams/cm? Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor:		1000 .2 .5 .2 .15 .3 0 1.5 0 .4 .003	
<u>Evapotranspiration coefficient:</u> <u>Bunoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year):</u> <u>Dry bulk density of soil (grams/cm?</u> Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor:	<u>)-</u>	1000 .2 .5 .2 .15 .3 0 1.5 0 .4 .003 1	
<u>Evapotranspiration coefficient:</u> <u>Bunoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year):</u> Dry bulk density of soil (grams/cm? Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity): on delivery ratio	1000 .2 .5 .2 .15 .3 0 1.5 0 .4 .003 1 .4 .4	
<u>Evapotranspiration coefficient:</u> <u>Bunoff coefficient:</u> Depth of soil <u>mixing layer or plow la</u> Volumetric <u>water content:</u> <u>Erosion rate (meters/year):</u> <u>D</u> ry bulk density of soil (grams/cm?) Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity	<u>)-</u>	1000 .2 .5 .2 .15 .3 0 1.5 0 .4 .003 1 .4 .4	
Evapotranspiration coefficient: <u>R</u> unoff coefficient: Depth of soil <u>mixing</u> layer or plow layor Volumetric <u>water</u> content: <i>Erosion rate (meters/year):</i> <u>D</u> ry bulk density of soil (grams/cm?) Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity): on delivery ratio	1000 .2 .5 .2 .15 .3 0 1.5 0 .4 .003 1 .4 .4	



Unsaturated Zone Hydrology						
Number of unsaturated zones: set in 1 preliminary inputs form						
Unsaturated zone number:	: 1:					
Thickness (meters)	4					
Dry bulk density (grams/cm?	1.5					
Total porosity	.4					
Effective porosity	.2					
Field capacity	.3					
Hydraulic conductivity (meters/year)	10					
b parameter	5.3					
Longitudinal dispersivity (meters)	.1					
Save Cancel						

Saturated Zone Hydrology

Thickness of saturated zone:		100		meters	:
Dry bulk density of saturated zone:		1.5		grams,	/cm?
<u>Iotal porosity of saturated zone:</u>		.4			
Effective porosity of saturated zone:		.2			
Hydraulic conductivity of saturated zone:		100		meters	/year
	to	well		urface erbody	
Hydraulic gradient of saturated zone:	.02		.02		
Depth of aquifer contributing:	10		5		meters below water table
Longitudinal dispersivity of saturated zone:	3		10		meters
<u>Horizontal lateral dispersivity of saturated zone:</u>	.4		1		meters
<u>Vertical lateral dispersivity of saturated zone:</u>	.02		.06		meters
					-
	Save				
	Cance	1			

Groundwater Transport				
Sub Screens				
	Wate <u>r</u> Use Para	meters		
Unsaturated Zone I	Properties	Saturated Zone Pro	perties	
Distance in the direction parallel	l to aquifer flow from	downgradient edge of c	contaminatior	n to
	<u>w</u> ell:		100	meters
	<u>s</u> urface water	body:	450	meters
Distance in the direction perpen	dicular to aquifer flow	v from center of contam	ination to	
	w <u>e</u> ll:		0	meters
	right edge of	surface water body:	<mark>-150</mark>	meters
	left edge of s	urface water body:	150	meters
Convergence criterion (fractiona	l accuracy desired):		.001	
Number of sub zones (to model o	dipsersion of progeny	produced in transit):		
Main sub zones in primary cont	amination		1	
Main sub zones in submerged p	orimary contamination	1	1	
Main sub zones in each partial	ly saturated zone		1	
Main sub zones in saturated zo	ne		1	
 nuclide specific retardation transformation 	in all sub zones, long	gitudinal dispersion in a	ll but the sub	zone of
O longitudinal dispersion in all transformation, parent retard			ll but the sub	zone of
O longitudinal dispersion in all transformation, progeny reta	sub zones, nuclide and ation in zone of tra	specific retardation in a ansformation	ll but the sub	zone of
	C	1		
	Save			
	- Cancel			

Surface Water Body			
Surface area of water in surface water body:		90000	square meters
Volume of surface water body:		150000	cubic meters
Potential evaporation:		1	m/year
Stream outflow (as a fraction of total outflow)		0.9983	🔽 use inflow ratio
Settling velocity of sediments		.1	cm/s
Density of bottom sediment		1.5	grams/cm?
Thickness of bottom sediment layer in adsorpti equilibrium of radionuclids with water	ion/desorption	.05	m
Sediment from primary contamination delivery i	atio	1	
Number of catchment areas	1 • •		
Characteristics of catchment area	1		
Smaller X coordinate (meters)	-1450		
Larger X coordinate (meters)	1550		
Smaller Y coordinate (meters)	-2450		
Larger Y coordinate (meters)	550		
Surface area (square meters)	9000000		
Runoff coefficient	.2		
Soil erodibility factor (tons/acre):	.4		
Slope-length-steepness factor:	.4		
Cover and management factor:	.003		
Support practice factor	1		
Sediment delivery ratio	0.2121	🔽 estimate u	sing catchment area
Fraction of deposited radionuclides reaching Surface water body	.02		
 Model atmospheric deposition on catchmen Approximate by atmospheric release 	ıt		
Convergence criterion for atmospheric deposit	ion	.001	
			1
	Save		



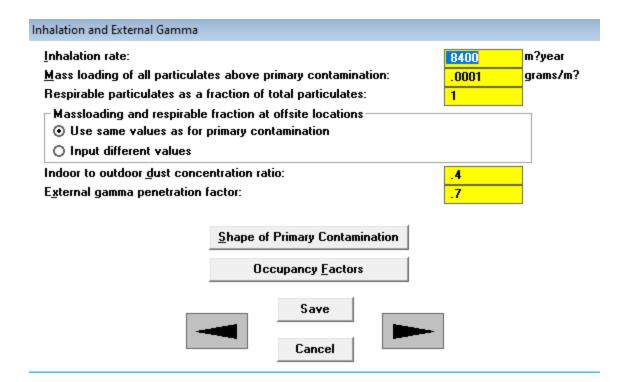
Ingestion Rates

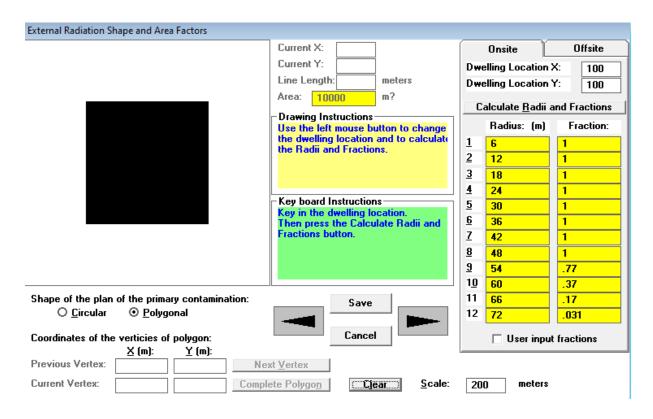
		Consumption rate		Fraction from affected area	
<u>D</u> rinking water		510	Liters/year	1	
<u>F</u> ish		5.4	kg/year	.5	
<u>C</u> rustacea and mollusks		.9	kg/year	.5	
Fruit, grain, non-leafy vege	etables	160	kg/year	.5	
Leafy <u>v</u> egetables		14	kg/year	.5	
M <u>e</u> at		63	kg/year	1	
Mjilk		92	Liters/year	1	
<u>S</u> oil (incidental)		36.5	grams/year		
	<u>E</u> iv	\$			
	Livestock Feed Factors				
		Save		1	
		Cancel]	

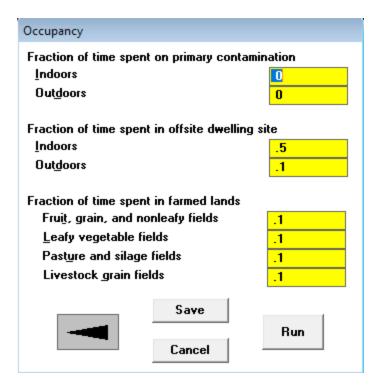
Plant Factors			
Сгорз		Fruit, grain, non-leafy	Leafy vegetables
Wet weight crop yield (kg/m?		.7	1.5
Duration of growing season (years)		.17	.25
Foliage to food transfer coefficient		.1	1
Weathering removal constant (1/year)		20	20
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot depth (meters)		1.2	.9
	Save Cancel		

Livestock Feed Factors			
Crops		Pasture, silage	Grain
Wet weight crop yield (kg/m?		1.1	.7
Duration of growing season (years)		.08	.17
Foliage to food transfer coefficient		1	.1
Weathering removal constant (1/year)		20	20
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot depth (meters)		.9	1.2
	Save		
	Cancel		

Livestock Intakes		
	Beef cattle	Dairy cows
<u>₩</u> ater (liters/day)	50	160
Pasture, and silage (kg/day)	14	44
<u>G</u> rain (kg/day)	54	11
Soil from pasture and silage (kg/day)	.1	.4
Soil from grain (kg/day)	.4	.1
Save		
Cancel		

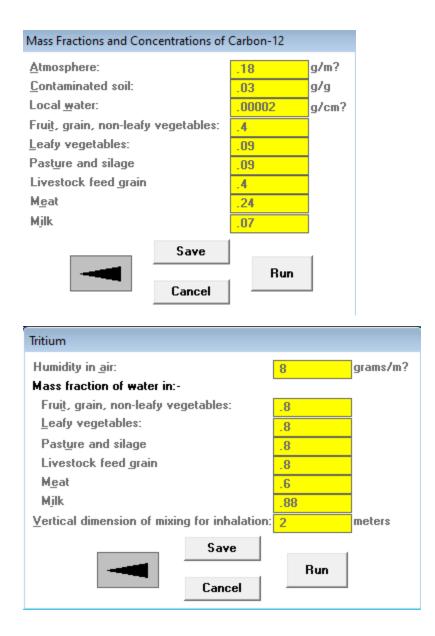






Radon

Adum		
Effective radon diffusion coefficient of cover:	.000002	m?s
Effective radon diffusion coefficient of contaminated zone:	.000002	m?s
Effective radon diffusion coefficient of floor:	3.E-7	m?s
Thickness of floor and foundation:	.15	meters
Density of floor and foundation:	2.4	g/cm?
Total porosity of floor and foundation:	.1	
Volumetric water content of floor and foundation:	.03	
Depth of Foundation below ground level:	-1	meters
Vertical dimension of mixing:	2	meters
Building room height:	2.5	meters
Building air <u>e</u> xchange rate:	.5	17hr
Building indoor area factor:	0	
Rn-222 emanation coefficient:	.25	
Rn-22 <u>0</u> emanation coefficient:	.15	
Effective radon diffusion coefficient of nonleafy veg field:	.000002	m?s
Effective radon diffusion coefficient of leafy vegetable field:	.000002	m?s
Effective radon diffusion coefficient of pasture:	.000002	m?s
Effective radon diffusion coefficient of livestock grain field:	.000002	m?s
Effective radon diffusion coefficient of offsite dwelling site:	.000002	m?s
Save		
Bun		
Cancel		



3.(b) Followed Step 3) in the test case for "Save" button: worked as expected

```
TITLE = 'test menu File -> New/Save',
.....
```

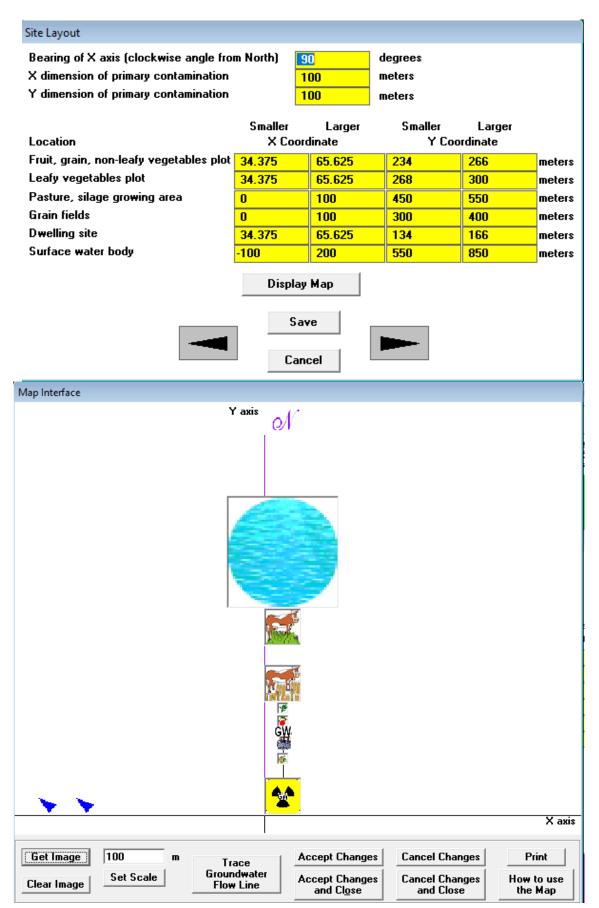
4. Followed Step 4) of the test case description. Opened file "BASIC RESRAD-OFFSITE INSTALLATION QA.ROF" in the QAFiles folder rather than the file with file name ending with "US.ROF". Worked as expected.

Title & Radiological Data					
Title: Basic QA check of the RESRAD-OFFSITE installation					
		_			
Location of dose, slope and transfer	r factor database: C:\RESRAD_FAMILY\DCF\3.1				
Radionuclide transformations based	on 💿 ICRP 107 🔿 ICRP 38				
ICRP 60 based external, inhalation,	and ingestion dose conversion factors				
External exposure dose library	DCFPAK3.02	r			
Internal exposure dose library	DOE STD-1196-2011 (Reference Person)	r			
Slope factor (risk) library	DCFPAK3.02 Morbidity	r			
Transfer factor library	RESRAD Default Transfer factors	•			
Number of nuclide	0 days es in the database with half life greater than the cut-off 155 nuclides lacking dose conversion factors or risk factors: 4	_			
Calculation Time points		٦			
Number of points: 2048 Minimum time increment between	■ ■ ■ □ points (year): □ 1/1 □ Linear spacing □ Log spacing				
Update progress of computation m		_			
Save input file when a form is saved					
✓ Use line draw <u>c</u> haracter	Close				

Compare the file generated by "Save as" button using the following command statement. The differences between the two files were output to the file named diff.txt. File diiff.txt indicates that there was no difference between the two files, meaning the "Save as" button worked as expected.

:\Users\Cheng∛ang>fc	"C:\Users\Cheng∛an	g\Research\Proj	ects\RESRAD\OFF	SITE\v4. 0\Rei	leaseTesting\033	3-001\test002.rof	″ ″C:
RESRAD_Fami1y\OFFSIT	E\4.0\QAfiles\BASIC	RESRAD-OFFSITE	INSTALLATION Q	A. ROF // >C:\U:	sers\Cheng⊮ang\B	Research\Projects	\RESRA
\OFFSITE\v4.0\Release	eTesting\033-001\di	ff.txt					

5. Followed Step 5) of the test case. This step should follow Test Case 029-001, rather than Test Case 35-004. Worked as expected.



Onsite Scenario Primary Contamination		
X dimension of primary contamination	100	meters
Y dimension of primary contamination	100	meters

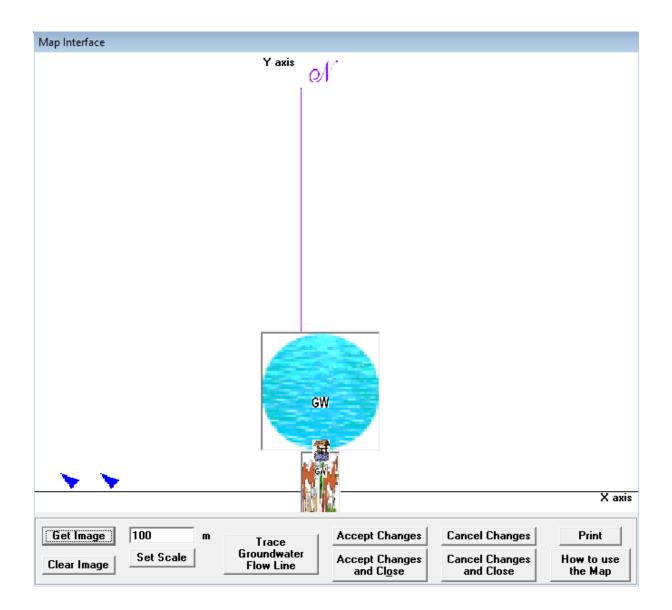
These dimensions are used to initialize the locations of the agricultural/farmed lands, the well and the surface water body.

l

Save	
------	--

- C - C - C - C - C - C - C - C - C - C		
Site	310	out
SILE		out
	-	

X dimension of primary contamination Y dimension of primary contamination		00 00	meters meters			
Location	Smaller X Coor	Larger	Smaller X Cor	Larger ordinate		
Fruit, grain, non-leafy vegetables plot		54.545	-120	100	meter	
Leafy vegetables plot	45.455	50	-120	100	meter	
Pasture, silage growing area	54.545	100	-120	100	meter	
Grain fields	0	45.455	-120	100	meter	
Dwelling site	34.189	65.811	34.189	65.811	meter	
Surface water body	-100	200	100	400	meter	
Save Cancel						



6. Followed Step 6) of the test case description. This step should follow Test Case 029-002, rather than Test Case 35-005. Worked as expected.

Site Layout Bearing of X axis (clockwise angle from North) degrees 90 X dimension of primary contamination meters 100 Y dimension of primary contamination 100 meters Smaller Smaller Larger Larger Location X Coordinate Y Coordinate Fruit, grain, non-leafy vegetables plot 68.377 100 34.189 65.812 meters Leafy vegetables plot 31.623 34,189 65.812 0 meters Pasture, silage growing area 0 200 100 meters 50 Grain fields 0 200 0 50 meters **Dwelling site** 34.189 65.812 34.189 65.812 meters Surface water body 99 399 100 meters 200 Display Map Save Cancel Map Interface Y axis N GW X axis Get Image 100 **Cancel Changes** Print Accept Changes m Trace Groundwater to Primary Contamination Set Scale **Cancel Changes** How to use Clear Image Flow Line and Cl<u>o</u>se and Close the Map

12.21 TEST CASE 033-002 TESTER'S REPORT

Documented in Test-033-002_report.docx of 2/20/2020 6:47 AM

Test Case 033-002 report

By Cheng Wang 2/17/2020

Objective: to test the Change Title navigation function from the left panel of GUI. Conclusion: the code worked as expected.

Procedure:

1.Followed the procedure in the test case description. Worked as expected.

The left panel and the right panel of the expected results in test case description should switch.

Title & Radiological Data				
Title: RESRAD-OFFSITE Default	Parameters			
Location of dose, slope and transfe	r factor database:	C:\RESRAD_FAM	ILY\DCF\3.1	
Radionuclide transformations based	on	ICRP 107	C ICRP 38	
ICRP 60 based external, inhalation,	and ingestion dose c	onversion factors		
External exposure dose library	DCFPAK3.02			_
Internal exposure dose library	DOE STD-1196-201	1 (Reference Pers	son)	-
Slope factor (risk) library	DCFPAK3.02 Morbie			•
Transfer factor library	RESRAD Default Tr	ransfer factors		-
Number of nuclide	days	-	than the cut-off 225 s or risk factors: 6	
Calculation Time points Number of points: 2048 Minimum time increment between	▼ points (year):	1/1	 ⊙ Linear spacing ○ Log spacing 	
Update progress of computation m Save input file when a form is sa Use line draw <u>character</u>		1. v S	econds	
	Close			

Title & Radiological Data				
<u>I</u> itle: RESRAD-OFFSITE Default	Parameters			
Location of dose, slope and transfe	r factor database:	C:\RESRAD_FAM	IILY\DCF\3.1	
Radionuclide transformations based		C ICRP 107	• ICRP 38	
ICRP 60 based external, inhalation,	and ingestion dose	conversion factors	•	
External exposure dose library	ICRP 60			T
Internal exposure dose library	ICRP 72 (Adult)			•
Slope factor (risk) library	FGR 13 Morbidity			•
Transfer factor library	RESRAD Default 1	ransfer factors		-
Number of nuclide	days 💽 💽 es in the database w uclides lacking dose	-	than the cut-off 209 s or risk factors: 8	
Calculation Time points <u>N</u> umber of points: 2048 <u>M</u> inimum time increment between	▼ points (year):	1/1	 Linear spacing Log spacing 	
Update progress of computation m		1. 💌	Seconds	
∨ Use line draw <u>c</u> haracter	Close			

12.22 TEST CASE 033-003 TESTER'S REPORT

Documented in Test-033-003_report.docx of 2/20/2020 6:49 AM

Test Case 033-003 report

By cheng wang 2/17/2020

Objective: To Test the functionality of Set Pathways navigation in the left panel of GUI. Conclusion: the code worked as expected.

Procedure:

1. Followed the procedure of the test case description.

- Visually check for Steps 2-6; worked as expected
- For Step 7), worked as expected



• For Step 11), worked as expected

SELPATH = 1,

• For Step 12), worked as expected

Summary of Pathway	Selections
Pathway	? User Selection
l external gamma	? active
2 inhalation (w/o radon)	? suppressed
3 plant ingestion	? suppressed
4 meat ingestion	? suppressed
5 milk ingestion	? suppressed
6 aquatic foods	? suppressed
7 drinking water	? suppressed
8 soil ingestion	? suppressed
9 radon	? suppressed
	?

• For Step 14), worked as expected

SELPATH = 257,

• For Step 15), worked as expected

Summary	of	Pathway	Selections
---------	----	---------	------------

Pathway	?	User Selection
l external gamma	+	active ?
2 inhalation (w/o radon)	?	suppressed
3 plant ingestion	?	suppressed
4 meat ingestion	2	suppressed
5 milk ingestion	2	suppressed
6 aquatic foods	2	suppressed
7 drinking water	2	suppressed
8 soil ingestion	2	suppressed
9 radon	2	active
	_	?

12.23 TEST CASE 033-004 TESTER'S REPORT

Documented in Test-033-004_report.docx of 2/20/2020 6:50 AM

Test Case 033-004 report

By Cheng Wang 2/17/2020

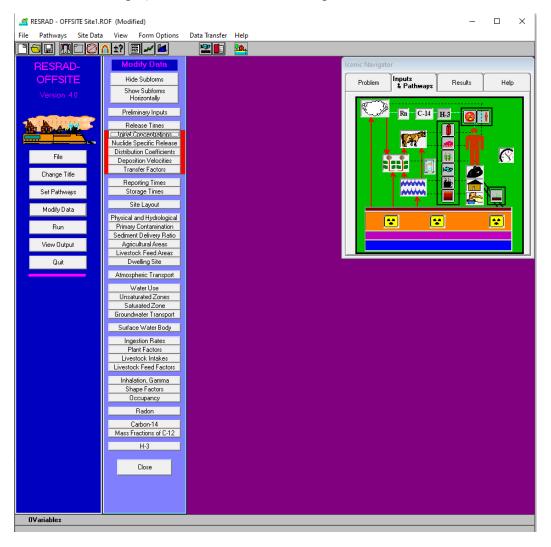
Objective: Test the functionality of Modify Data navigation in the left panel of GUI.

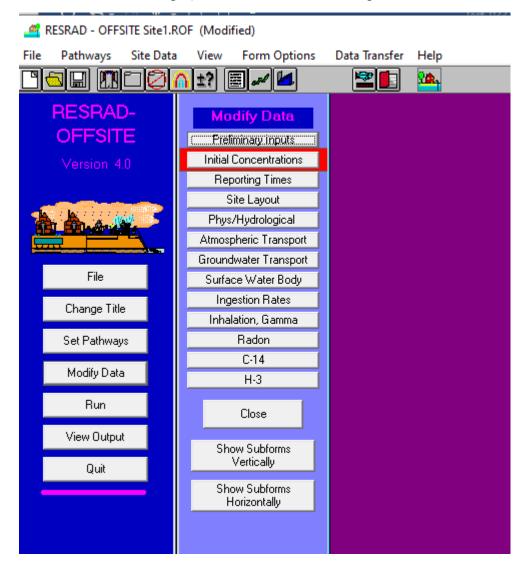
Conclusion: the code worked as expected.

Procedure:

1. Followed the procedure of test case description.

• Screenshot for Step 1) of test case. Worked as expected.

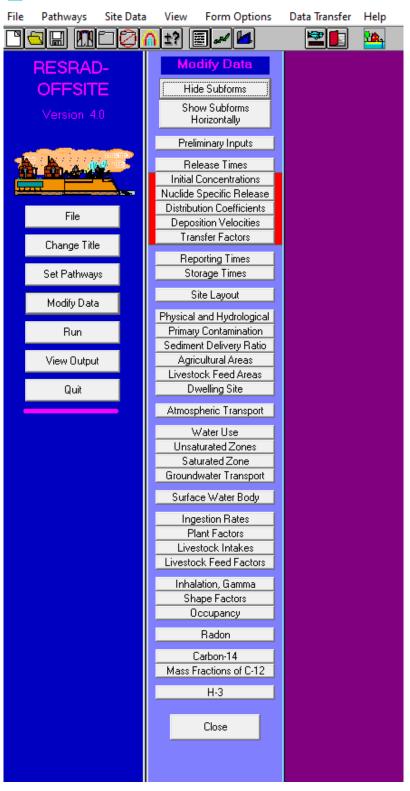




• Screenshot for Step 2) of test case. Worked as expected.

• Screenshot for Step 3). Worked as expected.

RESRAD - OFFSITE Site1.ROF (Modified)



• Screenshot for Step 4). Worked as expected.

<u></u> I	at RESRAD - OFFSITE Site1.ROF (Modified) -								
File	Pathways	Site Data	View	Form Options	Data Transfer	Help			
	RESRAD)-					Modify Data		
	OFFSIT	Е	Preli	minary Inputs					
	Version 4	n			Release Tir				
			Initial (Concentrations	Nuclide Specific	Release	Distribution Coefficients	Deposition Velocities	Transfer Factors
			Rep	orting Times	Storage Tin	nes			
	h	a 👘	S	ite Layout					
			Physical	and Hydrological	Primary Contarr	iination	Agricultural Areas	Livestock Feed Areas	Dwelling Site
					Sediment Delive	ry Ratio			
	File		Atmosp	oheric Transport					
	Change Title	•	W	Vater Use	Unsaturated 2	lones	Saturated Zone	Groundwater Transport	
	Set Pathway	s	Surfac	ce Water Body					
			Inge	estion Rates	Plant Fact	ors	Livestock Intakes	Livestock Feed Factors	
	Modify Data		Inhal	ation, Gamma	Shape Fact	ors	Occupancy		
	Run			Radon			Carbon-14		H-3
	View Outpu						Mass Fractions of C-12		
	view o utpu								C. Harris
	Quit			Hide Subf	forms		Close	Sr	now Subforms Vertically
						_			

• Screenshot for Step 5). Worked as expected

12.24 TEST CASE 033-005 TESTER'S REPORT

Documented in Test-033-005_report.docx of 2/20/2020 6:52 AM

Test Case 033-005 report

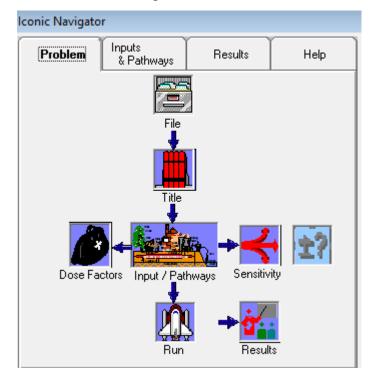
By Cheng Wagn 2/17/2020

Test Objective: To test the functionality of Iconic Navigator.

Results: the code worked as expected.

Procedure:

- 1) Launch the code.
- 2) Click Problem tab of Iconic Navigator.

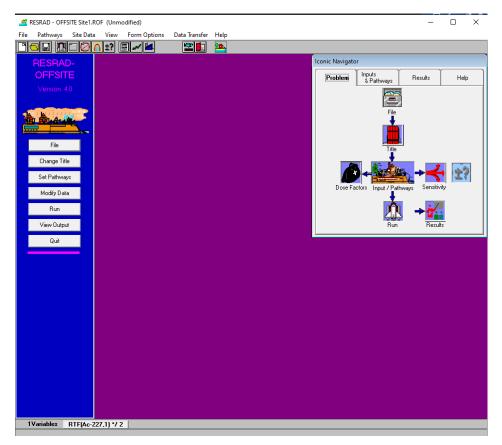


a. Clicking File icon should bring up the window for selection of input file. Select an input file, and the file should be loaded to the main interface.

janize 🔻 👘 New folde	er				III 🔻 🔟
WRF-Hydro_i 🖈 🔦	Name	Date modified	Туре	Size	
🔺 iCloud Drive 🖈	SATURATED FLUXIN KD 0.ROF	1/15/2020 4:38 PM	ROF File	27 KB	
032-001	Site1.ROF	1/23/2020 4:03 PM	ROF File	25 KB	
033-001	Site2.ROF	1/23/2020 4:26 PM	ROF File	26 KB	
033-003	Site3.ROF	1/23/2020 4:31 PM	ROF File	25 KB	
033-005	Site4.ROF	1/23/2020 4:32 PM	ROF File	25 KB	
	Site5.ROF	1/23/2020 4:33 PM	ROF File	25 KB	
• OneDrive	Site6.ROF	1/23/2020 4:33 PM	ROF File	25 KB	
This PC	Site7.ROF	1/23/2020 4:34 PM	ROF File	25 KB	
3D Objects	Site8.ROF	1/23/2020 4:36 PM	ROF File	25 KB	
-	Site9.ROF	1/23/2020 4:37 PM	ROF File	25 KB	
Desktop	Site10.ROF	1/23/2020 4:43 PM	ROF File	25 KB	
Documents	Site11.ROF	1/23/2020 9:53 PM	ROF File	25 KB	
Downloads	UNSATURATED FLUXIN KD 0.ROF	1/15/2020 4:34 PM	ROF File	27 KB	
Music	VROFF_CASE1.ROF	1/28/2020 11:20 AM	ROF File	26 KB	
Pictures	VROFF_Case3.ROF	1/28/2020 11:27 AM	ROF File	25 KB	
Videos	VROFF_Case4.ROF	12/18/2019 10:26 AM	ROF File	25 KB	
Local Disk (C:)					
New Volume (Dr					

Worked as expected.

b. Clicking Title icon should bring up the Title & Radiological Data form



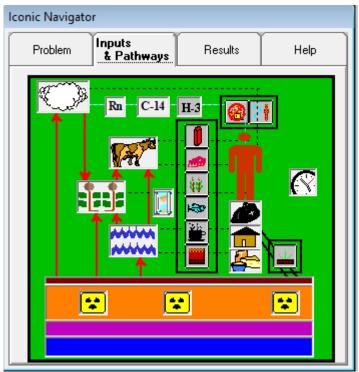
RESRAD - OFFSITE Site1.ROF (Unmodified)							
File Pathways Site Data View Form Options Data Transfer Help							
	<u>n 1</u> 🗐 🖌 🔟 🛛 🔛 🔛						
RESRAD-	Title & Radiological Data						
OFFSITE	Litle: RESRAD-OFFSITE Default Parameters						
Version 4.0							
	Location of dose, slope and transfe						
	Radionuclide transformations based	i on O ICRP 107 💿 ICRP 38					
	ICRP 60 based external, inhalation,	, and ingestion dose conversion factors					
	External exposure dose library	ICRP 60					
File	Internal exposure dose library ICRP 72 (Adult)						
Change Title	Slope factor (risk) library FGR 13 Morbidity						
Set Pathways	Transfer factor library RESRAD Default Transfer factors						
	Cut-off half life: 30 days						
Modify Data	,						
Run	Number of nuclides in the database with half life greater than the cut-off 209						
View Output	Number of nuclides lacking dose conversion factors or risk factors: 8						
Quit	Calculation Time points						
	Minimum time increment between points (year):						
	Update progress of computation message every: 1.						
	Save input file when a form is sa	aved					
	✓ Use line draw <u>c</u> haracter						
		Close					

Worked as expected.

c. Clicking Dose Factors should bring up the DCF Editor window.

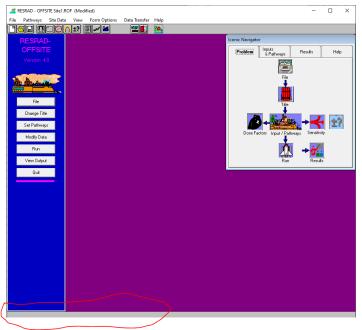
e Conversion Factor (DCF) Editor March 24, 2016 al Exposure dose factors	
March 24, 2016	
al Exposure dose factors	
tion and Ingestion dose factors	
for slope (risk factors)	
rbidity 🔽	
me of the ne w DCF library	
ription	
Create	
r	ription ▼

d. Clicking Input/Pathway should open the Inputs & Pathways tab of Iconic Navigator.



Worked as expected.

e. Clicking Sensitivity icon should turn on/off the Sensitivity Input Summary at the bottom left corner of the main interface.



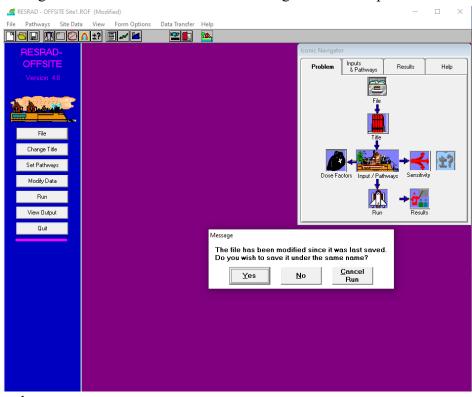
Comparison with the screenshot in Step 2). a shows the code worked as expected by turning off the sensitivity parameter information.

f. Clicking Uncertainty Analysis button should bring up the Uncertainty and Probabilistic Analysis form.

Sample specifications Parameter distributions Input rank regression Variable Description Statistics of uncertain or probabilistic parameter Kd of Ac-227 in Unsaturated zone Kd of Ac-227 in Unsaturated zone 1 Distribution TRUNCATED LOGNORMAL-N Imput rank regression Mean (Mu) of underlying normal 6.72 Standard deviation (Sigma) of underlying normal 6.72 Upper quantile .001 Upper quantile .999	Uncertainty and Probabilistic Analysis Step by step analysis	Related inputs	Post run regression			
Variable Description Statistics of uncertain or probabilistic parameter Kd of Ac-227 in Unsaturated zone Kd of Ac-227 in Unsaturated zone 1 Distribution TRUNCATED LOGNORMAL-N Image: Comparison of the second		· · · · ·				
Variable Description Kd of Ac-227 in Unsaturated zone Kd of Ac-227 in Unsaturated zone Mean (Mu) of underlying normal Standard deviation (Sigma) of underlying normal Upper quantile 001 Upper quantile 999	Sample specifications Para	μ	•	· · ·		
Standard deviation (Sigma) of underlying normal 3.22 Lower quantile 001 Upper quantile 999 Previous parameter • Next parameter • Update Parameter stats and distribution Restore parameter • Holp Restore Parameter stats	Kd of Ac-227 in Unsaturated zone	Kd of Ac-227 in U	nsaturated zone 1			
Lower quantile 001 Upper quantile 999 Previous parameter 999 Vertex parameter Update Parameter stats and distribution Restore parameter Holp		Mean (Mu) of underlying normal 6.72				
Upper quantile 999 Previous parameter Vupdate Parameter stats and distribution Remove parameter Velo Restore Parameter stats		Standard deviation (Sigma) of underlying normal 3.22				
Previous parameter Vertex Parameter stats and distribution Remove parameter		Lower quantile .001				
Next parameter Update Parameter stats and distribution			Upper quantile .999			
		Next parameter	Update Parame	Restore Parameter stats		

Worked as expected.

g. Clicking Run button should run the code using the loaded input file.



h. Clicking Results should open the Results tab of the Iconic Navigator.

Eont: MS LineDraw 🗸 7.4 🗸 🛛 🗃 📄 Page: 🚺 🗸	¥ 🛧			
RZSRAD-OFFSITZ, Version 4.0 T?Limit = 30 days Parent Dose Report Title : RZSRAD-OFFSITZ Default Parameters File : Sitel.ROF	02/18/2020	09:22	Page	1
Table of Contents				
Part I: Mixture Sums and Single Radionuclide Guidelines				
?				
Dose Conversion Factor (and Related) Parameter Summary	4			
Site-Specific Parameter Summary Summary of Pathway Selections	33			
Contaminated Zone and Total Dose Summary	34			
Total Dose Components	34			
Time = 0.0002+00	35			
Time = 1.0002+00	36			
Time = 3.0002+00	37			
Time = 6.0002+00	38			
Time = 1.2002+01	39			
Time = 3.000E+01	40			
Time = 7.500Z+01	41			
Time = 1.750E+02	42			
Time = 4.200E+02	43			
Time = 9.700E+02	44			
Dose/Source Ratios Summed Over All Pathways	45			
Single Radionuclide Soil Guidelines	45			
Dose Per Nuclide Summed Over All Pathways	46			
Soil Concentration Per Nuclide	46			
Run Time Information	47			

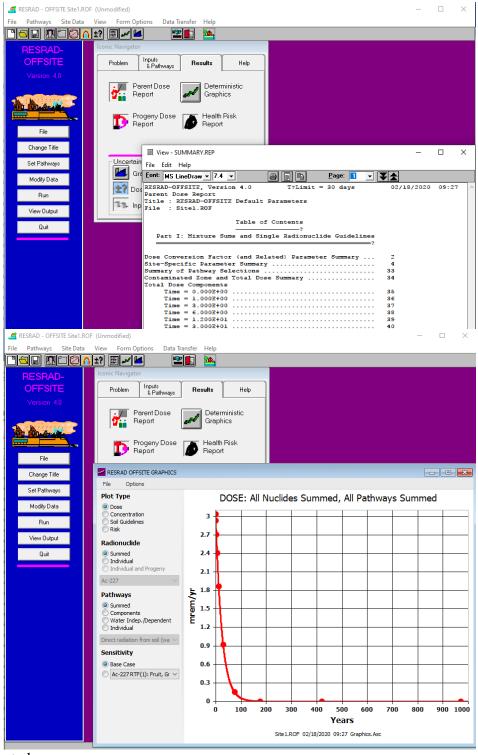
Worked as expected.

- 3) Clicking Input & Pathways Tab.
 - a. Clicking each icon should open one associated form. Then run the code.

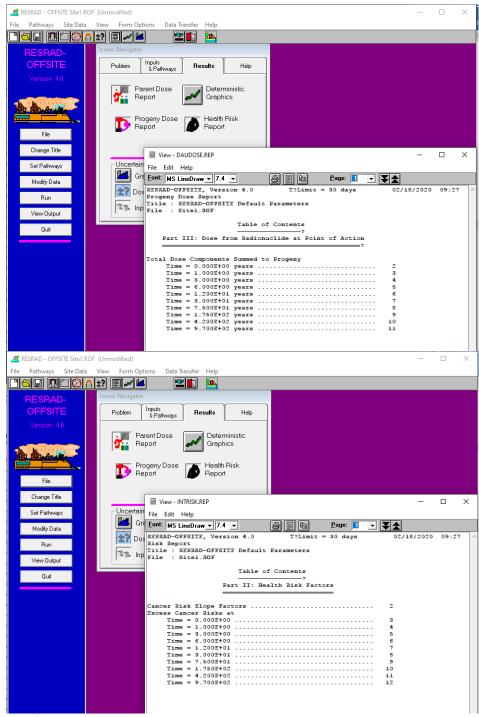
Worked as expected.

4) Click Results tab.

a. Clicking Parent Dose Report button should open Summary.rep file. Clicking Deterministic Graphics icon should open the graphics Wresplot.exe with loaded data.



b. Clicking Progeny Dose Report icon should open DAUDOSE.REP file, Clicking Health Risk Report icon should open INTRISK.REP file.



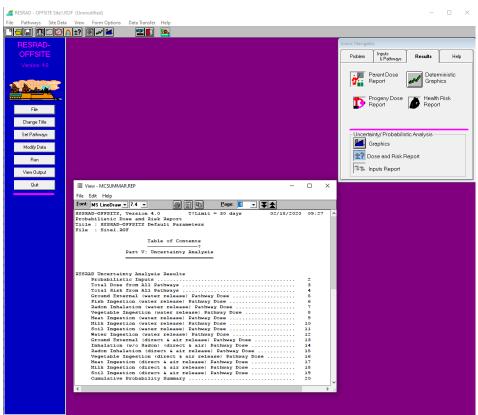
Worked as expected.

c. Run the code with uncertainty analysis.

d. Clicking Graphics under Uncertainty/Probabilistic Analysis frame should open forms Uncertainty and Probabilistic Analysis, Probabilistic/Uncertainty Outputs, and Probabilistic Temporal Plots.

a RESRAD - OFFSITE S	ite1.ROF (Unmodified) e Data View Form Options Data Transfer Helo	- o ×
RESRAD- OFFSITE Version 40	Probabilites' temporal Perts	Potebolikić / Uncertainty Outguds Pite dovces Prodem Potern Dose Potern Dose Potern Dose Poterninistic Probabilistic / Uncertainty Outguds Potern Dose Potern Dose Poterninistic
Diange Title Set Pathnays Modify Data Run View Output Quit	3/37 PM dokes Ø Bija peerde /4/ Repetition Ø Repetition Ø Repetition 2/27 - Ø Linear Linear Ø Linear C Logartinic Valit Ø Linear C Logartinic I 1/52 - Precamilie to Ø I	
		Plot Starge Plot for ten AP Planty Plot for t
		Uncertainty and Probabilistic Analysis Sample specifications Parameter distributions Input rank correlations Output specifications
		Step by step analysis Related inputs Post run regression
		Generate input samples (LHS) ····· View scatter plots of input View histogram of input View cdt of input
		Specify and generate related reputs Plots of Related and Probabilistic Inputs View coll of related View coll of related Plots of Probabilistic Disputs, Probabilistic Inputs and Related Input Plots of Probabilistic Disputs, Probabilistic Inputs and Related Input Plots of Probabilistic Disputs, Probabilistic Inputs, and Related Input
		Econocate output sampler (ICSTNUD-0) View coll of output View coll are piblic of output Vi input Vi output
		Generale output lings controlition and regretation confluents
		□ Sort alphabetically before run □ Suppress uncertainty analysis this session □K

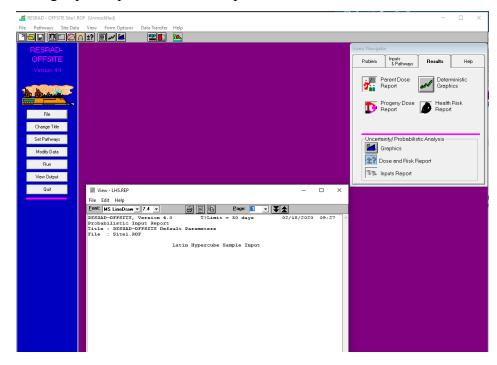
Worked as expected.



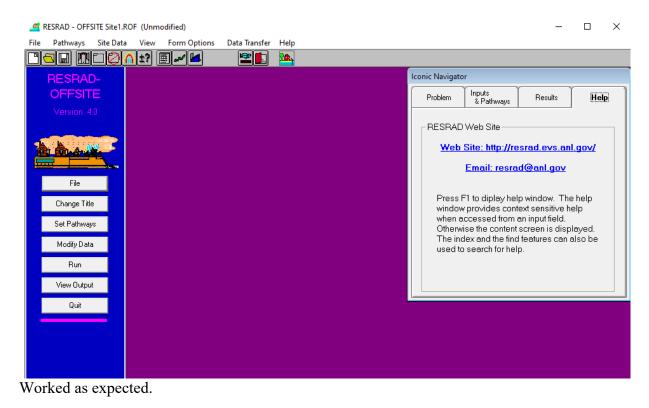
e. Clicking Dose and Risk Report icon should open MCSUMMAR.REP file.

Worked as expected.

f. Clicking Input Report icon should open LHS.REP file.



5) Clicking Help tab and the REARD program website and contact information should present under this tab, as well as the function of F1 key for help.



12.25 TEST CASE 034-001 TESTER'S REPORT

Documented in Test-034-001_report.docx of 2/20/2020 6:54 AM

Test Case 034-001 report

By Cheng Wang 2/18/2020

Test Objective: To test the functionality of Form Preliminary Inputs.

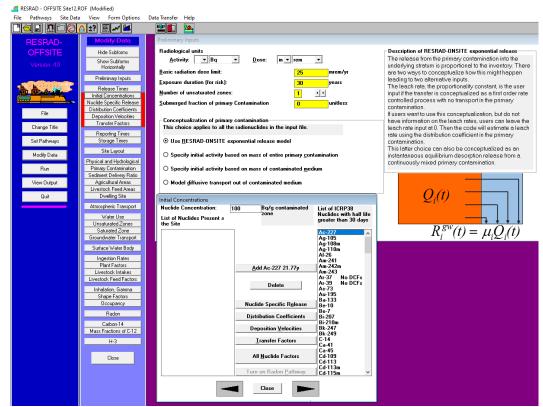
Test conclusion: the code worked as expected.

Procedure:

1) On the left panel, click Modify Data -> Preliminary Inputs. The form should pop up with Figure a as default setting, including the units and values in textboxes. The background of each textbox should be in yellow if the values are default values; otherwise, in white.

Preliminary Inputs	
Radiological units	Description of RESRAD-ONSITE exponential release
Activity: p Ci Dose: m rem Image: Ci Basic radiation dose limit: 25 mrem/yr Exposure duration (for risk): 30 years Number of unsaturated zones: 1 Image: Ci Submerged fraction of primary Contamination 0 unitless	The release from the primary contamination into the underlying stratum is proportional to the inventory. There are two ways to conceptualize how this might happen leading to two alternative inputs. The leach rate, the proportionality constant is the user input if the transfer is conceptualized as a first order rate controlled process with no transport in the primary contamination. If users want to use this conceptualization, but do not
Conceptualization of primary contamination This choice applies to all the radionuclides in the input file.	have information on the leach rates, users can leave the leach rate input at 0. Then the code will estimate a leach rate using the distribution coefficient in the primary contamination. This latter choice can also be conceptualized as an instantaneous equilibrium desorption release from a continuously mixed primary contamination.
 Use <u>R</u>ESRAD-ONSITE exponential release model Specify initial activity based on mass of entire primary <u>c</u>ontamination 	
\bigcirc Specify initial activity based on mass of contaminated <u>m</u> edium	
O Model diffusive transport out of contaminated medium Save Cancel	$Q_{i}(t)$ $R_{i}^{gw}(t) = \mu_{i}Q_{i}(t)$

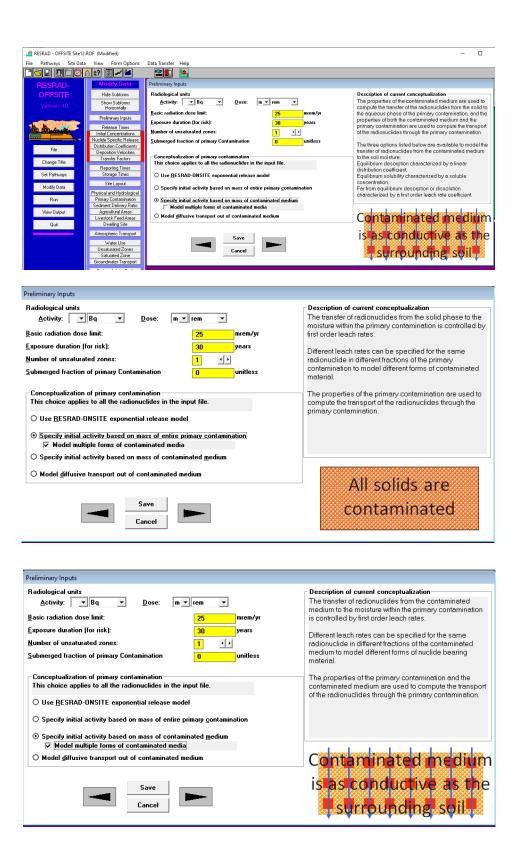
2) Change the unit to Bq. The unit in Forms Initial Concentrations and Transfer Factors should change accordingly.



Worked as expected.

3) Changing the selection of Conceptualization frame from top to bottom in order, the form should look like Figure a, b, c and d, respectively. Selection of "Model multiple forms of contaminated media" under settings of either Figure b or c will change the other's setting.

A RESRAD - OFFSITE Site12			- 0
File Pathways Site Data		Data Transfer Help	
RESRAD-	Modify Data	Preliminary Inputs	
OFFSITE Version 4.0	Hide Subforms Show Subforms Horizontally Preliminary Inputs Brelease Times	Radiological units <u>Activity:</u> <u>Bq</u> <u>Pose:</u> <u>m rem r</u> <u>Satis radiation does limit:</u> <u>25</u> merem/yr <u>Exposure duration (for risk)</u> <u>30</u> years	 Description of current conceptualization The properties of the primary contamination are used to compute the transfer of the radionuclides from the solid to the aqueous phase of the primary contamination, and the transport of the radionuclides through the primary contermination.
File Change Title	Initial Concentrations Nuclide Specific Release Distribution Coefficients Deposition Velocities Transfer Factors	Number of unsaturated zones: 1 > Submerged fraction of primary Contamination 0 unitless	The three options listed below are available to model the transfer of radionucidids from the contaminated medium to the soil moisture . Equilibrium desorption characterized by a linear distribution coefficient.
Set Pathways Modify Data Run	Reporting Times Storage Times Site Layout Physical and Hydrological Primary Contamination	Use BESRAD-ONSITE exponential release model Specify initial activity based on mass of entire primary contamination	Equilibrium solubility characterized by a soluble concentration. Far from equilibrium desorption or dissolution characterized by a first order leach rate coefficient.
View Output Quit	Sediment Delivery Ratio Agricultural Areas Livestock Feed Areas Dwelling Site	Specify initial activity based on mass of contaminated medium Model giffusive transport out of contaminated medium	All solids are
	Atmospheric Transport Water Use Unsaturated Zones Saturated Zone Groundwater Transport	Save Cancel	contaminated
	Surface Water Body		



🔏 RESRAD - OFFSITE Site12	.ROF (Modified)		- 0
File Pathways Site Data	View Form Options	Data Transfer Help	
RESRAD-	Modify Data	Preliminary Inputs	
OFFSITE Version 4.0	Hide Subforms Show Subforms Horizontally	Radiological units Activity: VBq V Dose: m Vrem V Basic radiation dose limit: 25 mrem/yr	Description of current conceptualization The transfer of radionuclides from the contaminated medium to the moisture within the contaminated medium is controlled by equilibrium desprotion characterized by
	Preliminary Inputs Release Times Initial Concentrations Nuclide Specific Release	Exposure duration (for risk): 30 years <u>Number of unsaturated zones:</u>	a linear distribution coefficient. The code models the diffusive transport out of the representative fragments of the contaminated medium.
File Change Title	Distribution Coefficients Deposition Velocities Transfer Factors Reporting Times	Submerged fraction of primary Contamination 0 unitless Conceptualization of primary contamination This choice applies to all the radionuclides in the input file.	and the advective dispersive transport over the primary contamination.
Set Pathways Modify Data	Storage Times Site Layout Physical and Hydrological	 Use <u>RESRAD-ONSITE</u> exponential release model Specify initial activity based on mass of entire primary <u>contamination</u> 	
Run	Primary Contamination Sediment Delivery Ratio	O Specify initial activity based on mass of contaminated medium	
View Output	Agricultural Areas Livestock Feed Areas	Model diffusive transport out of contaminated medium	No moisture flow
Quit	Dwelling Site Atmospheric Transport Water Use Unsaturated Zones Saturated Zone Groundwater Transport	Save Cancel	through contaminated

worked as expected.

4) The Number of Unsaturated Zones should be able to be changed between 0 and 5. Once this value is change, need to check Form Unsaturated Zones to check if the number of unsaturated zone changed in that form accordingly.

Preliminary Inputs							
Radiological units				Г	Description of cur	rrent conceptualization	
Activity: 💌 Bq 💌 👖	ose: m 🔻	rem 💌			The transfer of ra	dionuclides from the solid phase to the e primary contamination is controlled by	
<u>B</u> asic radiation dose limit: 25 mrem/yr					first order leach ra	ates.	
Exposure duration (for risk):	xposure duration (for risk):					tes can be specified for the same	
Number of unsaturated zones: 5					radionuclide in different fractions of the primary		
Submerged fraction of primary Contamir					contamination to model different forms of contaminated material		
					materiai.		
Conceptualization of primary contamination						the primary contamination are used to	
This choice applies to all the radionuclides in the input file.					compute the transport of the radionuclides through the primary contamination.		
O Use <u>R</u> ESRAD-ONSITE exponential	O Use <u>R</u> ESRAD-ONSITE exponential release model					auon.	
Specify initial activity based on ma	ee of entire	imaru contami	nation				
Specify initial activity based on ina Model multiple forms of contain		inary <u>c</u> ontain	nation				
O Specify initial activity based on ma	ss of contami	nated <u>m</u> edium					
O Model diffusive transport out of co	ntaminated me	aium			Δ.	ll solids are	
	ncel				co	ntaminated	
Unsaturated Zone Hydrology	-1						
Number of unsaturated zones: set in preliminary inputs form	5						
Unsaturated zone numbe		2:	3:	4:	5:		
Thickness (meters)	4	4	4	4	4		
Dry bulk density (grams/cm? Total porosity	1.5 .4	1.5 .4	1.5 .4	1.5 .4	1.5 .4		
Effective porosity	.4 .2	.4	.4	.4	.2		
Field capacity	.2	.3	.3	.2	.3		
Hydraulic conductivity (meters/year)	10	10	10	10	10		
b parameter	5.3	5.3	5.3	5.3	5.3		
Longitudinal dispersivity (meters)	.1	.1	.1	.1	.1		
-	-	Save Cancel					

Worked as expected.

5) Submerged fraction of Primary Contamination should be able to changed 0-1; however, once its value is larger than 0, the Number of Unsaturated Zone should update to 0 automatically.

Radiological units	Description of current conceptualization
Activity: 💌 Bq 💌 Dose: m 💌 rem 💌	The transfer of radionuclides from the solid phase to the
asic radiation dose limit: 25 mrem/yr	moisture within the primary contamination is controlled first order leach rates.
xposure duration (for risk):	
umber of unsaturated zones:	Different leach rates can be specified for the same radionuclide in different fractions of the primary
ubmerged fraction of primary Contamination	contamination to model different forms of contaminated material.
Conceptualization of primary contamination	The properties of the primary contamination are used to
This choice applies to all the radionuclides in the input file.	compute the transport of the radionuclides through the
O Use <u>R</u> ESRAD-ONSITE exponential release model	primary contamination.
⊙ Specify initial activity based on mass of entire primary <u>c</u> ontamination [♥ Model multiple forms of contaminated media	
O Specify initial activity based on mass of contaminated medium	
O Model diffusive transport out of contaminated medium	
	All solids are
	All solids are
Save	
	contaminated
Cancel	
Cancel	
Insaturated Zone Hydrology	
Insaturated Zone Hydrology	
Iumber of unsaturated zones: set in 0 Unsaturated zones: set in 0 Unsaturated zone number:	
Insaturated Zone Hydrology Iumber of unsaturated zones: set in 0 Unsaturated zone number: hickness (meters)	
Iumber of unsaturated zones: set in Umber of unsaturated zones: set in Unsaturated zone number: hickness (meters) by bulk density (grams/cm?	
Iumber of unsaturated zones: set in Unsaturated zone number: hickness (meters) by bulk density (grams/cm? iotal porosity	
Insaturated Zone Hydrology Iumber of unsaturated zones: set in Unsaturated zone number: hickness (meters) Iry bulk density (grams/cm? olal porosity (ffective porosity	
Insaturated Zone Hydrology Iumber of unsaturated zones: set in Unsaturated zone number: hickness (meters) hy buk density (grams/cm? 'otal porosity ffective porosity iedd capacity	
Insaturated Zone Hydrology Aumber of unsaturated zones: set in reliminary inputs form Unsaturated zone number: Chickness (meters) Dy bulk density (grams/cm? fotal porosity Effective porosity Effective porosity Hydraulic conductivity (meters/year)	
Insaturated Zone Hydrology Aumber of unsaturated zones: set in unsaturated zone number: hickness (meters) by bulk density (grams/cm? otal porosity iffective porosity ield capacity Updraulic conductivity (meters/year) parameter	
nsaturated Zone Hydrology Aumber of unsaturated zones: set in Unsaturated zone number: (hickness (meters) Dry bulk density (grams/cm? (otal porosity Effective porosity Field capacity Ugdraulic conductivity (meters/year) o parameter	
nsaturated Zone Hydrology Number of unsaturated zones: set in Unsaturated zone number: (hickness (meters) Dry bulk density (grams/cm? fotal porosity Effective porosity Effective porosity Field capacity Updraulic conductivity (meters/year) o parameter	
nsaturated Zone Hydrology Number of unsaturated zones: set in reliminary inputs form Unsaturated zone number: Fhickness (meters) Jy bulk density (grams/cm? Fotal porosity Field capacity Hydraulic conductivity (meters/year) o parameter .ongitudinal dispersivity (meters)	
Insaturated Zone Hydrology Aumber of unsaturated zones: set in Unsaturated zone number: hickness (meters) hy bulk density (grams/cm? 'otal porosity fiedice porosity fiedice porosity fiedice porosity ugdraulic conductivity (meters/year) parameter .ongitudinal dispersivity (meters)	

6) Change the values in textboxes and the units, save the input to Test13.rof, then check whether the input file is correctly written. The variables in this form include BRDL, ED, and NS. SUBMERGEDF, PCOPTION, and MULTIFORM.

Preliminary Inputs	
Radiological units Activity: ▼ Bq ▼ Dose: m ▼ rem ▼	Description of current conceptualization The transfer of radionuclides from the solid phase to the moisture within the primary contamination is controlled by
Basic radiation dose limit: 26 mrem/yr	first order leach rates.
Exposure duration (for risk): 31 years Number of unsaturated zones: 0 • Submerged fraction of primary Contamination .6 unitless	Different leach rates can be specified for the same radionuclide in different fractions of the primary contamination to model different forms of contaminated material.
Conceptualization of primary contamination This choice applies to all the radionuclides in the input file.	The properties of the primary contamination are used to compute the transport of the radionuclides through the primary contamination.
 Use <u>RESRAD-ONSITE</u> exponential release model Specify initial activity based on mass of entire primary <u>contamination</u> Model multiple forms of contaminated media 	
\bigcirc Specify initial activity based on mass of contaminated $\underline{m}edium$	
O Model <u>d</u> iffusive transport out of contaminated medium	All solids are
Cancel	contaminated

```
- .
BRDL = 26,
ED = 31,
NS = 0,
MULTIFORM = 1,
PCOPTION = 1,
SUBMERGEDF = .6,
```

12.26 TEST CASE 034-002 TESTER'S REPORT

Documented in Test-034-002_report.docx of 2/20/2020 6:55 AM

Test Case 034-002 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Form Release Times.

Conclusion: the code worked as expected.

Procedure:

1) On the left panel, clicking Modify Data -> Release Times should open a pop-up window with caption "Times at which Release Properties are Specified (years)".

Worked as expected.

Times at which Release Properties are Specif	d (years)	
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes	O Insert new 1st time and shift down existing times and associated release data Interview Interv	а
Sth time at which release changes Sth time at which release changes Tth time at which release changes 8th time at which release changes		
<u>9</u> th time at which release changes Number of times at which the release properties are specified	1 Add new 2nd time at which release changes	
Times are in ascending order	Close	

2) Clicking "Insert New 1sth time and shift down existing times and associated release data" 8 times. Every click should shift down the newly generated textbox by one row. The default of each generated textbox should be 0.

Times at which Release Properties are Specif	ed (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	Insert new 1st time and shift down existing times and associated release data Delete 1st time and associated release data and shift up existing data 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Sh time at which release changes Number of times at which the release properties are specified Times are in ascending order.	0Add new 9th time at which release changes

Worked as expected.

3) Click "Delete 1st time and associated release data and shift up exiting data" for 8 times, all the newly generated textboxes should be deleted.

<u>I</u> st time at which release begins 2nd time at which release changes	0	1st time and sh nd associated i	ift down existing release data	Delete 1st time and associated release da and shift up existing data
3rd time at which release changes				· · · · · · · · · · · · · · · · · · ·
th time at which release changes				
ith time at which release changes				
<u>ith time at which release changes</u>				
<u>7</u> th time at which release changes				
<u>3</u> th time at which release changes				
<u>I</u> th time at which release changes				
Number of times at which the release properties are specified	1	Add	i new 2nd time at	which release changes
Times are in ascending order.		Close		

Worked as expected.

4) Clicking "Add new 2th time at which release changes" should generate a textbox corresponding to 2th release time.

Continue from Step 3) screenshot.

Times at which Release Properties are Specifed (years)		
1st time at which release begins 0 2nd time at which release changes 0 3rd time at which release changes 0 4th time at which release changes 0 5th time at which release changes 0 6th time at which release changes 0 9th time at which release changes 0	Insert new 2nd time and shift down existing times and associated release data	Delete 2nd time and associated release data and shift up existing data
9th time at which release changes Number of times at which the release properties are specified	Add new 3rd time at wh	nich release changes
Times are in ascending order.		

Worked as expected.

5) Specifying a value to each box in an increasing order. Change the value if the top box to a negative value, an error message should pop-up. Similarly, changing the largest value to more than 100000 should also trigger an error message window.

Times at which Release Properties are Specif	fed (years)	
1st time at which release begins	-5	1
2nd time at which release changes	10	Insert new 2nd time and shift down existing Delete 2nd time and associated release data
	100	times and associated release data and shift up existing data
4th time at which release changes	1000	
5th time at which release changes	10000	-
<u>6</u> th time at which release changes 100000		-
7th time at which release changes		
8th time at which release changes		
9th time at which release changes		
Number of times at which the release properties are specified	6	Add new 7th time at which release changes
		Close
Times are in ascending order.	-	
Inhalation, I	Gamma	Message
Shape Fa		The succession of DELTINE(1) is less that the lawse
Occupa	ancy	The current value of RELTIME(1) is less than the lower bound of 0. The value can be reset to the lower
Rado	on	bound value, the default value, or reentered.
Carbon	-14	
Mass Fraction	ns of C-12	Lower Default Reenter
Times at which Release Properties are Specif	fed (years)	
1st time at which release begins	0	Insert new 1st time and shift down existing Delete 1st time and associated release data
2nd time at which release changes	10	times and associated release data and shift up existing data
<u>3</u> rd time at which release changes	100	
4th time at which release changes	1000	
5th time at which release changes	10000	-
<u>6</u> th time at which release changes	100000	-
7th time at which release changes	100001	-
8th time at which release changes		
9th time at which release changes		Add any Obb time at which release at any
Number of times at which the release properties are specified	7	Add new 8th time at which release changes
Times are in ascending order.	_	Close
Times are in ascending order.	-	
Inhalation,	Course 1	
Innaiation, Shape Fa		Message
Occupa		The current value of RELTIME(7) exceeds the upper
Rado		bound of 100000. The value can be reset to the upper
		bound value, the default value, or reentered.
Carbon		
Mass Fraction		Upper Default Reenter

6) Change the third textbox value to a value less than the one in the second box, a warning message should show in the bottom-left box. Clicking Close. An error message should pop-up pointing out this error.

Times at which Release Proper	rties are Specifed (years)		
1st time at which release by 2nd time at which release of 3rd time at which release of 4th time at which release of 5th time at which release of 6th time at which release of 2th time at which release of 9th time at which the 9th time at which the 9th time at which the 9th time at the specified 1st the specified the 9th time of times at which the 9th time of times at the specified the 9th times at the specified	hanges 10 hanges 9 hanges 10000 hanges 10000 hanges 100000 hanges hanges hanges hanges he release 6	Insert new 4th time and shift down existing times and associated release data Add new 7th time at the second sec	Delete 4th time and associated release data and shift up existing data which release changes
Times at which Release Prope <u>1</u> st time at which release b <u>2</u> nd time at which release c <u>3</u> rd time at which release c <u>4</u> th time at which release c <u>5</u> th time at which release c 6th time at which release c	egins 0 changes 10 changes 9 changes 1000 changes 1000	Insert new 4th time and shift down existing times and associated release data	g Delete 4th time and associated release data and shift up existing data
Zth time at which release c <u>8</u> th time at which release c <u>9</u> th time at which release c Number of times at which t properties are specified No time on the list can be previous time.	changes changes changes the release 6	Add new 7th time	at which release changes
	Inhalation, Gamma Shape Factors Occupancy Radon Carbon-14 Mass Fractions of C-12 H-3	The 2nd re	e times can not decrease down the list. lease time is larger than the 3rd release se the release times. <u>O</u> k

7) Make sure the input to this form is correct, close the form. Check Form Nuclide Specific Release. The release time in the form should change accordingly.

(
Times at which Release Properties are S	specifed (years)
1st time at which release begins	Insert new 1st time and shift down existing Delete 1st time and associated release data
2nd time at which release changes	10 times and associated release data and shift up existing data
<u>3</u> rd time at which release changes	100
4th time at which release changes	1000
5th time at which release changes	10000
<u>6</u> th time at which release changes	100000
<u>7</u> th time at which release changes	
8th time at which release changes	
9th time at which release changes	Add new 7th time at which release changes
Number of times at which the relea properties are specified	se 6
propercies are specified	
Times are in ascending order	
Radionuclide Specific Release	Element Ac
O Fi ⊙ E	sfer mechanism irst Order Rate Controlled Transfer quilibrium Desorption Transfer quilibrium Solubility Transfer
Time at	which release begins or changes (years) 0 10 100 1000 10000 Add Next Time
Cumulative fraction of rad	ionuclide bearing material that is releasable 1 1 1 1 1 1
Incremental fraction of ra	dionuclide bearing becomes releasable of the stepwise at time of the stepwise at time of the stepwise at time of the stepwise of of time of the stepwise of the s
Distribution o	coefficient in primary contamination (cm?g) 20
	adionuclide becomes available for release) In the same manner as for release to groundwater) Beginning at time zero
	Save Cancel

Worked as expected.

8) save the file to Test14.rof, and then check the values in the generated input file. The variable to check is RELTIME(1) - (9).

Worked as expected.

RELTIME (1) = 0, RELTIME (2) = 10, RELTIME (3) = 100, RELTIME (4) = 1000, RELTIME (5) = 10000, RELTIME (6) = 100000, RELTIME (7) = 0, RELTIME (8) = 0, RELTIME (9) = 0,

12.27 TEST CASE 034-003 TESTER'S REPORT

Documented in Test-034-003_report.docx of 2/18/2020 8:41 AM

Test Case 034-003 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Form Initial Concentrations.

Conclusion: The code worked as expected.

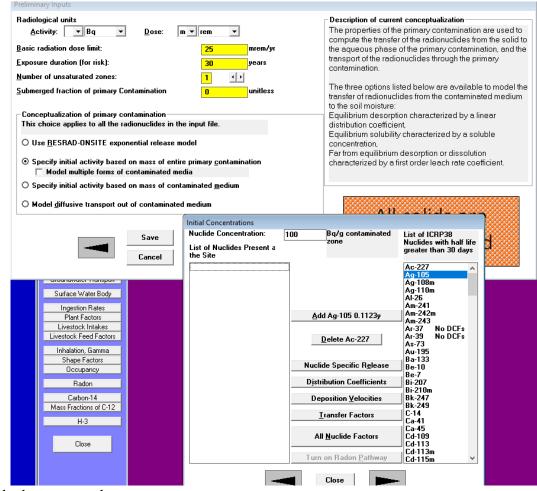
- Suggest modify Step 4) of test case description to "Frame "Transfer Mechanism" should be available after a radionuclide is selected."
- Suggest modify Step 8) of test case description: change "identical" to "equivalent"

Procedure:

1) Open the Initial Concentrations window and visually check the format, fonts, spelling, and default setting.

The form presents as expected.

2) Check the unit is correct according to Form Preliminary Inputs.



Worked as expected.

3) The upper right box should indicate the radionuclide database and cutoff half-life.

4) Frame "Transfer Mechanism" should be available.

Nuclide Concentration: List of Nuclides Presen the Site	100 Bq/g contaminated zone t a	List of ICRP38 Nuclides with half life greater than 30 days	
ihe Site åg−105 100	Transfer Mechanism	Ac-227 Ag-105 Ag-108m Ag-110m Al-26 Am-241 Am-242m Am-243 Ar-37 No DCFs Ar-39 No DCFs Ar-39 No DCFs As-73 Au-195 Ba-133 Be-10 Be-7 Bi-207 Bi-207 Bi-210m Bk-247 Bk-249	
	<u>I</u> ransfer Factors	C-14 Ca-41	
	All <u>N</u> uclide Factors	Ca-45 Cd-109 Cd-113	
	Turn on Radon <u>P</u> athway	Cd-113m Cd-115m	

Worked as expected after adding a radionuclide.

5) Select Ac-227, then click button "Add Ac-227 21.77y", Ac-227 should be added to the left panel with a concentration of 100 unit. Highlight it and then change the Nuclide Concentration value to 50. Its concentration should update to 50 in the left panel.

Initial Concentrations		
Nuclide Concentration:	100 Bq/g contaminated	List of ICRP38
List of Nuclides Present a the Site	zone	Nuclides with half life greater than 30 days
Ac-227 100	Transfer Mechanism	Ac-227
	• Equilibrium <u>D</u> esorption	Ag-105
	O Equilibrium <u>S</u> olubility	Ag-108m Ag-110m
	O First Order <u>Rate Controlled</u>	AI-26 Am-241
	<u>A</u> dd Ag-105 0.1123y	Am-242m Am-243
	Delete	Ar-37 No DCFs Ar-39 No DCFs As-73 Au-195
	Nuclide Specific R <u>e</u> lease	Ba-133 Be-10
	Distribution Coefficients	Be-7 Bi-207 Bi-210m
	Deposition <u>V</u> elocities	Bk-247 Bk-249
	<u>Transfer Factors</u>	C-14 Ca-41
	All <u>N</u> uclide Factors	Ca-45 Cd-109 Cd-113
	Turn on Radon Pathway	Cd-113m Cd-115m ¥
	Close	•
Initial Concentrations		
Nuclide Concentration:	50 Bq/g contaminated	List of ICRP38
List of Nuclides Present a the Site	zone	Nuclides with half life greater than 30 days
≜ c−227 50	Transfer Mechanism	Ac-227
	• Equilibrium <u>D</u> esorption	Ag-105
	O Equilibrium <u>S</u> olubility	Ag-108m Ag-110m
	O First Order <u>R</u> ate Controlled	Al-26 Am-241
	<u>A</u> dd Ag-105 0.1123y	Am-242m Am-243
	Delete Ac-227	Ar-37 No DCFs Ar-39 No DCFs As-73 Au-195
	Nuclide Specific R <u>e</u> lease	Ba-133 Be-10
	Distribution Coefficients	Be-7 Bi-207 Bi-210m
	Deposition <u>V</u> elocities	Bk-247 Bk-249
		C-14
	<u> </u>	- Ca-41
	<u>Transfer Factors</u> All <u>N</u> uclide Factors	Ca-45 Cd-109 Cd-113
		Ca-45 Cd-109

Worked as expected.

6) Clicking Delete "Ac-227" should remove it from the left panel.

Initial Concentrations						
Nuclide Concentration:	50 Bq/g contaminated	List of ICRP38 Nuclides with half life				
List of Nuclides Present a the Site	2010	greater than 30 days				
,		Ac-227 A Ag-105 Ag-108m Ag-110m Al-26 Am-241				
	<u>A</u> dd Ag-105 0.1123y	Am-242m				
	Delete Ac-227	Am-243 Ar-37 No DCFs Ar-39 No DCFs As-73 Au-195 Ba-133				
	Nuclide Specific R <u>e</u> lease	Be-10				
	Distribution Coefficients	Be-7 Bi-207 Bi-210m				
	Deposition <u>V</u> elocities	Bk-247 Bk-249				
	<u>T</u> ransfer Factors	C-14 Ca-41				
	All <u>N</u> uclide Factors	Ca-45 Cd-109 Cd-113				
	Turn on Radon <u>P</u> athway	Cd-113m Cd-115m V				
Close						

Worked as expected.

7) Select U-238 from right panel and add it. The radionuclides in the U-238 decay change with half-life larger than the cutoff halflife should be added to the left panel with U-2328 having a concentration of 50 units and all others zero concentration.

Initial Concentrat	ions				
Nuclide Concer List of Nuclides the Site		50 Bq/g contaminated zone	List of ICRP38 Nuclides with half life greater than 30 days		
Pb-210 Po-210 Ra-226 Th-230 U-234 U-238	0 0 0 0 0 50	 Transfer Mechanism € Equilibrium <u>D</u>esorption Capilibrium <u>S</u>olubility First Order <u>R</u>ate Controlled 	Te-123 Te-123m Te-125m Te-127m Te-129m Th-228		
0-238	50	<u>A</u> dd V-49 0.9035y	Th-229 Th-230		
		Delete	Th-232 Ti-44 TI-204 Tm-170		
		Nuclide Specific R <u>e</u> lease	Tm-171 U-232		
		Distribution Coefficients	U-233 U-234 U-235		
		Deposition <u>V</u> elocities	U-236 U-238		
		<u>T</u> ransfer Factors	V-49 ₩-181		
		All <u>N</u> uclide Factors	W-185 W-188 Xe-127 No DCFs		
		Turn on Radon <u>P</u> athway	Y-88 Y-91 ¥		
Close					

Worked as expected.

8) Close the form and save the project to Test15.rof. Check the variables NUCNAM and S. Their value should be identical to the input to the form.

```
NUCNAM = 'Pb-210+D', 'Po-210', 'Ra-226+D', 'Th-230', 'U-234',
'U-238', 'U-238+D', 'LAST',
S = 5*0, 2*1351.351,
```

Note that 1351.351 pCi is equivalent to 50 Bq. Change the concentration to 50 pCi and save the input file to Test165.rof.

```
NUCNAM = 'Pb-210+D', 'Po-210', 'Ra-226+D', 'Th-230', 'U-234',
'U-238', 'U-238+D', 'LAST',
S = 5*0, 2*50,
```

Worked expected. Suggest to modify the test case description.

12.28 TEST CASE 034-004 TESTER'S REPORT

Documented in Test_034-004_report.docx of 2/18/2020 9:05 AM

Test Case 034-004 Report

By Cheng Wang 2/18/2020

Objective: To the functionality of Form Nuclide Specific Release.

Conclusion: The code worked as expected.

Procedure:

1) Select U-238 in Form Initial Concentrations with all default setting, and set release time to 0, 10, 100, and 1000 in Release Time form.

Times at which Release Properties are Specife	d (years)		
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 5th time at which release changes 7th time at which release changes 8th time at which release changes	0 10 100 1000	Insert new 4th time and shift down existing times and associated release data	Delete 4th time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	4	Add new 5th time at wh	ich release changes
No time on the list can be less than the previous time.	-	Close	

2) Open the Form "Nuclide Specific Release". Initial Concentrations Form should also be opened automatically if not opened at the time. Visually check the format, fonts, spelling, and default setting.

Radionuclide Specific Release					
Radionuclide Pb-210	Element Pb				
Release to ground water	Transfer mechanism O First Order Rate Controlled Transfer O Equilibrium Desorption Transfer O Equilibrium Solubility Transfer				
Т	ime at which release begins or changes (years)	10	100	1000	Add Next Time
Cumulative fraction	of radionuclide bearing material that is releasable 1	1	1	1	
Incremental fractio	linearly over time○ n of radionuclide bearing becomes releasable stepwise at time ④	0	0 ⊙	0 0	
Distrib	ution coefficient in primary contamination (cm?g) 100				
Release from surface layer	Radionuclide becomes available for release In the same manner as for release to groundwater Beginning at time zero Save Cancel				

Radionuclide Specific Release					
Radionuclide U-238	Element U				
Release to ground water	Transfer mechanism First Order Rate Controlled Transfer Equilibrium Desorption Transfer Equilibrium Solubility Transfer				
Ti	ime at which release begins or changes (years)	10	100	1000	Add Next Time
Cumulative fraction	of radionuclide bearing material that is releasable 1	1	1	1	
Incremental fraction	linearly over time⊙ n of radionuclide bearing becomes releasable stepwise at time ⊙	0 ⊙	0 ⊙	0 ⊙	
Distribu	ution coefficient in primary contamination (cm?g) 50				
Release from surface layer	Radionuclide becomes available for release ⊙ In the same manner as for release to groundwate ○ Beginning at time zero	r			
	Save Cancel				

Worked as expected.

3) Check Radionuclide can be selected for each one in U-238 decay chain.

Worked as expected, as shown in the screenshots in Step 2).

4) A button called "Add Next Time" should be available next the last release time. Clicking it should close the Nuclide Specific Release form and open Release Times form. In the Release Time form, add the 5th release starting time, 5000 yr and close the form.

Worked as expected.

Times at which Release Properties are Specif	:d (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	0 10 100 1000 5000 Insert new 5th time and shift down existing times and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	5 <u>A</u> dd new 6th time at which release changes
Times are in ascending order.	Close

5) Clicking a specific release time in the Nuclide Specific Release form should result in closing the form and open the Release Time form with the specified release time highlighted for modification.

Clicking the second release time "10" in the form generated the following screenshot.

Times at which Release Properties are Specif	ed (years)				
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	0 10 100 5000		d time and shift down exis I associated release data	sting	Delete 2nd time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified Times are in ascending order.	5	C	Add new 6th tin	ne at v	which release changes
	-				

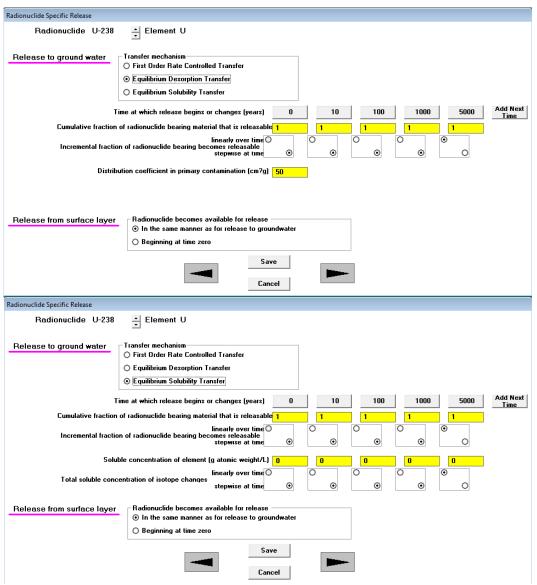
Worked as expected.

6) Open the Form "Nuclide Specific Release" again, the newly added release starting time of 5000 should be added into the release time row.

Radionuclide Specific Release					
Radionuclide U-238	Element U				
Release to ground water	Transfer mechanism O First Order Rate Controlled Transfer © Equilibrium Desorption Transfer				
	C Equilibrium Solubility Transfer				
Ti	ne at which release begins or changes (years)	0 10	100 1000	5000	Add Next Time
Cumulative fraction	of radionuclide bearing material that is releasable 1	1	1 1	1	
Incremental fraction	linearly over time of radionuclide bearing becomes releasable step w ise at time		o ⊙ ⊙	© ○	
Distribu	tion coefficient in primary contamination (cm?g) 50				
Release from surface layer	■Radionuclide becomes available for release ③ In the same manner as for release to groundwat ○ Beginning at time zero	ler			
	Save Cancel				
Worked as expected.					

7) Changing the options in Transfer Mechanism frame should change the interface. Figures a-c show the interfaces corresponding to First order release, Equilibrium Desorption, and Equilibrium Solubility release, respectively.

Radionuclide Specific Release							
Radionuclide U-238	Element U						
	Transfer mechanism 9 First Order Rate Controlled Transfer) Equilibrium Desorption Transfer) Equilibrium Solubility Transfer						
Time	e at which release begins or changes (years)	0	10	100	1000	5000	Add Next Time
Cumulative fraction of	radionuclide bearing material that is releasable	1	1	1	1	1	
Incremental fraction	linearly over time⊙ of radionuclide bearing becomes releasable stepwise at time	٥	0	•	0	⊙ ○	
Lead	Leach rate (1/year) linearly over time stepwise at time stepwise at time		0 0 0	0) ⊙	0 0 0	<mark>0</mark> ⊙	
Release from surface layer	Radionuclide becomes available for release						
	In the same manner as for release to grou	ndwater					
	O Beginning at time zero						



Worked as expected.

8) Change one value or option for each radionuclide, close the form, and save the file to Test15.rof.

Changed Transfer mechanism to the following:

Pb-210: First order rate controlled transfer

Po-210: Equilibrium desorption

Ra-226: Equilibrium solubility

Th-230: First order rate controlled transfer

U-234: Equilibrium desorption

U-238: Equilibrium solubility

Changed the Cumulative fraction of radionuclide bearing material that is releasable to the following values.

Pb-210: 0.1

Po-210: 0.2

- Ra-226: 0.3
- Th-230: 0.4

U-234: 0.5

U-238: 0.6

9) Check the values in the generated input file match the inputs in the interface. The variables include RELTIME, RLEACH, SOLUB, RELFRAC, RELTIMEOPT, RELOPT, RELOPT.

```
\text{RELTIME}(1) = 0,
RELTIME(2) = 10,
RELTIME (3) = 100,
RELTIME(4) = 1000,
RELTIME(5) = 5000,
RELTIME(6) = 0,
RELTIME(7) = 0,
RELTIME(8) = 0,
RELTIME(9) = 0,
RLEACH = 63*0,
SOLUB = 63*0,
RELFRAC = .1, 8*1, .2, 8*1, .3, 8*1, .4, 8*1, .5, 8*1, .6, 8*1,
 .6, 8*1,
RELTIMEOPT = 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0,
 4*1, 5*0, 4*1, 5*0,
RELTIMEOPTP = 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0,
 4*1, 5*0, 4*1, 5*0,
RELOPT = 0, 1, 2, 0, 3*2,
RELAIRTIMEOPT = 7*0,
```

12.29 TEST CASE 034-005 TESTER'S REPORT

Documented in Test-034-005_report.docx of 2/20/2020 7:27 AM

Test Case 034-005 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Distribution Coefficients form.

Conclusion: the code worked as expected.

The following minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Distribution Coefficients			
Radionuclide Pb-	210		
Location Contaminated medium: Contaminated zone:	Distribution coefficient (cm gi 109 100		Distribution coefficient (cm?g) 100 100
Unsaturated zone <u>1</u> :	100	Fruit, grain, nonleafy fields Leafy vegetable fields Pasture, silage growing areas Livestock feed grain fields	100 100 100 100
S <u>a</u> turated zone: Number of unsaturated z in preliminary inputs form		Dwelling site Save Cancel	100

Procedure:

1) With U-238 selected with default settings. Open Distribution Coefficients form and visually check the format, fonts, spelling, and default setting.

Initial Concentrations				
	100	Ci/g contaminated	List of ICRP38	
List of Nuclides Present a		zone	Nuclides with half life	
the Site			greater than 30 days	
Pb-210 0]		Th-228	
Po-210 0 Ra-226 0			Th-229 Th-230	
Th-230 0			Th-232	
U-234 0 U-238 100			Ti-44 TI-204	
	Add	l V-49 0.9035y	Tm-170 Tm-171	
			U-232	
	<u>D</u>	elete U-238	U-233 U-234	
			U-235	
	Nuclide	Specific R <u>e</u> lease	U-236 U-238	
	Distrib	ution Coefficients	V-49 W-181	
	Discip	ution coefficients	W-185	
	Depo	sition <u>V</u> elocities	W-188 Xe-127 No DCFs	
	<u> </u>	ansfer Factors	Y-88	
			Y-91 Yb-169	
	All <u>N</u>	Luclide Factors	Zn-65 Zr-88	
			Zr-93	
	lurno	n Radon <u>P</u> athway	Zr-95 ¥	
Distribution Coefficients				
Radionuclide U-238	- .			
	Distribution			Distribution
Location coe	fficient (cm?	Location		coefficient
Contaminated medium:	g) 50			(cm?g)
Contaminated zone:	50	· ·	t in surface water body	50
-	00	Bottom sediment in :	surface water body	50
Unsaturated zone <u>1</u> :	50	Frui <u>t, g</u> rain, nonleaf	y fields	50
		Leafy vegetable fiel	ds	50
		Past <u>u</u> re, silage grow	ing areas	50
		Livestock feed grain	n fields	50
Saturated zone:	50	Dwelling site		50
Number of unsaturated zones	:			
in preliminary inputs form	1			
		Save		
		Cancel		

Worked as expected.

The form should be available for inputs as shown in the Figure in Expected Results.
 Worked as expected, as shown in the screenshot of Step 2)

3) When either of the first or second options in Conceptualization of Primary Contamination in Preliminary form is selected, the distribution coefficient input box for Contaminated Medium will be gray out.

Preliminary Inputs			
Radiological units Activity: p V Ci V	Dose: m v rem v		on of current conceptu erties of the primary o
,			the transfer of the rad
Basic radiation dose limit:	25 mrem/yr		ous phase of the prim of the radionuclides t
Exposure duration (for risk):	30 years	contamin	
<u>Number of unsaturated zones:</u>		The three	options listed below
Submerged fraction of primary Contan		transfer o to the soil	f radionuclides from t I moisture:
Conceptualization of primary contan This choice applies to all the radion		distributio	m desorption charac on coefficient, m solubility characte
O Use <u>R</u> ESRAD-ONSITE exponenti	al release model	concentra	
 Specify initial activity based on r Model multiple forms of contact 			ized by a first order le
O Specify initial activity based on r	ass of contaminated <u>m</u> edium		
O Model <u>d</u> iffusive transport out of c	ontaminated medium		All soli
			Mi SUII
	Save		contam
	ancel		contan
Distribution Coefficients			
Radionuclide U-238			
Distributi Location coefficient (c	m? Location	Distribution coefficient (cm?q)	
Contaminated medium: 50	g) Suspended sediment in surface water body	(cm/y) 50	
<u>C</u> ontaminated zone: 50	Bottom sediment in surface water body	50	
Unsaturated zone <u>1</u> : <u>50</u>			
	 Fruit, grain, nonleafy fields Leafy vegetable fields 	50 50	
	Pasture, silage growing areas	50	
	Livestock feed grain fields	50	
S <u>a</u> turated zone: 50	Dwelling site	50	
Number of unsaturated zones: sel	1		
in preliminary inputs form	Save		
	Cancel		

worked as expected.

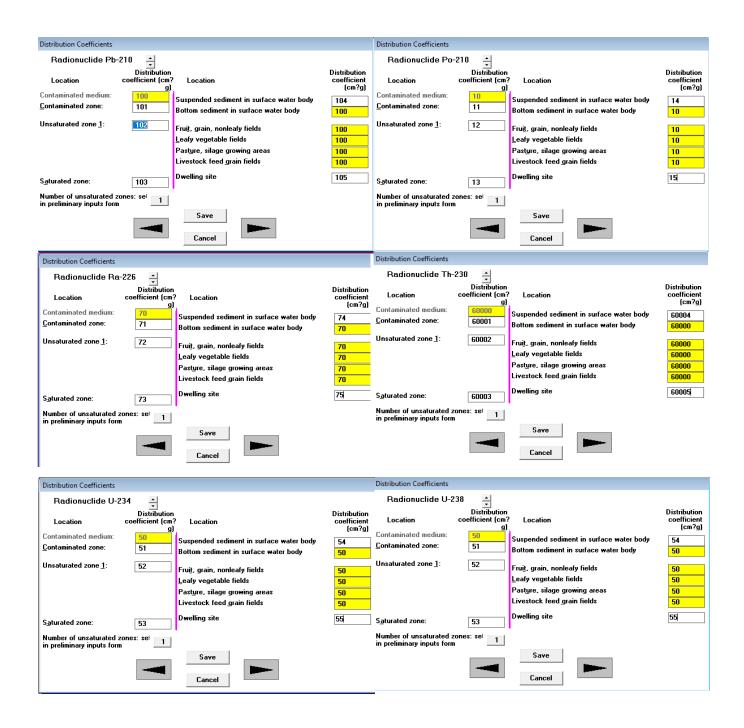
4) Clicking the value of Number of Unsaturated Zone should open the Preliminary Inputs form

Preliminary Inputs	
Radiological units	Description of RI
Activity: p ▼ Ci ▼ Dose: m ▼ rem ▼	The release fron
	underlying stratu
Basic radiation dose limit: 25 mrem/yr	are two ways to (leading to two al
Exposure duration (for risk): 30 years	The leach rate, t
Number of unsaturated zones:	input if the transfe
Submerged fraction of primary Contamination 0 unitless	controlled proce
	contamination. If users want to u
Conceptualization of primary contamination	have information
This choice applies to all the radionuclides in the input file.	leach rate input a
⊙ Use RESRAD-ONSITE exponential release model	rate using the dis contamination.
	This latter choice
O Specify initial activity based on mass of entire primary contamination	instantaneous ec
O Cassify initial activity based on many of contrained and in-	continuously mix
O Specify initial activity based on mass of contaminated <u>medium</u>	
O Model diffusive transport out of contaminated medium	
	(
	2
Save	
Cancel	
Distribution Coefficients	
Radionuclide U-238	
Distribution Location coefficient (cm? Location	Distribution coefficient
g)	(cm?g)
Contaminated medium: 50 Suspended sediment in surface water bo	dy 50
<u>C</u> ontaminated zone: <u>50</u> Bottom sediment in surface water body	50
Unsaturated zone 1: 50 Function and the Galactic Galactic	
Fruit, grain, nonleaty fields	50
Leafy vegetable fields	50
Past <u>u</u> re, silage growing areas Livestock feed grain fields	50
LIYESLUCK IEEU YIAIN NEIOS	50
Saturated zone: 50 Dwelling site	<mark>50</mark>
Number of unsaturated zones: sel	
Save	
Save	
Save Cancel	

worked as expected.

5) Change at least one value for each radionuclide, and save the project to Test17.rof.

Made the changes as shown in the screenshot.



6) Check the following variables in the generated input file and their value should match the input, DCACTC, DCACTCM, DCACTDWE, DCACTSWB, DCACTSWS, DCACTU1, DCACTS, DCACTV1, DCACTV2, DCACTL1, DCACTL2.

```
DCACTC = 101, 11, 71, 60001, 3*51,
DCACTCM = 100, 10, 70, 60000, 3*50,
DCACTDWE = 105, 15, 75, 60005, 3*55,
DCACTSWB = 100, 10, 70, 60000, 3*50,
DCACTSWS = 104, 14, 74, 60004, 3*54,
DCACTU1 = 102, 12, 72, 60002, 3*52,
DCACTU1 = 103, 13, 73, 60003, 3*53,
DCACTV1 = 100, 10, 70, 60000, 3*50,
DCACTV2 = 100, 10, 70, 60000, 3*50,
DCACTL1 = 100, 10, 70, 60000, 3*50,
DCACTL2 = 100, 10, 70, 60000, 3*50,
```

12.30 TEST CASE 034-006 TESTER'S REPORT

Documented in Test-034-006_report.docx of 2/18/2020 11:50 AM

Test Case 034-006 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Deposition Velocities form

Conclusion: the code worked as expected.

Procedure:

1) Select U-238 with default settings. Open Deposition Velocity form and visually check the format, fonts, spelling, and default setting.

Deposition Velocities					
Radionuclide Pb-210 📑 Element Pb Atmospheric transport					
Deposition velocity of respirable particulates0.001m/sDeposition velocity of all particulates0.001m/s					
Save					
Cancel					

Worked as expected.

2) Change at least one value for each radionuclide in the U-238 decay chain. Save the form and the project to Test18.rof.

Made the following changes:

Deposition velocity of respirable particulates for Pb-210, Po-210, Ra-226 were changed to 0.002, 0.003, 0.004, respectively.

Deposition velocity of all particulates for Th-230, U-234, U-238 were changed to 0.005, 0.007, and 0.007, respectively.

3) Check the variables DEPVEL, and DEPVELT in the generated file; they should match the input values in the interface.

DEPVEL = .002, .003, .004, 4*.001, DEPVELT = 3*.001, .005, 3*.007,

12.31 TEST CASE 034-007 TESTER'S REPORT

Documented in Test-034-007_report.docx of 2/18/2020 12:13 PM

Test Case 034-007 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Transfer Factors form.

Conclusion: the code worked as expected.

Procedure:

1) Select U-238 with all default settings. Open Transfer Factors form, and visually check the format, fonts, spelling, and default setting.

dify Data	_	Transfer Factors	
e Subforms		Radionuclide: Pb-210 🔹	Element Pb
w Subforms orizontally		Soil to plant transfer factor	
		Frui <u>t,</u> grain, nonleafy vegetables	<mark>0.01 (</mark> pCi/kg)/(pCi/kg)
minary Inputs		Leafy vegetables:	0.01 (pCi/kg)/(pCi/kg)
Initial Concentrations		Pasture, silage:	<mark>0.01 (</mark> pCi/kg)/(pCi/kg)
Nuclide Concentration:	0 pCi/g contamii zone	Livestock feed grain:	<mark>0.01 (</mark> pCi/kg)/(pCi/kg)
List of Nuclides Present a the Site		Intake to animal product tra	nsfer factor
Pb-210 0		M <u>e</u> at:	0.0008 (pCi/kg)/(pCi/d)
Po-210 0		M <u>i</u> lk:	0.0003 (pCi/L)/(pCi/d)
Ra-226 0 Th-230 0 U-234 0		Water to aquatic food transf	fer factor
U-238 100		Fish:	300 (pCi/kg)/(pCi/L)
	<u>A</u> dd V-49 0.9035j	Crustacea:	100 (pCi/kg)/(pCi/L)
	Delete	-	Save
	Nuclide Specific R <u>e</u> le		Cancel
	Distribution Coefficie		
	Deposition <u>V</u> elocitie	TI-204	
	<u>T</u> ransfer Factors	U-232 U-233	
	All <u>N</u> uclide Factor	s U-234 U-235 U-236	
	Turn on Radon <u>P</u> ath	way V-49 V	
-	Close		

Worked as expected.

2) Change at least one value for each radionuclide, and save the form.

Made the following changes:

	Pb-210	Po-210	Ra-226	Th-230	U-234	U-238
Fruit, grain	0.01	.001	.05	.001	.0025	.0025
Leafy	.02	.002	.04	.002	.0026	.0026
Pasture	.02	.003	.04	.003	.0027	.0027
Livestock	.02	.004	.04	.004	.0028	.0028
Meal	.0009	.005	.001	.0001	.00035	.00035
milk	0004	.00035	.001	.000005	.0007	.0007
Fish	301	101	51	.100	11	11
Crustacea	101	20001	250	501	61	61

3) Save the project to Test19.rof. Check the following variables' values; they should match the input. RTF, I_M, BIOFAC.

```
RTF = .01, .001, .05, .001, 3*.0025, .02, .002, .04, .002, 3*.0026,
.02, .003, .04, .003, 3*.0027, .02, .004, .04, .004, 3*.0028,
I_M = .0009, .005, .001, .0001, 3*.00035, .0004, .00035, .001,
.000005, 3*.0007,
BIOFAC = 301, 101, 51, 100, 3*11, 101, 20001, 250, 501, 3*61,
```

12.32 TEST CASE 034-008 TESTER'S REPORT

Documented in Test-034-008_report.docx of 2/18/2020 12:24 PM

Test Case 034-008 report

By cheng wang 2/18/2020

Objective: To test the functionality of Reporting Times form Conclusion: The code worked as expected.

Procedure:

Click Modify Data -> Reporting Times. Visually check the format, fonts, and spelling.
 Worked as expected.

2) It should have contents as shown in the figure, allowing up to 9 input times.

Reporti	ng Times				
Time	s at which outp	ut is reported (y	ears):		
Ø	000	886	00		
1	10	100	1000	10000	10000
	Add		R <u>e</u> move	1) 2) <u>3</u>)	1 3 6
		<u>S</u> torage Time	s	<u>4</u>)	12
		-	1	<u>5)</u>	30
		Save		<u>6)</u>	75
				<u>Z</u>)	175
		Cancel		<u>8)</u>	420
				<u>9</u>)	970

3) Check the lower and upper bounds. Each value should be (0, 100000]

Reporting Times					
Times at which output is re	eported (years):				
0 000 0	000	8			
1 10	100	1000	10000	100000	
	age Times Save	Remove	1) -1 2) 3 3) 6 4) 12 5) 30 6) 75 7) 175 8) 420		
			<u>9)</u> 970		
ractors ck Intakes Feed Factors on, Gamma a Factors upancy adon	of 0.		an be reset	to the lov entered.	he lower bound wer bound R <u>e</u> enter

When a number larger than 100000 was input, it is changed to 100000 automatically.

Worked as expected.

4) Check Add and Remove buttons

Reporting Times						
Times at which outpu	it is reported (years):	:		_		
0000	8					
1 10	100	1000	10000 10	0000		
Add		R <u>e</u> move	1) 1 2) 3			
	<u>S</u> torage Times		<u>3)</u> <u>4)</u> 12			
	Save		<u>5)</u> 30			
	Cancel	ng Times				
		s at which outpu	ut is reported (years):		
	Ø	000	88			
	1	10	100	1000	10000	100000
		Add		R <u>e</u> move	1) 1 2) 3 3) 6	
			<u>S</u> torage Times		<u>4</u>) 12	
			Save		<u>5</u>) 30 <u>6</u>) 0	
	1		Cancel			

Worked as expected.

Reporting Times					
Times at which output	ut is reported (years):				
0 000	8				*
1 10	100	1000	10000	10000	D
Add	Save Cancel	R <u>e</u> move	1) 2) 3) 4) 5)	1 3 6 12 30	
: Factors ck Intakes Feed Factors on, Gamma = Factors upancy adon bon-14 tions of C-12 H-3	Storage Times Surface water: Well water: Fruits, grain & no Leafy vegetables Pasture and silag Livestock feed g Meat: Mjlk: Fish: Crustacea and m	e rain:	e	1 1 14 1 1 45 20 1 7 7 7	days days days days days days days days

5) Clicking "Storage times" button should bring the form up.

Worked as expected.a

6) Save the form and the project to Test20.rof.

Check the variable T(1)-(10) in the file; they should be identical to the input in GUI.
 Worked as expected.

T(1)	=	0,
T(2)	=	1,
T(3)	=	з,
T(4)	=	6,
T(5)	=	12,
T(6)	=	30,
T(7)	=	ο,
T(8)	=	ο,
T (9)	=	ο,
T(10)) =	= 0,

12.33 TEST CASE 034-009 TESTER'S REPORT

Documented in Test-034-009_report.docx of 2/18/2020 12:31 PM

Test Case 034-009 report

By cheng wang 2/18/2020

Objective: To test the functionality of Storage Times form.

Conclusion: The code worked as expected

Procedure:

Click Modify Data -> Storage Times. Visually check the format, fonts, and spelling.
 Worked as expected.

Storage Times		
Surf <u>a</u> ce water:	1	days
W <u>e</u> ll water:	1	days
Fruits, grain & nonleafy vegetables:	14	days
Leafy vegetables:	1	days
Pasture and silage	1	days
Livestock feed grain:	45	days
<u>M</u> eat:	20	days
Mjlk:	1	days
<u>F</u> ish:	7	days
<u>C</u> rustacea and mollusks:	7	days
Save Cancel		

2) Check the lower and upper bounds for each input box value. It should be no less than 0.

	Storage Times							
Stora	Surf <u>a</u> ce water:	1	days					
Surf	W <u>e</u> ll water: Frui <u>t</u> s, grain & nonleafy vegetables:	1	days days					
₩ <u>e</u> i	Leafy vegetables:	1	days					
Fruit	T date and anage	1	days					
Leal Pasi	Livestock feed grain: <u>M</u> eat:	45	days					
	<u>m</u> eac. Milk:	2.0e60	days days					
	<u>F</u> ish:	7	days					
	<u>C</u> rustacea and mollusks:	7	days					
<u>F</u> ish Crus		Message						
	Cancel	of 1E+34.	The va	of STOR_T(7) exc lue can be reset to value, or reentere				
		<u>u</u>	pper	<u>D</u> efault	R <u>e</u> enter			
	bound value, the default value, or reentered.							
		Lowe	er	<u>D</u> efault	R <u>e</u> enter			

Worked as expected.

3) Change two or more values.

Changed values for Surface water, Well water, and Crustacea and mollusks to 2, 3, and 10, respectively.

- 4) Save the form and the project to Test21.rof.
- 5) Check the variable STOR_T(1)-(10) in the file; they should be identical to the input in GUI.

STOR_T(1)	= 2,
STOR_T(2)	= 3,
STOR_T(3)	= 14,
STOR_T(4)	= 1,
STOR_T(5)	= 1,
STOR_T(6)	= 45,
STOR_T(7)	= 20,
STOR_T(8)	= 1,
STOR_T(9)	= 7,
STOR_T (10) = 10,

12.34 TEST CASE 034-010 TESTER'S REPORT

Documented in Test-034-010_report.docx of 2/18/2020 12:39 PM

Test Case 034-010 report

By cheng wang 2/18/2020

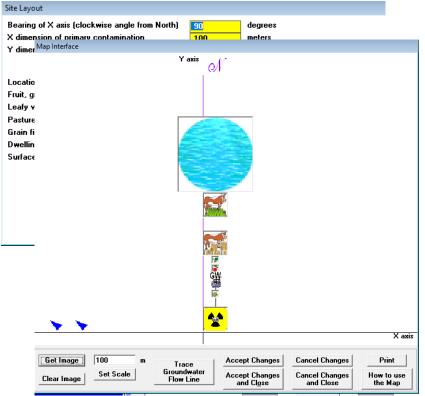
Objective: To test the functionality of Site Layout form.

Conclusion: the code worked as expected.

Procedure:

1) Open Site Layout form and visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected. F6 worked as expected.



2) Clicking Display Map should bring up the Map Interface window.

3) Change the values for Bearing of X axis, X and Y dimensions, and at least one value on each row and column of the site coordinate table.

Bearing of X axis (clockwise angle from	n North) 🛛	190	degrees			
X dimension of primary contamination	ĺ	150	meters			
Y dimension of primary contamination	[150	meters			
	Smaller	Larger	Smaller	Larger		
Location	X Coo	ordinate	Y Co	ordinate		
Fruit, grain, non-leafy vegetables plot	40	65.625	234	266	meter	
Leafy vegetables plot	34.375	70	268	300	meter	
Pasture, silage growing area	0	100	455	550	meter	
Grain fields	0	100	300	450	meter	
Dwelling site	45	65.625	134	166	meter	
Surface water body	-100	250	550	850	meter	
Display Map Save Cancel						

- 4) Save the project to Test22.rof.
- 5) Check the following variables in the file; they should be identical to the input in GUI. NXBEARING, SOURCEXY, AGRIXY, DWELLXY, SWXY.

```
NXBEARING = 190,
SOURCEXY(1) = 150,
SOURCEXY(2) = 150,
AGRIXY(1,1) = 40,
AGRIXY(2,1) = 65.625,
AGRIXY(3,1) = 234,
AGRIXY(4,1) = 266,
AGRIXY(1,2) = 34.375,
AGRIXY(2,2) = 70,
AGRIXY(3,2) = 268,
AGRIXY(4,2) = 300,
AGRIXY(1,3) = 0,
AGRIXY(2,3) = 100,
AGRIXY(3,3) = 455,
AGRIXY(4,3) = 550,
AGRIXY(1,4) = 0,
AGRIXY(2, 4) = 100,
AGRIXY(3, 4) = 300,
AGRIXY(4, 4) = 450,
DWELLXY(1) = 45,
DWELLXY(2) = 65.625,
DWELLXY(3) = 134,
DWELLXY(4) = 166,
SWXY(1) =-100,
SWXY(2) = 250,
SWXY(3) = 550,
SWXY(4) = 850,
```

12.35 TEST CASE 034-011 TESTER'S REPORT

Documented in Test-034-011_report.docx of 2/18/2020 12:56 PM

Test Case 034-011 report

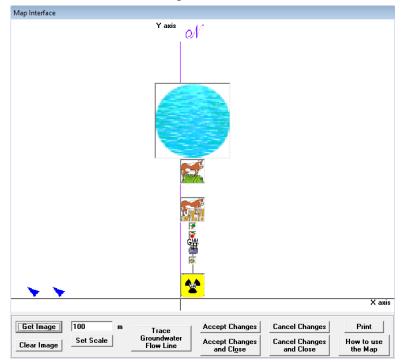
By cheng wang 2/18/2020

Objective: To test the functionality of Map Interface form.

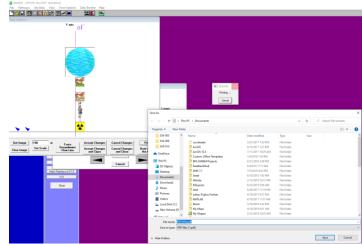
Conclusion: the code worked as expected.

Procedure:

- 1) Open Map Interface form by clicking Modify Data -> Site Layout -> Display Map
- 2) It should include the functions as shown in the figure.



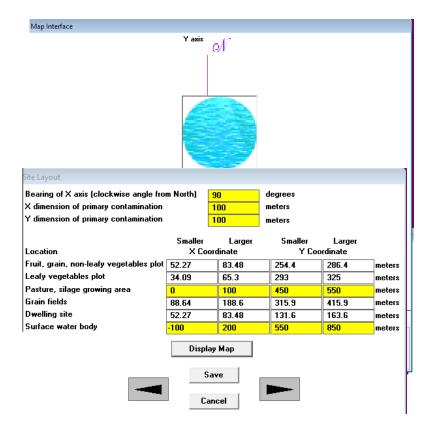
3) Check the following buttons: Print, How to use the Map, Accept/Cancel changes, Accept/Cancel Changes and Close.



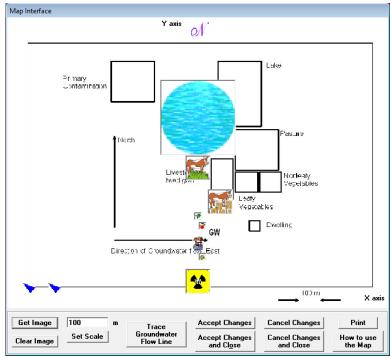
How to use the map button opens file mapGuideRO.pdf

Accept changes, Cancel Changes button, Accept Changes and Close button, and Cancel Changes and Close button worked as expected.

4) Move each icon in the map a little and the purple Y-axis line, then click Accept Changes and Close. The coordinate table in the Site Layout form should update accordingly.

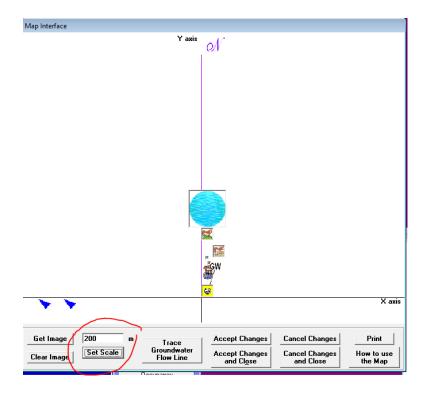


5) Click Get Image should direct to select an image file. Select the file HypotheticalSuburbanScenarioOutline.JPG under UserFiles folder. The image should load to the code. Click Clear Image should remove the file from the code.



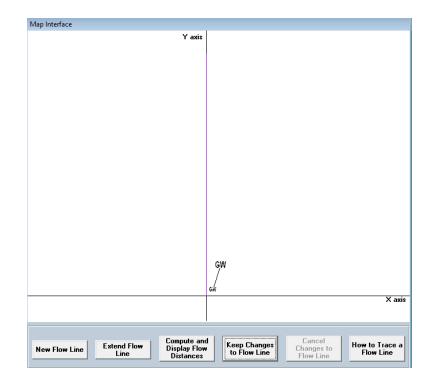
worked as expected. "Clear Image" just removed the loaded picture.

6) Change the scale value and click "Set Scale". The image should change accordingly.



Worked as expected.

7) Click Trace Groundwater Flow Line, the widow should update with GW line.



worked as expected.

8) Clicking How to Trace a Flow Line button should open a file named GwFlowLinRO.pdf. Following the procedure in the file and check each button functions as designed.

12.36 TEST CASE 034-012 TESTER'S REPORT

Documented in Test-034-12_report.docx of 2/18/2020 1:25 PM

Test Case 034-012 report

By cheng wang 2/8/2020

Objective: To test the functionality of Physical and Hydrological form.

Conclusion: the code worked as expected.

Procedure:

1) Open Physical and Hydrological form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

Physical and Hydro	logical
Site properties Precipitatio <u>n</u> : Rainfall and ru Sub-area prop	inoff factor: 160 meters/year
	Primary <u>C</u> ontamination
	S <u>e</u> diment Delivery
	Agricultural Areas
	Livestock Feed Growing Areas
	Offsite <u>D</u> welling Site
-	Save Cancel

2) It should contain Site Properties input, as shown in the figure.

Worked as expected.

3) Clicking each of the five buttons in Sub-area Properties section should bring up the corresponding forms.

Worked as expected.

4) Change the precipitation value and rainfall and runoff factor, save the form, and save the project to Test24.rof.

Changed the values to 2 and 162 respectively.

5) Check the variables PRECI and RAINEROS in the generated file. They should be identical to the input in GUI.

PRECIP = 2, RAINEROS = 162,

12.37 TEST CASE 034-013 TESTER'S REPORT

Documented in Test-034-013_report.docx of 2/20/2020 7:27 AM

Test Case 034-013 report

By cheng wang 2/18/2020

Objective: To test the functionality of Primary Contamination form.

Conclusion: the code worked as expected.

minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

Primary Contamination				
Area of primary contamination			10000	square meters
Length of contamination par	allel to aquifer flo	w:	100	meters
Depth of soil mixing layer:			.15	meters
Mass loading of all particula			.0001	grams/m?
Deposition velocity of all par			.001	meters/s
Respirable particulates as a			1	
Deposition velocity of respire	able particulates	(to compute atmospheric release):	.001	meters/s
Irrigation applied per year:			.2	meters in a yea
Evapotranspiration coefficie	nt:		.5	
Runoff coefficient:			.2	
Slope-length-steepness fact	DI:		.4	
Cover and management fact	or:		.003	
Support practice factor:			1	
Fraction of primary contamin	ation that is subm	nerged	0	
Soil layer - Location relative to water ta		Contaminated zone above below		
<u>I</u> hickness:	0	2 meters		
Soil erodibility factor:	.4	.4 tons/acre		
Dry bulk density:	1.5	1.5 grams/cm?		
Erosion rate:	1.147E-05	1.147E-05 meters/year		
Total porosity:	.4	.4		
Volumetric <u>w</u> ater content:	.05			
Effective porosity:		.4		
Hydraulic conductivity:		10 meters/year		
Field capacity:		.3		
<u>b</u> parameter:		5.3		
Longitudinal dispersivity:		.05 meters		
		Save		
	-	Save		

Procedure:

1) Open Primary Contamination form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

Primary Contamination					
Area of primary contamination.				10000	square meters
Length of contamination parall	el to aquifer flo	W:		100	meters
Depth of soil mixing layer:				.15	meters
Mass loading of all particulate	s:			.0001	grams/m?
Deposition velocity of all partic	culates (to com	pute atmosph	eric release):	.001	meters/s
Respirable particulates as a fr	action of total p	particulates		1	
Deposition velocity of respirab	le particulates	(to compute a	atmospheric release):	.001	meters/s
Irrigation applied per year:				.2	meters in a year
Evapotranspiration coefficient				.5	
Runoff coefficient:				.2	
Slope-length-steepness factor:				.4	
Cover and management factor				.003	
Support practice factor:				1	
Fraction of primary contaminat	ion that is subm	nerged		0	
Soil laver ->	Clean cover	Contor	ninated zone		
Location relative to water table		above	below		
<u>T</u> hickness:	0	2	meters		
Soil erodibility factor:	.4	.4	tons/acre		
Dry bulk density:	1.5	1.5	grams/cm?		
Erosion rate:	1.147E-05	1.147E-05	meters/year		
Total porosity:	.4	.4			
Volumetric water content:	.05				
Effective porosity:		.4			
Hydraulic conductivity:		10	meters/year		
Field capacity:		.3			
<u>b</u> parameter:		5.3			
Longitudinal dispersivity:		.05	meters		
			Save		
		-			
			Cancel		

2) It should contain Site Properties input, as shown in the figure.

Worked as expected.

3) Check the consistence of Area of Primary Contamination with the X and Y dimesons in Site Layout form.

The values are consistent.

4) Check the consistence of Factor of primary contamination that is submerged with the Submerged fraction of Primary Contamination in Preliminary Input.

Preliminary Inputs	
Radiological units Activity: p + Ci + Dose; m + rem +	Description of current conceptualization The properties of the primary contamination a
Basic radiation dose limit: 25 mrem/yr Exposure duration (for risk): 30 years	compute the transfer of the radionuclides from the aqueous phase of the primary contaminati transport of the radionuclides through the prima
Number of unsaturated zones:	contamination.
Submerged fraction of primary Contamination Conceptualization of primary contamination This choice apolies to all the radionuclides in the input file.	The three options listed below are available to transfer of radionuclides from the contaminate to the soil moisture: Equilibrium desorption characterized by a line
	distribution coefficient
Use Primary Contamination Area of primary contamination: Length of contamination parallel to aquifer flow:	10000 square meters 100 meters
Depth of soil mixing layer:	.15 meters
O Spec Mass loading of all particulates:	.0001 grams/m?
O Mod Deposition velocity of all particulates (to compute atmospheric release):	.001 meters/s
Respirable particulates as a fraction of total particulates	1
Deposition velocity of respirable particulates (to compute atmospheric relea	
Irrigation applied per year:	.2 meters in a year
Evapotranspiration coefficient:	<mark>.5</mark>
Runoff coefficient:	.2
Slope-length-steepness factor:	.4
Cover and management factor:	.003
Support practice factor:	1
Fraction of primary contamination that is submerged	0
Soil layer -> Clean cover Contaminated zone Location relative to water table -> above below	
Ihickness: 0 2 meters	
Soil erodibility factor: .4 .4 tons/acre	
Dry bulk density: 1.5 1.5 grams/cm?	
Erosion rate: 1.147E-05 1.147E-05 meters/year	
Total porosity: .4 .4	
Volumetric water content: .05	
Effective porosity: .4	
Hydraulic conductivity: 10 meters/year	
Field capacity: .3 b parameter: 5.3	
Longitudinal dispersivity: 05 meters	
Save Cancel	

The values matched.

5) Modify at least two values in each column, save the form, and then save the project to Test25.rof.

Made the following changes.

Primary Contamination							
Area of primary contamination: 10000 square meters							
Length of contamination parallel to aquifer flow:					meters		
Depth of soil mixing layer:				.25	meters		
Mass loading of all particulates	e			.0001	grams/m?		
Deposition velocity of all partic	ulates (to com	pute atmospheric	: release):	.001	meters/s		
Respirable particulates as a fra	action of total p	oarticulates		1			
Deposition velocity of respirab	e particulates	(to compute atm	ospheric release):	.001	meters/s		
Irrigation applied per year:				.2	meters in a year		
Evapotranspiration coefficient:				.5			
Runoff coefficient:				.2			
Slope-length-steepness factor:				.4			
Cover and management factor:				.003			
Support practice factor:				1			
Fraction of primary contaminati	on that is subm	nerged		.2			
Soil layer ->	Clean cover	Contamina	ited zone				
Location relative to water table	e ->	above	below				
<u>T</u> hickness:	.31	2	meters				
Soil erodibility factor:	.4	.4	tons/acre				
Dry bulk density:	1.5	1.5	grams/cm?				
Erosion rate:	1.147E-05	1.147E-05	meters/year				
Total porosity:	.4	.4					
Volumetric water content:	.05		_				
Effective porosity:		.41					
Hydraulic conductivity:			101 meters/year				
Field capacity:		.3					
<u>b</u> parameter:		5.3					
Longitudinal dispersivity:		.05	meters				
			Save				
	-						
			Cancel				

6) Check the following variables in the generated input file. They should be the same as input in the GUI. AREA, LCZPAQ, DM, MLFD, DEPVEL_DUSTT, RESPFRACPC, DEPVEL_DUST, RI, EVAPTR, RUNOFF, SLPLENSTPPC, CRPMANGPC, CONVPRACPC, THICK0, TPCZ, VCZ, DENSCZ, ERODIBILITYCZ, FCCZ, BCZ, HCCZ, EPCZ, ALPHALCZ, SUBMERGEDDEPTH, COVER0, TPCV, VCV, DENSCV, ERODIBILITYCV, PH2OCV AREA = 10000,LCZPAQ = 101,DM = .25,MLFD = .0001,DEPVEL_DUSTT = .001, RESPERACEC = 1, DEPVEL DUST = .001, RI = .2,EVAPTR = .5, RUNOFF = .2, SLPLENSTPPC = .4, CRPMANGPC = .003, CONVPRACPC = 1, THICKO = 2,TPCZ = .4,VCZ = 1.147E - 05, DENSCZ = 1.5, ERODIBILITYCZ = .4, FCCZ = .3,BCZ = 5.3,HCCZ = 10, EPCZ = .41,ALPHALCZ = .05, SUBMERGEDDEPTH = 0, COVER0 = .31,TPCV = .4,VCV = 1.147E - 05, DENSCV = 1.5, ERODIBILITYCV = .4, PH2OCV = .05,HCSZ = 101,

12.38 TEST CASE 034-014 TESTER'S REPORT

Documented in Test-034-014_report.docx of 2/18/2020 1:56 PM

Test Case 034-014 report

By cheng wang 2/18/2020

Objective: To test the functionality of Sediment Delivery Ratio form

Conclusion: the code worked as expected

Procedure:

1) Open Sediment Delivery Ratio form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Fate of Material Eroded from the Primary Contamination by Runoff	
Fraction of eroded radionuclides deposited at dwelling site Fraction of eroded radionuclides deposited in the nonleafy vegetable plot Fraction of eroded radionuclides deposited in the leafy vegetable plot Fraction of eroded radionuclides deposited in the pasture Fraction of eroded radionuclides deposited in the feed grain plot	0 0 0 0
Fraction of eroded radionuclides deposited in the surface water body	1
Save Cancel	

Worked as expected.

2) It should the input boxes, as shown in the figure.

3) Check the lower and upper bounds, which should be 0 and 1, respectively.

Fate of Material Eroded from the Primary Contamination by Runoff	
Fraction of eroded radionuclides deposited at dwelling site Fraction of eroded radionuclides deposited in the nonleafy vegetable plot Fraction of eroded radionuclides deposited in the leafy vegetable plot Fraction of eroded radionuclides deposited in the pasture Fraction of eroded radionuclides deposited in the feed grain plot Fraction of eroded radionuclides deposited in the sufface water body Save Cancel	-1 0 0 0 0 1
Badon bound of 0. The valu	SDRDWELL is less than the lower e can be reset to the lower ault value, or reentered. Default Reenter
Fraction of eroded radionuclides deposited at dwelling site Fraction of eroded radionuclides deposited in the nonleafy vegetable plot Fraction of eroded radionuclides deposited in the leafy vegetable plot Fraction of eroded radionuclides deposited in the feel grain plot Fraction of eroded radionuclides deposited in the set grain plot Fraction of eroded radionuclides deposited in the surface water body Save	0 0 0 0 1.1
Cancel The current value of	SDR exceeds the upper bound of reset to the upper bound value, reentered.

Worked as expected.

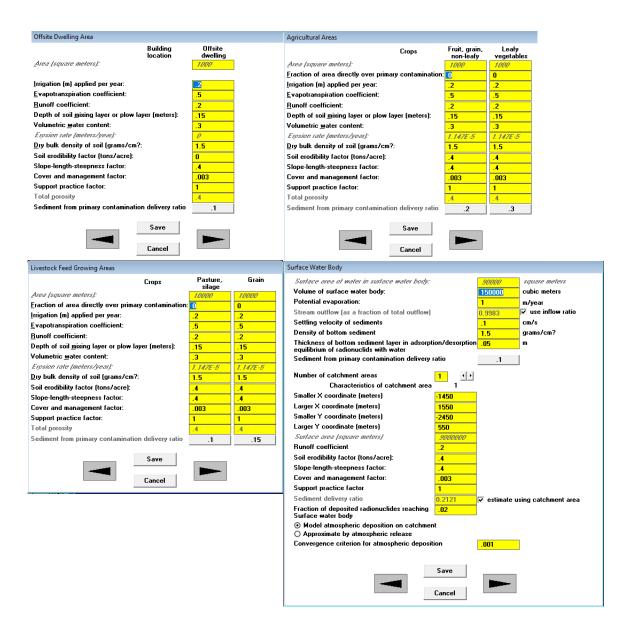
4) The summation of the values in this form should be 1. Make it more than one, and an error message should pop up.

Fate of Material Eroded from the Primary Contamine Fraction of eroded radionuclides deposited at d Fraction of eroded radionuclides deposited in th Fraction of eroded radionuclides deposited in th Fraction of eroded radionuclides deposited in th Fraction of eroded radionuclides deposited in th	welling site ne nonleafy vegetable plot ne leafy vegetable plot ne pasture ne feed grain plot	.5 0 0 0 0 1
Inhalation, Gamma Shape Factors Occupancy Radon Carbon-14 Mass Fractions of C-12 H-3	Cancel Message The sum of the fractions of o deposited at the offsite loca i.e what is specified to be d was eroded. Qk	ations exceeds unity,

Worked as expected.

5) Check the values input in the form are consistent with the ones in Forms Dwelling Site, Agricultural Areas, Livestock Feed Areas, and Surface Water Body.

Fate of Material Eroded from the Primary Contamination by Runoff	
Fraction of eroded radionuclides deposited at dwelling site Fraction of eroded radionuclides deposited in the nonleafy vegetable plot Fraction of eroded radionuclides deposited in the leafy vegetable plot Fraction of eroded radionuclides deposited in the pasture Fraction of eroded radionuclides deposited in the feed grain plot Fraction of eroded radionuclides deposited in the surface water body	.2 .3 .1 .15 .1
Save Cancel	



Worked as expected.

6) Change three or more values, save the form, and then save the project to Test26.rof.

Made changes as shown in the screenshot in Step 5).

7) Check the following variables in the generated input file; they should be identical to the input from GUI. SDR, SDROF(1)-(4) and SDRDELL

SDR = .1,

worked as expected.

SDROF(1) = .2, SDROF(2) = .3, SDROF(3) = .1, SDROF(4) = .15, SDRDWELL = .1,

12.39 TEST CASE 034-015 TESTER'S REPORT

Documented in Test-034-015_report.docx of 2/20/2020 7:29 AM

Test Case 034-015 report

By cheng wang 2/18/2020

Objective: To test the functionality of Agricultural Areas form.

Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used..

Agricultural Areas		
Сгоря	Fruit, grain, non-leafy	Leafy vegetables
Area (square meters):	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
<u>R</u> unoff coefficient:	.2	.2
Depth of soil <u>m</u> ixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm?:)	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

Procedure:

1) Open Agricultural Areas form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

Agricultural Areas		
Сгоря	Fruit, grain, non-leafy	Leafy vegetables
<u>Area (square meters):</u>	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil <u>mixing</u> layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

2) It should have the same input boxes as the figure has.

3) Check the Area values; they should be grayed out in this form but match the inputs in Site Layout form.

Bearing of X axis (clockwise angle fro X dimension of primary contamination Y dimension of primary contamination	m North)	90 100 100		degre meter: meter:	\$		
Location	Smaller X Cor	La ordinate	arger	S	maller Y Coo	Large rdinate	r
Fruit, grain, non-leafy vegetables plot		65.		234		266	meters
Leafy vegetables plot	34.375	65.		268		300	meters
Pasture, silage growing area	0	100		450		550	meters
Grain fields	0	100		300		400	meters
Dwelling site	34.375	65.		134		166	meters
Surface water body	-100	200		550		850	meters
Agricultural Areas							
Agricultural Areas	Crops		Fruit,	arain	Leal	u	
	ciops		non-l		vegeta		
<u>Area (square meters):</u>			1000		1000		
<u>Fraction of area directly over prin</u>	nary contami	nation:			0		
Irrigation (m) applied per year:			.2		.2		
Evapotranspiration coefficient:			.5		.5		
<u>Runoff coefficient:</u>	launa (mat).	.2		.2		
Depth of soil <u>mixing</u> layer or plow Volumetric water content:	iayer (meter	2):	.15		.15		
Erosion rate (meters/year):			.3	C E	.3	5	
Dry bulk density of soil (grams/cn	n 7 -		1.1471	-9	1.147E	9	
Soil erodibility factor (tons/acre):			1.5		1.5		
Slope-length-steepness factor:			.4 .4		.4 .4		
Cover and management factor:			.9		.4 .003		
Support practice factor:			1		1		
Total porosity			.4		.4		
Sediment from primary contaminal	tion deliverv	ratio		n l	0		
	Save Cancel						

4) Check the Erosion rate and Total Porosity values; they should be grayed out in this form but match the ones in Primary Contamination form

	Agricultural Areas						
			Crops	Fruit, grain,	Leafy		
	Area (square met	erst-		non-leafy	vegetables		
			nary contamination:		0		
	- Irrigation (m) appl			.2	.2		
	<u>E</u> vapotranspiratio	n coefficient:		.5	.5		
	Bunoff coefficien	t		.2	.2		
	Depth of soil mixi		layer (meters):	.15	.15		
	Volumetric water	content:		.3	.3		
	Enosion rate (met	ers/year):		1.147E-5	1.147E-5		
	Dry bulk density o	of soil (grams/c	m?:	1.5	1.5		
	Soil erodibility fac	tor (tons/acre)		.4	.4		
	Slope-length-stee	pness factor:		.4	.4		
	Cover and manag	ement factor:		.003	.003		
	Support practice	factor:		1	1		
	Total porosity			.4	.4		
	Sediment from pri	mary contamina	tion delivery ratio	0	0		
Primary Conta							
	nary contamination:					10000	square meters
	ontamination parall	el to aquifer flo	W:			100	meters
	il mixing layer:					.15	meters
	g of all particulates					.0001	grams/m?
			oute atmospheric re	leasej:		.001	meters/s
	particulates as a fra		articulates to compute atmospi			1	meters/s
	plied per year:	e particulates (to compute atmosp	nenc releasej.		.001 .2	
	piration coefficient:						meters in a year
Evapotransp Runoff coef						.5	
-	n-steepness factor:					.2 .4	
	nanagement factor:					.4	
	ctice factor:					1	
	primary contaminati	on that is subm	eraed			0	
	-		-			•	
Location rel	Soil layer -> ative to water table	Clean cover ->	Contaminated above	zone below			
Thickness:		0	2 mete	ers			
Soil erodibili	ity factor:	.4	.4 tons	/acre			
Dry bulk der	nsity:	1.5	1.5 gram	is/cm?			
Erosion rate	R."	1.147E-05	1.147E-05 met	ers/year			
Total porosi	ty:	.4	.4				
Volumetric y	yater content:	.05					
Effective po	rosity:		.4				
Hydraulic co	onductivity:		10 mete	rs/year			
<u>F</u> ield capaci	ity:		.3				
<u>b</u> parameter	:		5.3				
Longitudina	l dispersivity:		.05 mete	ers			
			Sa	ve –			
			Car	cel			

5) Check the Sediment delivery ratio values; they should be grayed out in this form but match the ones in Sediment Delivery Ratio form. Clicking the values in this form should bring up the Sediment Delivery Ratio form.

	Agricultural Areas			
	Crops	Fruit, grain, non-leafy	Leafy vegetables	
	Area (square meters):	1000	1000	
	Fraction of area directly over primary contamination:	0	0	
	Irrigation (m) applied per year:	.2	.2	
	Evapotranspiration coefficient:	.5	.5	
	<u>R</u> unoff coefficient:	.2	.2	
	Depth of soil mixing layer or plow layer (meters):	.15	.15	
	Volumetric <u>w</u> ater content:	.3	.3	
	Erosion rate (meters/year):	1.147E-5	1.147E-5	
	Dry bulk density of soil (grams/cm?:	1.5	1.5	
	Soil erodibility factor (tons/acre):	.4	.4	
	Slope-length-steepness factor:	.4	.4	
	Cover and management factor:	.003	.003	
	Support practice factor:	1	1	
	Total porosity	.4	.4	
	Sediment from primary contamination delivery ratio	0	0	
	Save Cancel			
Fate o	f Material Eroded from the Primary Contamination by Rur	noff		
Fract Fract Fract Fract	tion of eroded radionuclides deposited at dwelling site tion of eroded radionuclides deposited in the nonleafy tion of eroded radionuclides deposited in the leafy ver- tion of eroded radionuclides deposited in the pasture tion of eroded radionuclides deposited in the feed gra- tion of eroded radionuclides deposited in the surface of Save	vegetable plo getable plot in plot	•	0 0 0 0 1

6) Change at least three values in each column, save the form, and save the project to Test27.rof.

Made the following changes.

Agricultural Areas		
Сгоря	Fruit, grain, non-leafy	Leafy vegetables
<u>Area (square meters):</u>	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.21	.25
Evapotranspiration coefficient:	.5	.5
<u>R</u> unoff coefficient:	.23	.28
Depth of soil <u>mixing</u> layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters/year):	1.333E-5	1.437E-5
<u>D</u> ry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.45	.47
Cover and management factor:	.0031	.0032
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

7) Check the following variables in the generated file; they should be the same as inputs in GUI. AREAO(1) and (2), FAREA_PLANT(1) and (2), RIRRIG(1) and (2), EVAPTRN(1) and (2), RUNOF(1) and (2), DPTHMIXG(1) and (2), TMOF(1) and (2), EROSN(1) and (2), RHOB(1) and (2), ERODIBILITY(1) and (2), SLPLENSTP(1) and (2), CRPMANG(1) and (2), CONVPRAC(1) and (2), TPOF(1) and (2).

```
AREAO(1) = 1000,
AREAO(2) = 1000,
AREAO(3) = 10000,
AREAO(4) = 10000,
AREAODWELL = 1000,
FAREA PLANT(1) = 0,
FAREA PLANT(2) = 0,
FAREA PLANT(3) = 0,
FAREA PLANT(4) = 0,
RIRRIG(1) = .21,
RIRRIG(2) = .25,
RIRRIG(3) = .2,
RIRRIG(4) = .2,
RIRRIGDWELL = .2,
EVAPTRN(1) = .5,
EVAPTRN(2) = .5,
EVAPTRN(3) = .5,
EVAPTRN(4) = .5,
EVAPTRNDWELL = .5,
RUNOF(1) = .23,
RUNOF(2) = .28,
RUNOF(3) = .2,
RUNOF(4) = .2,
RUNOFDWELL = .2,
```

```
DPTHMIXG(1) = .15,
DPTHMIXG(2) = .15,
 DPTHMIXG(3) = .15,
DPTHMIXG(4) = .15,
DPTHMIXGDWELL = .15,
 TMOF(1) = .3,
 TMOF(2) = .3,
TMOF(3) = .3,
TMOF(4) = .3,
 TMOFDWELL = .3,
EROSN(1) = 1.333E-05,
EROSN(2) = 1.437E-05,
EROSN(3) = 1.147E-05,
EROSN(4) = 1.147E-05,
EROSNDWELL = 0,
RHOB(1) = 1.5,
RHOB(2) = 1.5,
RHOB(3) = 1.5,
RHOB(4) = 1.5,
RHOBDWELL = 1.5,
ERODIBILITY(1) = .4,
ERODIBILITY(2) = .4,
ERODIBILITY(3) = .4,
 ERODIBILITY(4) = .4,
  ERODIBILITYDWELL = 0,
  SLPLENSTP(1) = .45,
  SLPLENSTP(2) = .47,
  SLPLENSTP(3) = .4,
  SLPLENSTP(4) = .4,
  SLPLENSTPDWELL = .4,
```

CRPMANG(1) = .0031, CRPMANG(2) = .0032, CRPMANG(3) = .003, CRPMANG(4) = .003, CRPMANGDWELL = .003, CONVPRAC(1) = 1, CONVPRAC(2) = 1, CONVPRAC(3) = 1, CONVPRAC(4) = 1, CONVPRAC(4) = 1, TPOF(1) = .4, TPOF(2) = .4, TPOF(3) = .4, TPOF(4) = .4, TPOFDWELL = .4,

12.40 TEST CASE 034-016 TESTER'S REPORT

Documented in Test-034-016_report.docx of 2/20/2020 7:30 AM

Test Case 034-016 report

By cheng wang 2/18/2020

Objective: To test the functionality of Livestock Feed Areas form.

Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used..

Livestock Feed Growing Areas		
Сгоря	Pasture, silage	Grain
Area (square meters):	10000	10000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
<u>R</u> unoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters pear):	1.147E-5	1.147E-5
<u>D</u> ry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (toris/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

Procedure:

1) This form should contain the same input content as Agricultural Areas form but for Livestock Feed Area, including Pasture Silage and Grain

Livestock Feed Growing Areas		
Сгоря	Pasture, silage	Grain
Area (square meters):	10000	10000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

Worked as expected.

2) Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAO(3) and (4), FAREA_PLANT(3) and (4), RIRRIG(3) and (4), EVAPTRN(3) and (4), RUNOF(3) and (4), DPTHMIXG(3) and (4), TMOF(3) and (4), EROSN(3) and (4), RHOB(3) and (4), ERODIBILITY(3) and (4), SLPLENSTP(3) and (4), CRPMANG(3) and (4), CONVPRAC(3) and (4), TPOF(3) and (4).

Made the following changes to the file for Test Case 034-015 (test27.rof) and saved the input file as Test28.rof.

Livestock Feed Growing Areas		
Сгоря	Pasture, silage	Grain
Area (square meters):	10000	10000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.21	.22
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.35	.32
Erosion rate (meters/year):	1.264E-5	1.355E-5
Dry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.41	.42
Slope-length-steepness factor:	.43	.45
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0
Save Cancel		

```
AREAO(1) = 1000,
AREAO(2) = 1000,
AREAO(3) = 10000,
AREAO(4) = 10000,
AREAODWELL = 1000,
FAREA PLANT(1) = 0,
FAREA PLANT(2) = 0,
FAREA PLANT(3) = 0,
FAREA_PLANT(4) = 0,
RIRRIG(1) = .21,
RIRRIG(2) = .25,
RIRRIG(3) = .21,
RIRRIG(4) = .22,
RIRRIGDWELL = .2,
EVAPTRN(1) = .5,
EVAPTRN(2) = .5,
EVAPTRN(3) = .5,
EVAPTRN(4) = .5,
EVAPTRNDWELL = .5,
RUNOF(1) = .23,
RUNOF(2) = .28,
RUNOF(3) = .2,
RUNOF(4) = .2,
RUNOFDWELL = .2,
DPTHMIXG(1) = .15,
DPTHMIXG(2) = .15,
DPTHMIXG(3) = .15,
DPTHMIXG(4) = .15,
DPTHMIXGDWELL = .15,
```

```
TMOF(1) = .3,
TMOF(2) = .3,
TMOF(3) = .35,
TMOF(4) = .32,
TMOFDWELL = .3,
EROSN(1) = 1.333E-05,
EROSN(2) = 1.437E-05,
EROSN(3) = 1.264E-05,
EROSN(4) = 1.355E-05,
EROSNDWELL = 0,
RHOB(1) = 1.5,
RHOB(2) = 1.5,
RHOB(3) = 1.5,
RHOB(4) = 1.5,
RHOBDWELL = 1.5,
ERODIBILITY(1) = .4,
ERODIBILITY(2) = .4,
ERODIBILITY(3) = .41,
ERODIBILITY(4) = .42,
ERODIBILITYDWELL = 0,
SLPLENSTP(1) = .45,
SLPLENSTP(2) = .47,
SLPLENSTP(3) = .43,
SLPLENSTP(4) = .45,
SLPLENSTPDWELL = .4,
CTD T04/2012/01/11
```

```
CRPMANG(1) = .0031,

CRPMANG(2) = .0032,

CRPMANG(3) = .003,

CRPMANG(4) = .003,

CRPMANGDWELL = .003,

CONVPRAC(1) = 1,

CONVPRAC(2) = 1,

CONVPRAC(2) = 1,

CONVPRAC(4) = 1,

CONVPRAC(4) = 1,

TPOF(1) = .4,

TPOF(2) = .4,

TPOF(3) = .4,

TPOF(4) = .4,

TPOFDWELL = .4,
```

12.41 TEST CASE 034-017 TESTER'S REPORT

Documented in Test-034-017_report.docx of 2/20/2020 7:31 AM

Test Case 034-017 report

By cheng wang 2/18/2020

Objective: To test the functionality of Dwelling Site form.

Conclusion: the code worked as expected

Minor issue on the font format when computer system locale is Chinese; no issues when English (US) is used..

Offsite Dwelling Area	
Building location Area (square meters):	Offsite dwelling 1000
Irrigation (m) applied per year:	.2
Evapotranspiration coefficient:	.5
Runoff coefficient:	.2
Depth of soil mixing layer or plow layer (meters):	.15
Volumetric <u>w</u> ater content:	.3
Erosion rate (meters/year):	0
Dry bulk density of soil (grams/cm?	<mark>-1.5</mark>
Soil erodibility factor (tons/acre):	0
Slope-length-steepness factor:	.4
Cover and management factor:	.003
Support practice factor:	1
Total porosity	.4
Sediment from primary contamination delivery ratio	0
Save Cancel	

Procedure:

- Offsite Dwelling Area Building Offsite location dwelling Area (square meters): 1000 Irrigation (m) applied per year: Evapotranspiration coefficient: .5 Runoff coefficient: .2 Depth of soil mixing layer or plow layer (meters): .15 Volumetric water content: .3 Erosion rate (meters/year): n Dry bulk density of soil (grams/cm?: 1.5 Soil erodibility factor (tons/acre): 0 Slope-length-steepness factor: .4 Cover and management factor: .003 Support practice factor: 1 Total porosity A Sediment from primary contamination delivery ratio 0 Save Cancel
- 1) This form should contain the same input content as Agricultural Areas form but for Offsite Dwelling Area

Worked as expected.

2) Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAODWELL, FAREA_PLANTDWELL, RIRRIGDWELL, EVAPTRNDWELL, RUNOFDWELL, DPTHMIXGDWELL, TMOFDWELL, EROSNDWELL, RHOBDWELL, ERODIBILITYDWELL, SLPLENSTPDWELL, CRPMANGDWELL, CONVPRACDWELL, TPOFDWELL.

Made the following changes based on the file for Test Case 034-016 (test28.rof).

	Offsite Dwelling Area	
	Building	Offsite
	location	dwelling
	<u>Area (square meters):</u>	1000
	Irrigation (m) applied per year:	.25
	Evapotranspiration coefficient:	.5
	Runoff coefficient:	.278
	Depth of soil <u>mixing</u> layer or plow layer (meters):	.15
	Volumetric <u>w</u> ater content:	.3
	Erosion rate (meters/year):	0
	Dry bulk density of soil (grams/cm?:	1.5
	Soil erodibility factor (tons/acre):	0
	Slope-length-steepness factor:	.412
	Cover and management factor:	.003
	Support practice factor:	1
	Total porosity	.4
	Sediment from primary contamination delivery ratio	0
	C	
	Save	
	Cancel	
AREAO(1) = 1000,		
	TMOF(1) = .3,	CRPMANG(1) = .0031,
AREAO(2) = 1000,	TMOF(2) = .3,	CRPMANG(2) = .0032,
AREAO(3) = 10000,	TMOF(3) = .35,	CRPMANG(3) = .003,
AREAO(4) = 10000,	TMOF(4) = .32,	CRPMANG(4) = .003,
AREAODWELL = 1000,	TMOFDWELL = .3,	CRPMANGDWELL = .003
$FAREA_PLANT(1) = 0,$	21(0011(1) - 1.0002 00)	CONVPRAC(1) = 1,
$FAREA_PLANT(2) = 0,$		CONVPRAC(2) = 1,
$FAREA_PLANT(3) = 0,$		CONVPRAC(3) = 1,
$FAREA_PLANT(4) = 0,$	EROSN(4) = 1.355E-05,	CONVPRAC(4) = 1,
RIRRIG(1) = .21,	EROSNDWELL = 0,	CONVPRACDWELL = 1,
RIRRIG(2) = .25,	RHOB(1) = 1.5,	TPOF(1) = .4,
RIRRIG(3) = .21,	RHOB(2) = 1.5,	TPOF(2) = .4,
RIRRIG(4) = .22,	RHOB(3) = 1.5,	TPOF(3) = .4,
RIRRIGDWELL = .25,	RHOB(4) = 1.5,	TPOF(4) = .4,
EVAPTRN(1) = .5,	RHOBDWELL = 1.5 ,	TPOFDWELL = $.4$,
EVAPTRN(2) = .5,	ERODIBILITY(1) = $.4$,	
EVAPTRN(3) = .5,	ERODIBILITY(2) = $.4$,	
EVAPTRN(4) = .5,	ERODIBILITY(3) = $.41$,	
EVAPTRNDWELL = .5,	ERODIBILITY $(4) = .42$,	
RUNOF(1) = .23,	ERODIBILITYDWELL = 0,	
RUNOF(2) = .28,	SLPLENSTP(1) = .45,	
RUNOF(3) = .2,	SLPLENSTP(2) = $.47$,	
RUNOF(4) = .2,	SLPLENSTP(2) = .47, SLPLENSTP(3) = .43,	
RUNOFDWELL = .278,		
DPTHMIXG(1) = .15,	SLPLENSTP(4) = .45,	
DPTHMIXG(2) = .15, DPTHMIXG(2) = .15,	SLPLENSTPDWELL = .412,	
DPTHMIXG $(3) = .15$,		
DPTHMIXG $(4) = .15$,		

DPTHMIXGDWELL = .15, worked as expected.

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12.42 TEST CASE 034-018 TESTER'S REPORT

Documented in Test-034-018_report.docx of 2/18/2020 2:52 PM

Test Case 034-018 report

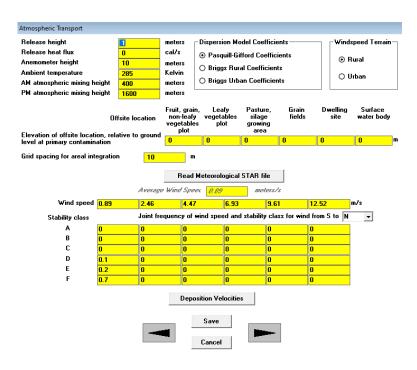
By Cheng Wang

Objective: To test the functionality of Atmospheric Transport form.

Conclusion: the code worked as expected.

Procedure

1) Open Atmospheric Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



Worked as expected.

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Clicking Read Meteorological STAR file should allow to select a STAR file from the available list installed in Application folder\Metfiles. Loading of a selected STAR file should update the table.

Release height Release heat flux Anemometer height Ambient temperature AM atmospheric mixing he PM atmospheric mixing he	5 100	D	meters cal/s meters Kelvin meters meters	⊙ Pasqı ⊖ Brigg	on Model uill-Gifford s Rural C s Urban C	d Coeffici oefficien	ients ts		Ispeed Terrain Rural Urban
Elevation of offsite locati	Offsite I		Fruit, gra non-leaf vegetabl plot	y vegeta	bles s it gi	asture, silage rowing area	Grain fields	Dwelling site	Surface water body
level at primary contamin		o ground	0	0	0		0	0	0
Wind speed	0.89	Average	Read Wind Spice 4.4	2.707		AR file meters/ 9.6	-	12.52	m/s
Stability class		Joint fre	quency of	wind spee	d and sta	bility cla	ss for wind	from S to N	•
	0.00166	0.0016	9 0		0	0		0	
A									
A B	0.00328	0.0037	0.0	0154	0	0		0	
					0 0.00053		0005	0 0	
В	0.00328	0.0037	3 0.0	0164	-	0.0		-	
B	0.00328 0.00087	0.0037	3 0.0 2 0.0	0164 0168	0.00053	0.0		0	
B C D	0.00328 0.00087 0.00029	0.0037 0.0023 0.0013	3 0.0 2 0.0 4 0.0	0164 0168 0051	0.00053 0.00176	0.0	0059	0 0.00009	

Read in AZ_PHOENIX.str.

worked as expected.

4) Clicking Deposition Velocities should bring up the Deposition Velocities form.

Added Ac-227 to initial contractions, and then click the mentioned button.

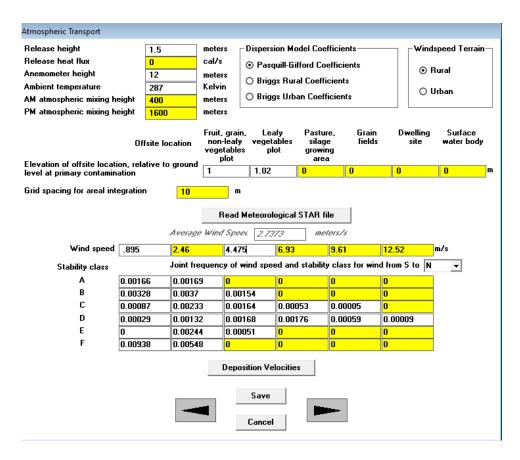
Deposition Velocities
Radionuclide Ac-227 Element Ac Atmospheric transport
Deposition velocity of respirable particulates0.001m/sDeposition velocity of all particulates0.001m/s
Save Cancel

Worked as expcted.

5) Change at least one value in each input area, save the form, and save the project to Test30.rof.

6) Check the following variables in the generated input file; they should be the same as the inputs from GUI. AIRRELHT, HEATFLX, ANH, TABK, AMIX, PMIX, AGRIELEV, DWELLELEV, SWELEV, WIND, WINDSPEED, DFREQ, ATGRID

Made the following changes.



```
DFREQ(1,1,1) = .00166,
                            DFREQ(2,1,1) = .00169,
                            DFREQ(3,1,1) = 0,
                            DFREQ(4,1,1) = 0,
                            DFREQ(5,1,1) = 0,
                            DFREQ(6,1,1) = 0,
                            DFREQ(1,2,1) = .00328,
                            DFREQ(2,2,1) = .0037,
                            DFREQ(3,2,1) = .00154,
AIRRELHT = 1.5,
                            DFREQ(4,2,1) = 0,
HEATFLX = 0,
                            DFREQ(5,2,1) = 0,
ANH = 12,
                           DFREQ(6,2,1) = 0,
TABK = 287,
                           DFREQ(1,3,1) = .00087,
AMIX = 400,
                            DFREQ(2,3,1) = .00233,
PMIX = 1600,
                           DFREQ(3,3,1) = .00164,
AGRIELEV(1) = 1,
                          DFREQ(4,3,1) = .00053,
AGRIELEV(2) = 1.02,
                            DFREQ(5,3,1) = .00005,
AGRIELEV(3) = 0,
                            DFREQ(6, 3, 1) = 0,
AGRIELEV(4) = 0,
                          DFREQ(1, 4, 1) = .00029,
DWELLELEV = 0,
                           DFREQ(2,4,1) = .00132,
SWELEV = 0,
                           DFREQ(3, 4, 1) = .00168,
WIND = 2.7373,
                          DFREQ(4, 4, 1) = .00176,
WINDSPEED(1) = .895,
                          DFREQ(5, 4, 1) = .00059,
WINDSPEED(2) = 2.46,
                          DFREQ(6, 4, 1) = .00009,
WINDSPEED(3) = 4.475,
                            DFREQ(1, 5, 1) = 0,
WINDSPEED(4) = 6.93,
                            DFREQ(2,5,1) = .00244,
WINDSPEED(5) = 9.61,
                            DFREQ(3, 5, 1) = .00051,
WINDSPEED(6) = 12.52,
                            DFREQ(4, 5, 1) = 0,
ATGRID = 10,
                            DFREQ(5, 5, 1) = 0,
                            DFREQ(6, 5, 1) = 0,
                            DFREQ(1, 6, 1) = .00938,
                            DFREQ(2, 6, 1) = .00548,
                            DFREQ(3, 6, 1) = 0,
```

DFREQ(4, 6, 1) = 0, DFREQ(5, 6, 1) = 0,DFREQ(6, 6, 1) = 0,

12.43 TEST CASE 034-019 TESTER'S REPORT

Documented in Test-034-019_report.docx of 2/20/2020 7:33 PM

Test Case 034-019 report

By cheng wang 2/18/2020

Objective: To test the functionality of Water Use form.

Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

Consumption per person Storace body well needs Use indoors of dwelling per person Storace body 1 4 Beef cattle per animal 50 Liters/day 0 1 Dairy cows per animal 160 Liters/day 0 1	Water Use					
Consumption per person Suitace body Well meeds Use indoors of dwelling per person 225 Liters/day 0 1 4 Beef cattle per animal 50 Liters/day 0 1 2 Dairy cows per animal 50 Liters/day 0 1 2 Irrigation applied to: rainon-leafy vegetables 2 m per year 0 1 7000 Lafy vegetables 2 m per year 0 1 7000 1 7000 Livestock feed grain 2 m per year 0 1 70000 1 70000 Well pumping rate: 2 m per year 0 1 70000 10000 70000				Fraction o	f water from	
Consumption per person 510 Liters/year 0 1 Use indoors of dwelling per person 225 Liters/day 0 1 Beef cattle per animal 50 Liters/day 0 1 2 Dairy cows per animal 160 Liters/day 0 1 2 Irrigation applied to: rolling per person 2 m per year 0 1 2 Fruit, grain, non-leafy vegetables .2 m per year 0 1 7000 Pasture, silage .2 m per year 0 1 7000 Uivestock feed grain .2 m per year 0 1 7000 Offsite dwelling site .2 m per year 0 1 7000 Well pumping rate: .2 m per year 0 1 7000 Well pumping rate .2 m per year 0 1 7000	Description of water usage	Quantity		Surface body	₩ell	compute well water
Use indoors of dwelling per person 225 Liters/day 0 1 Beef cattle per animal 50 Liters/day 0 1 2 Daity cows per animal 160 Liters/day 0 1 2 Irrigation applied to: r 0 1 2 Fruit, grain, non-leafy vegetables 2 m per year 0 1 1000 Pasture, silage 2 m per year 0 1 10000 Urivestock feed grain 2 m per year 0 1 10000 Offaite dwelling site 2 m per year 0 1 10000 Well pumping rate: \$100 cubic meters/year \$04.17 cubic meters/year	Consumption per person	510	Liters/year	0	1	
Dairy cows per animal 160 Liters/day 0 1 Z Irrigation applied to: s of Plot Equare me Fruit, grain, non-leafy vegetables 2 m per year 0 1 70000 Leafy vegetables 2 m per year 0 1 70000 Pasture, silage 2 m per year 0 1 70000 Offsite dwelling site 2 m per year 0 1 70000 Well pumping rate: \$100 cubic meters/year Well pumping rate \$5084.17 cubic meters/year	Use indoors of dwelling per person	225	Liters/day	0	1	- <u>•</u>
Irrigation applied to: a net way 0 1 2 of Plot (square metric) Fruit, grain, non-leafy vegetables 2 m per year 0 1 1000 1000 Leafy vegetables .2 m per year 0 1 1000 1000 Pasture, silage .2 m per year 0 1 10000 10000 Urystock feed grain .2 m per year 0 1 10000 10000 Offsite dwelling site .2 m per year 0 1 10000 10000 Well pumping rate: .2 .5084.17 cubic meters/year cubic meters/year	Beef cattle per animal	50	Liters/day	0	1	2
Fruit, grain, non-leafy vegetables 2 m per year 0 1 7000 Leafy vegetables 2 m per year 0 1 1000 Pasture, silage .2 m per year 0 1 1000 Livestock feed grain .2 m per year 0 1 1000 Offsite dwelling site .2 m per year 0 1 1000 Well pumping rate: .5100 cubic meters/year	Dairy cows per animal	160	Liters/day	0	1	2
Leafy vegetables ,2 m per year 0 1 1000 Pasture, silage ,2 m per year 0 1 10000 Livestock feed grain ,2 m per year 0 1 10000 Offsite dwelling site ,2 m per year 0 1 10000 Well pumping rate: \$100 cubic meters/year 5004,17 cubic meters/year	Irrigation applied to:					a of Plot (square me
Pasture, silage 2 m per year 0 1 10000 Livestock feed grain 2 m per year 0 1 10000 Offsite dwelling site 2 m per year 0 1 10000 Well pumping rate: 5100 cubic meters/year Well pumping rate needed to support specified water use: 5004.17 cubic meters/year	Fruit, grain, non-leafy vegetables	.2	m per year	0	1	1008
Livestock feed grain Offsite dwelling site Well pumping rate: Well pumping rate needed to support specified water use: 5100 5004.17 cubic meters/year 5004.17 cubic meters/year	Leafy vegetables	.2	m per year	0	1	1000
Offsite dwelling site 2 n per year 0 1 7000 Well pumping rate: 5100 cubic meters/year Well pumping rate needed to support specified water use: 5100 cubic meters/year	Pasture, silage	.2	m per year	0	1	10000
Well pumping rate: 5100 cubic meters/year Well pumping rate needed to support specified water use: 5084.17 cubic meters/year	Livestock feed grain	.2	m per year	0	1	10000
Well pumping rate needed to support specified water use: 5084.17 cubic meters/year	Offsite dwelling site	.2	m per year	0	1	1000
	Well pumping rate:		5	<mark>100</mark> cu	ibic meters/ye	ear
Save	Well pumping rate needed to suppor	t specified wa	ter use: 5	084.17 CU	ibic meters/ye	ear
Cancel	-					

Procedure:

1) Open Water Use form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

			Fraction of	water from	Number of individuals to
Description of water usage	Quantity		Surface body	Well	compute well wate needs
Consumption per person	510	Liters/year	0	1	
Use indoors of dwelling per person	225	Liters/day	0	1	4
Beef cattle per animal	50	Liters/day	0	1	2
Dairy cows per animal	160	Liters/day	0	1	2
Irrigation applied to:		-			a of Plot (square n
Fruit, grain, non-leafy vegetables	.2	m per year	0	1	1000
Leafy vegetables	.2	m per year	0	1	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.2	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000
Well pumping rate:		- 5	100 cu	bic meters/ye	ar
Well pumping rate needed to support	t specified wa	iter use: 5	084.17 cu	bic meters/ye	ar
-	-	Save			

Worked as expected.

2) It should have the same input boxes as the figure has.

Worked as expected.

3) Check the Area of Plot; which should be grayed out and consistent with the inputs in Site Layout form.

Worked as expected, as shown in the screenshot of Step 1).

4) Check the Fraction of water values. The summation of two columns should be 1.

Worked as expected, as shown in the screenshot of Step 1).

5) Changes at least two values in each column, save the form, and save the project to Test31.rof.

Made the following changes.

			Fraction of	f water from	Number of individuals to
Description of water usage	Quantity		Surface body	Well	compute well water needs
Consumption per person	515	Liters/year	.5	.5	
Use indoors of dwelling per person	225	Liters/day	0	1	4
Beef cattle per animal	50	Liters/day	.4	0.6	3
Dairy cows per animal	166	Liters/day	0	1	2
Irrigation applied to:		-			3 of Plot (square m
Fruit, grain, non-leafy vegetables	.25	m per year	0	1	1000
Leafy vegetables	.2	m per year	.3	0.7	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.26	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000
Well pumping rate:		-	757 cu	bic meters/ye	ar
Well pumping rate needed to support	t specified wa	iter use: 5	673.891 cu	bic meters/ye	ar
		Save		1	
		Cancel			

6) Check the following variables in the generated file; they should be the same as inputs in the GUI. DWI, FDWI, FSWD, FWWD, HHW, FSWHH, FWWHH, LWI, FSWLV, FWWLV, FSWIR, FWWIR, FSWIRDWELL, FWWIRDWELL, NDWI, NLWI, UW

, , _ , , _ , _
DWI = 515,
FDWI = 1,
FSWD = .5,
FWWD = .5,
HHW = 225,
FSWHH = 0,
FWWHH = 1,
LWI(1) = 50,
LWI(2) = 166,
FSWLV(1) = .4,
FWWLV(1) = .6,
FSWLV(2) = 0,
FWWLV(2) = 1,
FSWIR(1) = 0,
FWWIR(1) = 1,
FSWIR(2) = .3,
FWWIR(2) = .7,
FSWIR(3) = 0,
FWWIR(3) = 1,
FSWIR(4) = 0,
FWWIR(4) = 1,
FSWIRDWELL = 0,
FWWIRDWELL = 1,
NDWI = 4,
NLWI(1) = 3,
NLWI(2) = 2,
UW = 5757,

12.44 TEST CASE 034-020 TESTER'S REPORT

Documented in Test-034-020_report.docx of 2/20/2020 7:34 PM

Test Case 034-020 report

By cheng wang 2/18/2020

Objective: To test the functionality of Unsaturated Zones form.

Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

Unsaturated Zone Hydrology	
Number of unsaturated zones: set in	1
Unsaturated zone number	: 1:
Thickness (meters)	4
Dry bulk density (grams/cm?	1.5
Total porosity	.4
Effective porosity	.2
Field capacity	.3
Hydraulic conductivity (meters/year)	10
b parameter	5.3
Longitudinal dispersivity (meters)	.1
Save Cancel	

Procedure:

1) Open Unsaturated Zones form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

F	
Unsaturated Zone Hydrology	
Number of unsaturated zones: set in preliminary inputs form	1
Unsaturated zone numbe	r: 1:
Thickness (meters)	4
Dry bulk density (grams/cm?	1.5
Total porosity	.4
Effective porosity	.2
Field capacity	.3
Hydraulic conductivity (meters/year)	10
b parameter	5.3
Longitudinal dispersivity (meters)	.1
Save Cancel	

2) It should have the same input boxes as the figure has.

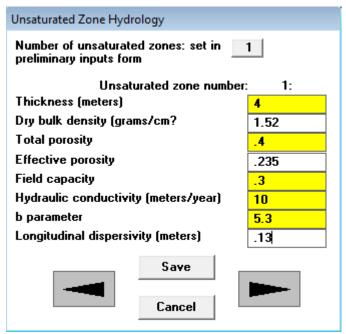
As shown in the screenshot of Step 1).

3) Clicking the Number of Unsaturated Zones should bring up the Preliminary Inputs form Worked as expected.

<complex-block><complex-block>

4) Modify at least two values for each unsaturated zone, save the form, and the save the project to Test32.rof.

Made the following changes.



5) Check the following variables in the generated file; they should be the same as inputs in GUI. H, DENSUZ, TPUZ, EPUZ, FCUZ, HCUZ, BUZ, ALPHALU

12.45 TEST CASE 034-021 TESTER'S REPORT

Documented in Test-034-021_report.docx of 2/20/2020 7:35 PM

Test Case 034-021 report

By Cheng Wang 2/18/2020

Objective: Test the functionality of Saturated Zone form

Conclusion: the code worked as expected

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

Saturated Zone Hydrology		
Thickness of saturated zone: Dry bulk density of saturated zone: Iotal porosity of saturated zone: Effective porosity of saturated zone: Hydraulic conductivity of saturated zone:	100 1.5 .4 .2 100	grams/cm? meters/year
	to well	to surface waterbody
Hydraulic gradient of saturated zone:	.02	.02
Depth of aquifer contributing:	10	5 meters below water table
Longitudinal dispersivity of saturated zone:	3	10 meters
Horizontal lateral dispersivity of saturated zone:	.4	1 meters
Vertical lateral dispersivity of saturated zone:	.02	.06 meters
	Save Cancel	

Procedure:

1) Open Saturated Zone form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

Thickness of saturated zone:		100		meters	
Dry <u>b</u> ulk density of saturated zone:		1.5		grams	'cm?
<u>I</u> otal porosity of saturated zone:		.4			
Effective porosity of saturated zone:		.2			
Hydraulic conductivity of saturated zone:		100		meters	/year
	to	well		urface erbody	
Hydraulic gradient of saturated zone:	.02		.02		
Depth of aquifer contributing:	10		5		meters below water table
Longitudinal dispersivity of saturated zone:	3		10		meters
Horizontal lateral dispersivity of saturated zone:	.4		1		meters
Vertical lateral dispersivity of saturated zone:	.02		.06		meters
Vertical lateral dispersivity of saturated zone:	.02 Save Cance		.06 I		meters

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Modify at least two values for each unsaturated zone, save the form, and the save the project to Test33.rof.

Made the following changes.

Saturated Zone Hydrology					
Thickness of saturated zone:		101		meters	
Dry bulk density of saturated zone:		1.51		grams.	/cm?
Total porosity of saturated zone:		.4			
Effective porosity of saturated zone:		.21			
Hydraulic conductivity of saturated zone:		100		meters	/year
	to	well		urface erbody	
Hydraulic gradient of saturated zone:	.023		.025		
Depth of aquifer contributing:	10		5		meters below water table
Longitudinal dispersivity of saturated zone:	3		10		meters
Horizontal lateral dispersivity of saturated zone:	.41		3		meters
Vertical lateral dispersivity of saturated zone:	.02		.06		meters
	Save Cance				

4) Check the following variables in the generated file; they should be the same as inputs in GUI. DPTHAQ, DENSAQ, TPSZ, EPSZ, HCSZ, HGW, DWIBWT, ALPHALOW, ALPHATW, ALPHAVW, HGSW, DPTHAQSW, ALPHALOSW, ALPHATSW, ALPHAVSW

```
DPTHAQ = 101,

DENSAQ = 1.51,

TPSZ = .4,

EPSZ = .21,

HCSZ = 100,

HGW = .023,

DWIBWT = 10,

ALPHALOW = 3,

ALPHATW = .41,

ALPHAVW = .02,

HGSW = .025,

DPTHAQSW = 5,

ALPHALOSW = 10,

ALPHATSW = 3,

ALPHAVSW = .06,
```

12.46 TEST CASE 034-022 TESTER'S REPORT

Documented in Test-034-022_report.docx of 2/18/2020 9:29 PM

Test Case 034-022 report

By cheng wang 2/18/2020

Objective: To test the functionality of Groundwater Transport form.

Conclusion: the code worked as expected.

Procedure:

1) Open Groundwater Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

W	ater Use Parameters		
,			
Unsaturated Zone Properti	saturated Zone Pro	operties	
istance in the direction parallel to agu	ifer flow from downgradient edge of	contaminativ	an to
• •	well:	100	meters
	surface water body:	450	meter
istance in the direction perpendicular			
	well:		meters
	right edge of surface water body:	-150	meter
	left edge of surface water body:	-150 150	meter
onvergence criterion (fractional accur		.001	
umber of sub zones (to model dipsersi	on of progeny produced in transit):		
Main sub zones in primary contaminati	on	1	
Main sub zones in submerged primary	contamination	1	
Main sub zones in each partially satur	ated zone	1	_
Main sub zones in saturated zone		1	
 nuclide specific retardation in all se transformation 	ub zones, longitudinal dispersion in a	Il but the su	ıb zone of
O longitudinal dispersion in all sub zo transformation, parent retardation i	nes, nuclide specific retardation in a n zone of transformation	II but the su	ıb zone of
	nes, nuclide specific retardation in a in zone of transformation	all but the su	ıb zone of

Cancel

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Clicking the three buttons should bring up the forms of Water Use, Unsaturated Zones, and Saturated Zone

Worked as expected.

4) Check the options for subzone dispersion; they should respond to selection

Worked as expected.

5) Change at least three values, save the form, and then save the project to Test34.rof

Made the following changes.

Sub Screens				
	Wate <u>r</u> Use Para	meters		
<u>Unsaturated</u> Zone	Properties	Sa <u>t</u> urated Zone Pro	perties	
Distance in the direction parall	el to aquifer flow from	downgradient edge of	contaminatio	on to
	<u>w</u> ell:		101	meters
	<u>s</u> urface water	body:	452	meters
Distance in the direction perpe	ndicular to aquifer flow	from center of contan	ination to	
	w <u>e</u> ll:		0	meter
	right edge of	surface water body:	-150	meter
	left edge of s	urface water body:	155	meter
Convergence criterion (fraction	al accuracy desired):		.001	
Number of sub zones (to model	dipsersion of progeny	produced in transit):		
Main sub zones in primary cor	ntamination		2	
Main sub zones in submerged	primary contamination		1	
Main sub zones in each partia	ally saturated zone		3	
Main sub zones in saturated z	one		4	
 nuclide specific retardation transformation 	n in all sub zones, lon <u>c</u>	jitudinal dispersion in a	ll but the su	lb zone of
 longitudinal dispersion in a transformation, parent reta 	II sub zones, nuclide s rdation in zone of tran	pecific retardation in a sformation	ll but the su	ib zone of
O longitudinal dispersion in a transformation, progeny rel	II sub zones, nuclide s tardation in zone of tra	pecific retardation in a nsformation	ll but the su	ıb zone of

6) Check the following variables in the generated file; they should be the same as inputs in GUI. OFFLPAQW, OFFLPAQS, OFFLNAQW, OFFLNAQSN, OFFLNAQSF, EPS, NPCM, NPCMF, NPCZ, NPCZF, NSPCZ, NSPCZF, NPSS, NPSSF, NAQS, NAQSF

Worked as expected.

OFFLPAQW = 101, OFFLPAQS = 452, OFFLNAQW = 0, OFFLNAQSN =-150, OFFLNAQSF = 155, EPS = .001,NPCM = 1, NPCMF = 1, NPCZ = 2, NPCZF = 1, NSPCZ = 1,NSPCZF = 1,NPSS = 3,NPSSF = 1, NAQS = 4, NAQSF = 1,

12.47 TEST CASE 034-023 TESTER'S REPORT

Documented in Test-034-023_report.docx of 2/20/2020 7:37 AM

Test Case 034-023 report

By cheng wang 2/18/2020

Objective: To test the functionality of Surface Water Body form.

Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

Surface Water Body					
Surface area of water in surface water body:		90000	square meters		
Volume of surface water body:		150000	cubic meters		
Potential evaporation:		1	m/year		
Stream outflow (as a fraction of total outflow)		0.9983	🗸 use inflow ratio		
Settling velocity of sediments		.1	cm/s		
Density of bottom sediment		1.5 (grams/cm?		
Thickness of bottom sediment layer in adsorption/desorption equilibrium of radionuclids with water		.05	m		
Sediment from primary contamination delivery i	atio	1			
Number of catchment areas	1 1				
Characteristics of catchment area	1				
Smaller X coordinate (meters)	-1450				
Larger X coordinate (meters)	1550				
Smaller Y coordinate (meters)	-2450				
Larger Y coordinate (meters)	550				
Surface area (square meters)	900000				
Runoff coefficient	.2				
Soil erodibility factor (tons/acre):	.4				
Slope-length-steepness factor:	.4				
Cover and management factor:	.003				
Support practice factor	1				
Sediment delivery ratio	0.2121	🔽 estimate u	sing catchment area		
Fraction of deposited radionuclides reaching Surface water body	.02				
 Model atmospheric deposition on catchment Approximate by atmospheric release 					
Convergence criterion for atmospheric deposition					
	Save	_			
	- · · ·				
	Cancel				

Procedure:

1) Open Surface Water Body form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

Surface area of water in surface water body:		90000	square meters
Volume of surface water body:		150000	cubic meters
Potential evaporation:		1	m/year
Stream outflow (as a fraction of total outflow)		0.9983	🔽 use inflow ratio
Settling velocity of sediments		.1	cm/s
Density of bottom sediment		1.5	grams/cm?
Thickness of bottom sediment layer in adsorption/desorption equilibrium of radionuclids with water		.05	m
Sediment from primary contamination delivery r	atio	1	
Number of catchment areas	1 • •		
Characteristics of catchment area	1		
Smaller X coordinate (meters)	-1450		
Larger X coordinate (meters)	1550		
Smaller Y coordinate (meters)	-2450		
Larger Y coordinate (meters)	550		
Surface area (square meters)	9000000		
Runoff coefficient	.2		
Soil erodibility factor (tons/acre):	.4		
Slope-length-steepness factor:	.4		
Cover and management factor:	.003		
Support practice factor	1		
Sediment delivery ratio	0.2121	🔽 estimate u	sing catchment area
Fraction of deposited radionuclides reaching Surface water body	.02		
 Model atmospheric deposition on catchmen Approximate by atmospheric release 	t		
Convergence criterion for atmospheric deposit	ion	.001	
			1
	0		
	Save		

2) It should have the same input boxes as the figure has.

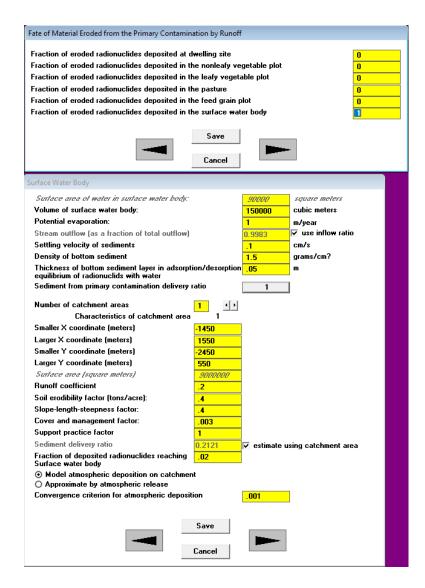
As shown in the screenshot of Step 1).

3) Check the Surface area of water body, which should be consistent with the inputs in Site Layout form

Bearing of X axis (clockwise angle from North) X dimension of primary contamination		90	degrees meters		
Y dimension of primary contamination			meters		
annension of primary containination		100	meters		
Location	Smaller X Coo	Larger rdinate	Smaller Y Coo	Larger rdinate	
Fruit, grain, non-leafy vegetables plot		65.625	234	266	meter
Leafy vegetables plot	34.375	65.625	268	300	meter
Pasture, silage growing area	0	100	450	550	meter
Grain fields	0	100	300	400	meter
Dwelling site	34.375	65.625	134	166	meter
Surface water body	-100	200	550	850	meter
	Displa	у Мар			
Surface Water Body		_			
Surface area of water in surface wa	ter body:			ware meters	
	Volume of surface water body:			bic meters	
Potential evaporation:				'year	
Stream outflow (as a fraction of total outflow) 0.9983			io		
Settling velocity of sediments cm/s					
Density of bottom sediment 1.5 grams/cm?					
Number of catchment areas					
Characteristics of catch	ment area	1			
Smaller X coordinate (meters)	_				
Smaller X coordinate (meters) Larger X coordinate (meters)	-	1			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters)	-	1 1450			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters)		1 1450 1550 2450 550			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) Surface area (square meters)		1 1450 1550 2450 550 9000000			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) Surface area (square meters) Runoff coefficient		1 1450 1550 2450 550 9000000 2			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) <i>Surface area (square meters)</i> Runoff coefficient Soil erodibility factor (tons/acre):		1 1450 1550 2450 550 9000000 2 2 4			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) <i>Surface area (square meters)</i> Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor:		1 1450 2550 2450 550 9000000 2 2 4 4 4			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) <i>Surface area (square meters)</i> Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor:		1 1450 1550 2450 550 2 900000 2 2 4 4 4 003			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) <i>Surface area (square meters)</i> Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor		1 1450 1550 2450 550 2 2 4 4 4 4 4 003			
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) Surface area (square meters) Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor Sediment delivery ratio Fraction of deposited radionuclides		1 1450 1550 2450 550 2 2 4 4 4 4 4 003	estimate using	j catchment ai	ea
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) Larger Y coordinate (meters) Surface area (square meters) Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor Sediment delivery ratio Fraction of deposited radionuclides i Surface water body © Model atmospheric deposition on	reaching	1 1450 1550 2450 550 550 550 2 4 4 4 4 003 .2121 ↓	estimate usin <u>c</u>	j catchment aj	ea
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) Surface area (square meters) Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor Sediment delivery ratio Fraction of deposited radionuclides factor surface water body © Model atmospheric deposition on Q Approximate by atmospheric releated to the surface stress of the	reaching catchment ase	1 1450 1550 2450 550 2 2 4 4 4 4 003 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		ı catchment aı	ea
Smaller X coordinate (meters) Larger X coordinate (meters) Smaller Y coordinate (meters) Larger Y coordinate (meters) Larger Y coordinate (meters) Surface area (square meters) Runoff coefficient Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor Sediment delivery ratio Fraction of deposited radionuclides i Surface water body To Model atmospheric deposition on	reaching catchment ase	1 1450 1550 2450 550 2 2 4 4 4 4 003 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	^r estimate using 001	ı calchment aı	ea

The values matched.

4) Check the Sediment Delivery ration button, which should be consistent with the input in Sediment Delivery Ration form. Clicking it should bring up the Sediment Delivery Ratio form.



5) Check the Number of catchment areas. The left and right arrow button should allow delete or add one catchment with default settings

Contains and at makes in and and we took - too		00000	annan matara
Surface area of water in surface water body:		90000	square meters
Volume of surface water body:		150000	cubic meters
Potential evaporation:		1	m/year ▼ use inflow ratio
Stream outflow (as a fraction of total outflow)		0.9983	
Settling velocity of sediments		.1	cm/s
Density of bottom sediment		1.5	grams/cm?
Thickness of bottom sediment layer in adsorptio equilibrium of radionuclids with water	on/desorption	.05	m
Sediment from primary contamination delivery ra	atio	1	
	2 • •		
Characteristics of catchment area	1	2	
	-1450	-1450	
Larger X coordinate (meters)	1550	-1125	
	-2450	550	
Larger Y coordinate (meters)	550	600	
Surface area (square meters)	9000000	16250	
Runoff coefficient	.2	.2	
Soil erodibility factor (tons/acre):	.4	.4	
Slope-length-steepness factor:	.4	.4	
		.003	
Cover and management factor:	.003	.000	
Support practice factor	.003 1	1	
Support practice factor			
Support practice factor	1	1	
Support practice factor Sediment delivery ratio Fraction of deposited radionuclides reaching Surface water body • Model atmospheric deposition on catchment	1 0.2121 .02	1	
Support practice factor Sediment delivery ratio Fraction of deposited radionuclides reaching Surface water body	1 0.2121 .02	1	

6) Validate the catchment area using the coordinates

Surface Water Body					
Surface area of water in surface water body:		90000	square meters		
Volume of surface water body:		150000	cubic meters		
Potential evaporation:		1	m/year		
Stream outflow (as a fraction of total outflow)		0.9983	🔽 use inflow ratio		
Settling velocity of sediments		.1	cm/s		
Density of bottom sediment		1.5	grams/cm?		
Thickness of bottom sediment layer in adsorpti equilibrium of radionuclids with water	.05	m			
Sediment from primary contamination delivery i	1				
Number of catchment areas	2 ()				
Characteristics of catchment area		2			
Smaller X coordinate (meters)	-1450	-1450			
Larger X coordinate (meters)	1550	-1125			
Smaller Y coordinate (meters)	-2450	550			
Larger Y coordinate (meters)	550	600			
Surface area (square meters)	900000	16250			
Runoff coefficient	.2	.2			
Soil erodibility factor (tons/acre):	.4	.4			
Slope-length-steepness factor:	.4	.4			
Cover and management factor:	.003	.003			
Support practice factor	1	1			
Sediment delivery ratio	0.2121	1			
Fraction of deposited radionuclides reaching Surface water body	.02	.02			
 Model atmospheric deposition on catchment 	ıt				
O Approximate by atmospheric release					
Convergence criterion for atmospheric deposition		.001			
Save					
Cancel					

The values matched.

7) Modify at least three values in each column, save the form, and then save the project to Test35.rof

Made the following changes.

Surface Water Body			
Surface area of water in surface water body:		90000	square meters
Volume of surface water body:	150000	cubic meters	
Potential evaporation:		1.1	m/year
Stream outflow (as a fraction of total outflow)		0.9983	✓ use inflow ratio
Settling velocity of sediments		.12	cm/s
Density of bottom sediment		1.56	grams/cm?
Thickness of bottom sediment layer in adsorpti equilibrium of radionuclids with water	ion/desorption	.05	m
Sediment from primary contamination delivery i	atio	1	
Number of catchment areas	2 1 1		
Characteristics of catchment area	1	2	
Smaller X coordinate (meters)	-1450	-1450	
Larger X coordinate (meters)	1550	-1125	
Smaller Y coordinate (meters)	-2450	550	
Larger Y coordinate (meters)	550	600	
Surface area (square meters)	9000000	16250	
Runoff coefficient	.2	.2	
Soil erodibility factor (tons/acre):	.41	.42	
Slope-length-steepness factor:	.4	.4	
Cover and management factor:	.0032	.0034	
Support practice factor	1	1	
Sediment delivery ratio	0.2121	1	
Fraction of deposited radionuclides reaching Surface water body	.023	.024]
 Model atmospheric deposition on catchment 	ł		
O Approximate by atmospheric release			
Convergence criterion for atmospheric deposit	.001		
	Save		
	Cancel		

8) Check the following variables in the generated file; they should be the same as the inputs in GUI. ALAKE, VLAKE, EVAPOT, FSTMFLOW, FSTMFLOWIN, VSETTLE, RHOBSED, THICKSED, SDR, NCATCH, CATCHXY, AREACA, RUNOFFCA, ERODIBILITYCA, SLPLENSTPCA, CRPMANGCA, CONVPRACCA, SDRCA, SDRACOR, DDRCA, COMPUTEDEP, CONVCRITATM

ALAKE = 90000,		
VLAKE = 150000,		
EVAPOT = 1.1,	AREACA(9) = 32500,	
FSTMFLOW = .9983,	AREACA(10) = 16250,	CONVPRACCA(1) = 1,
FSTMFLOWIN = 1,	RUNOFFCA(1) = .2,	CONVPRACCA(2) = 1,
VSETTLE = .12,	RUNOFFCA(2) = .2,	
RHOBSED = 1.56 ,	RUNOFFCA(3) = $.2$,	CONVPRACCA(3) = 1, CONVPRACCA(4) = 1,
THICKSED = .05,	RUNOFFCA(4) = .2,	
SDR = 1,	RUNOFFCA(5) = .2,	CONVPRACCA(5) = 1,
NCATCH = 2,	RUNOFFCA(6) = .2,	CONVPRACCA(6) = 1,
CATCHXY(1,1) =-1450,	RUNOFFCA $(7) = .2$,	CONVPRACCA(7) = 1,
CATCHXY(1,2) =-1450,	RUNOFFCA(8) = $.2$,	CONVPRACCA(8) = 1,
CATCHXY(1,3) =-1125,	RUNOFFCA(9) = $.2$,	CONVPRACCA(9) = 1,
CATCHXY(1,4) =-800,	RUNOFFCA $(10) = .2$,	CONVPRACCA(10) = 1,
CATCHXY(1,5) =-450,	ERODIBILITYCA(1) = .41,	SDRCA(1) = .2121,
CATCHXY(1,6) =-200,	ERODIBILITYCA(2) = $.42$,	SDRACOR = 0,
CATCHXY(1,7) = 200,	ERODIBILITYCA(3) = $.4$,	SDRCA(2) = 1,
CATCHXY(1, 8) = 550,		SDRCA(3) = 1,
CATCHXY(1,9) = 900,	ERODIBILITYCA(4) = $.4$,	SDRCA(4) = 1,
CATCHXY(1, 10) = 1225,	ERODIBILITYCA(5) = $.4$,	SDRCA(5) = 1,
CATCHXY(2,1) = 1550,	ERODIBILITYCA(6) = .4,	SDRCA(6) = 1,
CATCHXY(2,2) =-1125,	ERODIBILITYCA(7) = $.4$,	SDRCA(7) = 1,
CATCHXY(2,3) =-800,	ERODIBILITYCA(8) = .4,	SDRCA(8) = 1,
CATCHXY(2, 4) = -450,	ERODIBILITYCA(9) = .4,	SDRCA(9) = 1,
CATCHXY(2,5) =-100,	ERODIBILITYCA(10) = $.4$,	SDRCA(10) = 1,
CATCHXY(2, 6) = 300,	SLPLENSTPCA(1) = .4,	DDRCA(1) = .023,
CATCHXY(2,7) = 550,	SLPLENSTPCA(2) = .4,	DDRCA(2) = .024,
CATCHXY(2, 8) = 900,	SLPLENSTPCA(3) = .4, SLPLENSTPCA(4) = .4,	DDRCA(3) = .02,
CATCHXY(2,9) = 1225,	SLPLENSIFCA(4) = .4, SLPLENSTPCA(5) = .4,	DDRCA(4) = .02,
CATCHXY(2, 10) = 1550,	SLPLENSTPCA(6) = .4,	DDRCA(5) = .02,
CATCHXY(3,1) =-2450,	SLPLENSTPCA(7) = .4,	DDRCA(6) = .02,
CATCHXY(3,2) = 550,	SLPLENSTPCA(8) = $.4$,	DDRCA(7) = .02,
CATCHXY(3,3) = 550,	SLPLENSTPCA(9) = $.4$,	DDRCA(8) = .02,
CATCHXY(3, 4) = 550,	SLPLENSTPCA(10) = .4,	DDRCA(9) = .02,
CATCHXY(3, 5) = 550,	CRPMANGCA(1) = .0032,	DDRCA(10) = .02,
CATCHXY(3, 6) = 850,	CRPMANGCA(2) = .0034,	COMPUTEDEP = 1,
CATCHXY(3,7) = 550,	CRPMANGCA(3) = .003,	CONVCRITATM = .001,
CATCHXY(3,8) = 550,	CRPMANGCA(4) = .003,	
CATCHXY(3,9) = 550,	CRPMANGCA(5) = .003,	
CATCHXY(3, 10) = 550,	CRPMANGCA(6) = .003,	
CATCHXY(4, 1) = 550,	CRPMANGCA(7) = .003,	
CATCHXY(4, 2) = 600,	CRPMANGCA(8) = .003,	
CATCHXY(4, 3) = 650,	CRPMANGCA(9) = .003,	
CATCHXY(4, 4) = 775,	CRPMANGCA(10) = .003,	
CATCHXY(4, 5) = 850,		
CATCHXY(4, 6) = 900,		
CATCHXY(4,7) = 850,		
CATCHXY(4, 8) = 775,		
CATCHXY(4,9) = 650,		
CATCHXY(4, 10) = 600,		
AREACA(1) = 9000000,		
AREACA(2) = 16250,		
AREACA(3) = 32500,		
AREACA(4) = 78750,		
AREACA(5) = 105000,		
AREACA(6) = 25000,		
AREACA(7) = 105000,		
AREACA(8) = 78750.		

12.48 TEST CASE 034-024 TESTER'S REPORT

Documented in Test-034-024_report.docx of 2/20/2020 7:38 AM

Test Case 034-024 report

By cheng wang 2/18/2020

Objective: To test the functionality of Ingestion Rates form.

Conclusion: the code worked as expected.

Procedure:

1) Open Surface Water Body form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

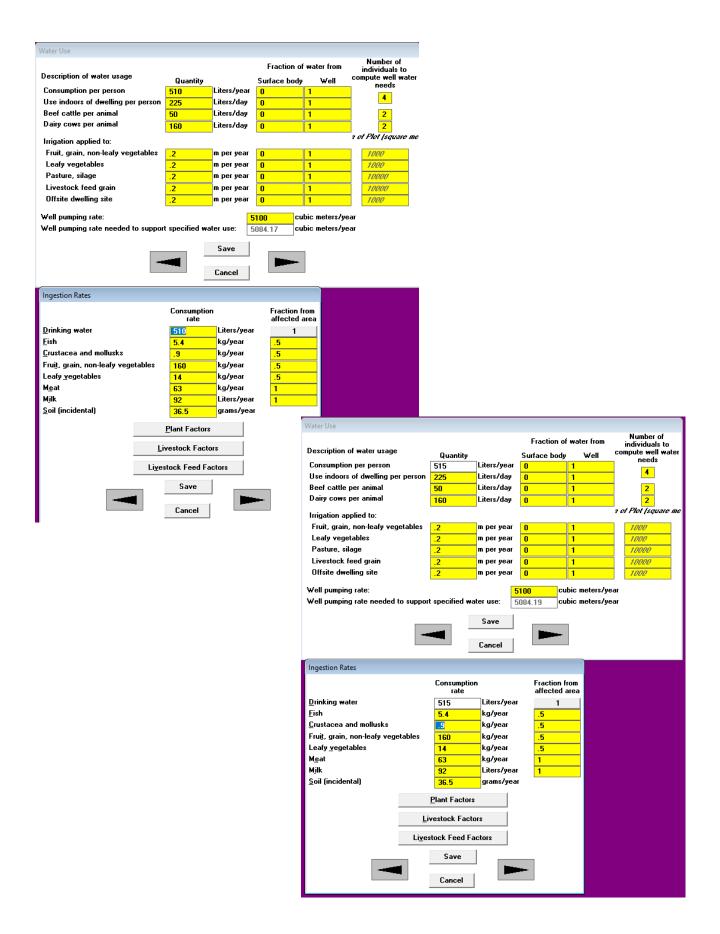
_				
Ingestion Rates				
		Consumption rate		Fraction from affected area
<u>D</u> rinking water		510	Liters/year	1
<u>F</u> ish		5.4	kg/year	.5
<u>C</u> rustacea and mollusks		.9	kg/year	.5
Frui <u>t,</u> grain, non-leafy vege	tables	160	kg/year	.5
Leafy <u>v</u> egetables		14	kg/year	.5
M <u>e</u> at		63	kg/year	1
Mjik		92	Liters/year	1
<u>S</u> oil (incidental)		36.5	grams/year	
	E	lant Factors	_	
Livestock Factors				
Livestock Feed Factors				
Save Cancel				

Worked as expected.

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Check the Drinking Water Consumption rate, which should be consistent with the input in Water Use form. Medication of either one should change the other one automatically.



Worked as expected.

4) Check the Drinking water fraction from affected area, which should be consistent with the inputs from Water Use form. Clicking of this button should bring up the Water Use form.

Water Use						
Description	of water usage			Fraction o	f water from	Number of individuals to compute well water
	2	Quantity		Surface body		compute well water , needs
	on per person	510	Liters/year	.6	.3	4
	rs of dwelling per person	225	Liters/day	0	1	
	e per animal	50	Liters/day	0	1	2
Dairy cow	s per animal	160	Liters/day	0	1	2
Irrigation a	pplied to:					a of Plot (square me
Fruit, grai	n, non-leafy vegetables	.2	m per year	0	1	1000
Leafy veg	etables	.2	m per year	0	1	1000
Pasture, s	alage	.2	m per year	0	1	10000
Livestock	feed grain	.2	m per year	0	1	10000
Offsite dw	elling site	.2	m per year	0	1	1000
			-			
Well pumpi	ng rate: ng rate needed to suppor	Lanasifind			ıbic meters/ye ıbic meters/ye	
wen hamhi	ny rate needed to suppor	t specifieu wa	ater use.	5082.742 CL	idic meters/ye	di
		_	Save		_	
		- 1 B				
			Cancel			
	ingestion Rates					
			Consumption	1	Fraction fro	
	D. 1		rate		affected ar	ea
	Drinking water		510	Liters/year	.9	_
	Fish		5.4	kg/year	.5	_
	<u>C</u> rustacea and mollusks		.9	kg/year	.5	
	Fruit, grain, non-leafy ve	egetables	160	kg/year	.5	_
	Leafy <u>v</u> egetables		14	kg/year	.5	_
	M <u>e</u> at		63	kg/year	1	_
	Mjik Californiana P		92	Liters/year	1	
	<u>S</u> oil (incidental)		36.5	grams/year		
		I	Plant Factors			
		Liv	estock Facto	rs		
	Livestock Feed Factors					
	Save					
			Cancel			

Worked as expected.

5) Check the three buttons. Clicking them should bring up forms of Plant Factors, Livestock Factors, and Livestock Feed Factors.

6) Modify at least two values in each column, save the form, and then save the project to Test36.rof.

Made the following changes.

Ingestion Rates					
		Consumption rate		Fraction from affected area	
Drinking water		518	Liters/year	.9	
<u>F</u> ish		5.4	kg/year	.5	
<u>C</u> rustacea and mollusks		.9	kg/year	.5	
Fruit, grain, non-leafy vegeta	bles	160	kg/year	.5	
Leafy <u>v</u> egetables		18	kg/year	.5	
M <u>e</u> at		63	kg/year	1	
Milk		99	Liters/year	1	
<u>S</u> oil (incidental)		36.5	grams/year		
	Ē	Plant Factors			
Livestock Factors					
	Li <u>v</u> est	ock Feed Fac	ctors		
		Save Cancel		•	

7) Check the following variables in the generated file; they should be the same as inputs in GUI. DFI,DVI, DMI, SOIL, FFISH, FVEG, FMEMI

DWI = 518,
DFI(1) = 5.4,
DFI(2) = .9,
DVI(1) = 160,
DVI(2) = 18,
DMI(1) = 63,
DMI(2) = 99,
SOIL = 36.5,
FFISH(1) = .5,
FFISH(2) = .5,
FVEG(1) = .5,
FVEG(2) = .5,
FMEMI(1) = 1,
FMEMI(2) = 1,

12.49 TEST CASE 034-025 TESTER'S REPORT

Documented in Test-034-025_report.docx of 2/20/2020 7:39 AM

Test Case 034-025 report

By cheng wang 2/18/2020

Objective: To test the functionality of Plant Factors form.

Conclusion: the code worked as expected.

Minor issue on the font format when computer system locale is Chinese; no issues when English (US) is used.

Plant Factors			
Crops		Fruit, grain, non-leafy	Leafy vegetables
Wet weight crop yiekd (kg/m?		.7	1.5
Duration of growing season (years)		.17	.25
Foliage to food transfer coefficient		.1	1
Weathering removal constant (1/year)		20	20
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot depth (meters)		1.2	.9
	Save Cancel		

Procedure:

1) Open Plant Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Plant Factors				
Сгоря	Fruit, grain, non-leafy	Leafy vegetables		
Wet weight crop yield (kg/m?	.7	1.5		
Duration of growing season (years)	.17	.25		
Foliage to food transfer coefficient	.1	1		
Weathering removal constant (1/year)	20	20		
Foliar interception factor for irrigation	.25	.25		
Foliar interception factor for dust	.25	.25		
<u>R</u> oot depth (meters)	1.2	.9		
Save Cancel				

Worked as expected.

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Modify at least two values in each column, save the form, and then save the project to Test37.rof.

Made the following changes.

Plant Factors			
Сгоря		Fruit, grain, non-leafy	Leafy vegetables
Wet weight crop yield (kg/m?		.71	1.52
Duration of growing season (years)		.17	.25
Foliage to food transfer coefficient		.13	1
Weathering removal constant (1/year)		22	24
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot depth (meters)		1.25	.95
	Save Cancel		

- 4) Check the following variables in the generated file; they should be the same as inputs in GUI. YIELD, GROWTIME, FOLI_F, RWEATHER, FINTCEPT, DROOT
 - YIELD(1) = .71, YIELD(2) = 1.52, GROWTIME(1) = .17, GROWTIME(2) = .25, FOLI_F(1) = .13, FOLI_F(2) = 1, RWEATHER(1) = 22, RWEATHER(2) = 24, FINTCEPT(1,2) = .25, FINTCEPT(2,2) = .25, FINTCEPT(2,1) = .25, DROOT(1) = 1.25, DROOT(2) = .95,

12.50 TEST CASE 034-026 TESTER'S REPORT

Documented in Test-034-026_report.docx of 2/18/2020 10:28 PM

Test Case 034-026 report

By cheng wang 2/18/2020

Objective: To test the functionality of Livestock Intakes form.

Conclusion: the code worked as expected.

Procedure:

1. Opened Livestock Intakes form and check it visually. Worked as expected.

Livestock Intakes		
	Beef cattle	Dairy cows
<u>₩</u> ater (liters/day)	50	160
Pasture, and silage (kg/day)	14	44
<u>G</u> rain (kg/day)	54	11
Soil from pasture and silage (kg/day)	.1	.4
Soiļ from grain (kg/day)	.4	.1
		•

2. made the following changes and save the project as test38.rof.

Livestock Intakes			
		Beef cattle	Dairy cows
<u>₩</u> ater (liters/day)		51	162
Pasture, and silage (kg/day)		14	44
<u>G</u> rain (kg/day)		55	15
Soil from pasture and silage (kg/day)		.1	.4
Soiļ from grain (kg/day)		.41	.12
	Save Cancel		

3. checked the values of LWI, LFI, LSI in the generated input file with the input values in the GUI.

LWI (1)	= 51,	LFI(1,1)	= 14,
LWI (2)	= 162,	LFI(1,2)	= 55,
		LFI(2,1)	= 44,
		LFI(2,2)	= 15,
		LSI(1,1)	= .1,
		LSI(1,2)	= .41,
		LSI(2,1)	= .4,
		LSI(2,2)	= .12,

12.51 TEST CASE 034-027 TESTER'S REPORT

Documented in Test-034-027_report.docx of 2/20/2020 7:40 AM

Test Case 034-027 report

By cheng wang 2/18/2019

Objective: To test the functionality of Livestock Feed Factors form.

Conclusion: the code worked as expected.

Minor issue on the font format when computer system locale is Chinese; no issues when English (US) is used.

Livestock Feed Factors			
Crops		Pasture, silage	Grain
Wet weight crop yiel (kg/m?		1.1	.7
Duration of growing season (years)		.08	.17
Foliage to food transfer coefficient		1	.1
Weathering removal constant (1/year)		20	20
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot depth (meters)		.9	1.2
	Save Cancel		

Procedure:

1. open Livestock Feed Factors form; check it visually.

Livestock Feed Factors		
Сгорз	Pasture, silage	Grain
Wet weight crop yield (kg/m?	1.1	.7
Duration of growing season (years)	.08	.17
Foliage to food transfer coefficient	1	.1
Weathering removal constant (1/year)	20	20
Foliar interception factor for irrigation	.25	.25
Foliar interception factor for dust	.25	.25
<u>R</u> oot depth (meters)	.9	1.2
	Save Cancel	

Worked as expected.

2. made the following changes and save the project as test39.rof.

Livestock Feed Factors			
Сгорз		Pasture, silage	Grain
Wet weight crop yield (kg/m?		1.12	.71
Duration of growing season (years)		.08	.17
Foliage to food transfer coefficient		1	.1
Weathering removal constant (1/year)		21	22
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for dust		.25	.25
<u>R</u> oot depth (meters)		.93	1.27
	Save Cancel		

3. Compared the value of the following variables in the test39.rof with the input one in the form: YIELD(3), YIELD(4), GROWTIME(3), GROWTIME(4), FOLI_F(3), FOLI_F(4), RWEATHER(3), RWEATHER(4), FINTCEPT(3,2), FINTCEPT(4,2), FINTCEPT(3,1), FINTCEPT(4,1), DROOT(3), DROOT(4)

```
YIELD (3) = 1.12,

YIELD (4) = .71,

GROWTIME (3) = .08,

GROWTIME (4) = .17,

FOLI_F (3) = 1,

FOLI_F (4) = .1,

RWEATHER (3) = 21,

RWEATHER (4) = 22,

FINTCEPT (3,2) = .25,

FINTCEPT (4,2) = .25,

FINTCEPT (4,1) = .25,

DROOT (3) = .93,

DROOT (4) = 1.27,
```

The values matched the one in the GUI.

12.52 TEST CASE 034-028 TESTER'S REPORT

Documented in Test-034-028_report.docx of 2/20/2020 7:41 AM

By cheng Wang 2/18/2020

Objective: To test the functionality of Inhalation, Gamma form.

Conclusion: the code worked as expected.

Minor font format issue when computer system locale is Chinese; no issues when English (US) is used.

Inhalation and External Gamma			_
Inhalation rate:		8400	m?year
<u>Mass loading of all particulate</u>	s above primary contamination:	.0001	grams/m?
Respirable particulates as a fr	action of total particulates:	1	
– Massloading and respirable (raction at offsite locations		
O Use same values as for p	rimary contamination		
Input different values			
Mass loading of all particulate	s from non-leafy vegetable field:	.0001	grams/m?
Respirable fraction from non-le	eafy vegetable field:	1	† (
<u>Mass loading of all particulate</u>	s from leafy vegetable field:	.0001	grams/m?
Respirable fraction from leafy	vegetable field:	1	
<u>Mass loading of all particulate</u>	s from pasture and silage field:	.0001	grams/m?
Respirable fraction from pastu	re and silage field:	1	- \
<u>Mass loading of all particulate</u>	s from feed grain field:	.0001	grams/m?
Respirable fraction from feed	grain field:	1	
<u>Mass loading of all particulate</u>	s from offsite dwelling:	.0001	grams/m?
Respirable fraction from offsite	e dwelling:	1	
Indoor to outdoor <u>d</u> ust concer	tration ratio:	.4	
External gamma penetration fa	actor:	.7	
			_
	Shape of Primary Contamination		
	Occupancy <u>F</u> actors		
-	Save Cancel		

Procedure:

- 1) Open Inhalation, Gamma form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.
- 2) It should have the same input boxes as the left figure has.

une input coxes us	the feft figure has.	
Inhalation and External Gamma		
Respirable particulates as a	fraction at offsite locations	<mark>.0001 m</mark> ?year .0001 grams/m? 1
Indoor to outdoor <u>d</u> ust conce E <u>x</u> ternal gamma penetration		<u>.4</u> .7
	Shape of Primary Contamination Occupancy Factors	
	Save Cancel	-

As shown in the screenshot of Step 1).

3) Selection of Input different values under Massloading and respirable fraction at offsite locations should bring more input boxes, as shown in the right figure.

Inhalation rate:		8400	m?year
Mass loading of all particulates above primary contamination:		.0001	grams/m?
Respirable particulates as a fraction of total particulates:		1	
O Use same values as fo	le fraction at offsite locations r primary contamination		
 Input different values 			
<u>Mass loading of all particul</u>	ates from non-leafy vegetable field:	.0001	grams/m?
Respirable fraction from no	n-leafy vegetable field:	1	
<u>Mass loading of all particul</u>	ates from leafy vegetable field:	.0001	grams/m?
Respirable fraction from lea	fy vegetable field:	1	
<u>Mass loading of all particul</u>	ates from pasture and silage field:	.0001	grams/m?
Respirable fraction from pa	sture and silage field:	1	
<u>Mass loading of all particul</u>	ates from feed grain field:	.0001	grams/m?
Respirable fraction from fee	ed grain field:	1	
<u>Mass</u> loading of all particul	ates from offsite dwelling:	.0001	grams/m?
Respirable fraction from off	site dwelling:	1	
Indoor to outdoor <u>d</u> ust con	centration ratio:	.4	
E <u>x</u> ternal gamma penetratior	n factor:	.7	
	Shape of Primary Contamination		
	Occupancy <u>F</u> actors		
	Save Cancel	•	

4) Clicking the two buttons should bring up the forms of Shape Factors and Occupancy.

Worked as expected.

5) With Input different values selected, modify at least three inputs, save the form, and then save the project to Test40.rof.

Made the following changes.

Inhalation and External Gamma		
Inhalation rate: <u>M</u> ass loading of all particulat Respirable particulates as a f Massloading and respirable Use same values as for p O Input different values	fraction at offsite locations	8400 m?year .00123 grams/m? 1
Respirable fraction from non- Mass loading of all particulate	es from leafy vegetable field:	.0003 grams/m? 1 .0001 grams/m?
Respirable fraction from past	es from pasture and silage field: ure and silage field:	1 .0001 grams/m? 1
<u>Mass loading of all particulate</u> Respirable fraction from feed <u>M</u> ass loading of all particulate	grain field:	.0001 grams/m? <mark>1 .0001 g</mark> rams/m?
Respirable fraction from offsil Indoor to outdoor <u>d</u> ust conce E <u>x</u> ternal gamma penetration f	ntration ratio:	1 .42 .71
	<u>Shape of Primary Contamination</u> Occupancy <u>Factors</u>	
-	Save Cancel	b

6) Check the following variables in the input file; they should be the same as the inputs in GUI. INHALR, SAMEMLRF, MLTOTOF, RESPFRACOF, MLTOTDWELL, RESPFRACDWELL, SHF3, SHF1

```
INHALR = 8400,

SAMEMLRF = 1,

MLTOTOF(1) = .0003,

RESPFRACOF(1) = 1,

MLTOTOF(2) = .0001,

RESPFRACOF(2) = 1,

MLTOTOF(3) = .0001,

RESPFRACOF(3) = 1,

MLTOTOF(4) = .0001,

RESPFRACOF(4) = 1,

MLTOTDWELL = .0001,

RESPFRACDWELL = 1,

SHF3 = .42,

SHF1 = .71,

MLFD = .00123,
```

12.53 TEST CASE 034-029 TESTER'S REPORT

Documented in Test-034-029_report.docx of 2/20/2020 7:42 AM

Test Case 034-029 report

By cheng wang 2/19/2020

Objective: To test the functionality of Shape Factors form.

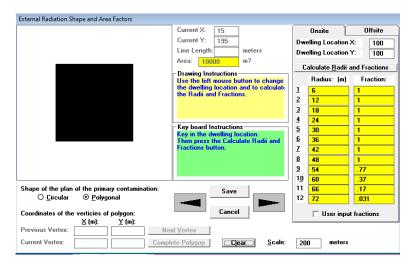
Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

	ape and Area I				
			Current X:	Onsite	Offsite
			Current Y:	Dwelling La	cation X: 100
			Line Length: meters	Dwelling Lo	
			Area: 10000 m?	Calculate	Badii and Fraction
			- Drawing Instructions	Radius	
			Use the left mouse button to change the dwelling location and to calculate	N	s. (iii) Flacuon.
			the Radii and Fractions.	$\frac{1}{2}$ $\frac{6}{12}$	1
				3 18 4 24	1
			- Key board Instructions	<u>5</u> 30	<u>'</u>
			Key in the dwelling location.	<u>5</u> 30 <u>6</u> 36	<u>'</u>
			Then press the Calculate Radii and Fractions button.	<u>5</u> 36 <u>7</u> 42	<u>'</u>
				8 48	
				9 <u>48</u> 9 <u>54</u>	1
				<u>3</u> 54 10 60	.77
hape of the plan o	of the primary	u contaminativ		11 66	.37
Circular	 O Polygor 		Save	12 72	.031
_					.031
Coordinates of the			Cancel	🔽 Us	er input fractions
Previous Vertex:	<u>X</u> (m):	<u>Y</u> (m):	March Marchan		
L			Next Vertex		
Current Vertex:			Complete Polygon <u>Cjean</u> <u>S</u> cale:	200	meters
xternal Radiation Sha	ape and Area	Factors			
xternal Radiation Sh	ape and Area	Factors	Current X: 35	Onsite	e Offsite
xternal Radiation Sha	ape and Area	Factors	Current Y: 23	Onsite Dwelling L	· ·
xternal Radiation Sh	ape and Area	Factors	Current Y: 23 Line Length: meters		ocation X: 100
xternal Radiation Shi	ape and Area	Factors	Current Y: 23	Dwelling L Dwelling L	ocation X: 100 ocation Y: 100
xternal Radiation Shi	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 9800 m? Drawing Instructions	Dwelling L Dwelling L	ocation X: 100 ocation Y: 100 e Badii and Fraction
xternal Radiation Shi	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 9800 m ² Drawing Instructions Begin the polygon by clicking the first	Dwelling L Dwelling L Calculate Radiu	ocation X: 100 ocation Y: 100
xternal Radiation Shi	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 3800 m? Drawing Instructions Begin the polygon by clicking the firs point with the left mouse button. DB	Dwelling L Dwelling L Calculate Radiu	ocation X: 100 ocation Y: 100 e Badii and Fraction
kternal Radiation Shi	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 3800 m? Drawing Instructions Begin the polygon by clicking the first point with the left mouse button, 0B Choose circular shape for the play of	Dwelling L Dwelling L Calculate Radiu	ocation X: 100 ocation Y: 100 e Badii and Fraction
ternal Radiation Shi	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 3800 m? Drawing Instructions Begin the polygon by clicking the firs point with the left mouse button. DB	Dwelling L Dwelling L Calculate Radiu	ocation X: 100 ocation Y: 100 e Badii and Fraction
cternal Radiation Shi	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 19800 Begin the polygon by clicking the first point with the felt mouse button OH Drawing Instructions: Begin the polygon by clicking the first point with the felt mouse button OH Choose circular shape for the plan of the primary contamination.	Dwelling L Dwelling L Calculate Radiu	ocation X: 100 ocation Y: 100 e Badii and Fraction
rternal Radiation Sh.	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 19800 meters 9800 meters meters Begin the polygon by clicking the firm point with the left mouse button DB Choose circular shape for the plan of the pinaxy contamination. Key board instructions Key hoard instructions at the first	Dwelling L Dwelling L Calculate Radiu 1 2 3 5	ocation X: 100 ocation Y: 100 e Badii and Fraction
ternal Radiation Sh.	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 19900 Drawing Instructions Begin the polyagen by clicking the first off with the left mause botton Choose circular shape for the plan of the primary contamination. Fey bard Instructions Expr in the coordinates of the first wettes in the Current Vetter imput Vetter.	Dwelling L Dwelling L Calculat Radiu 1 2 8 8 6	ocation X: 100 ocation Y: 100 e Badii and Fraction
rternal Radiation Sh	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 9900 m? Begin the polygon by clicking the firm point with the left mouse button Choose circular shape for the plan of the primary contamination. Key bard Instructions Key m the coordinates of the first Key m the coordinates of the first Key may be coordinates of the first first Key may be coordinates of the first first Key may be coordinates of the first	Dwelling L Dwelling L Calculat Radiu 1 2 3 5 6 7	ocation X: 100 ocation Y: 100 e Badii and Fraction
xternal Radiation Sh	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 3800 meters 3800 meters meters Praving Instructions Begin the polygon by clicking the first point with the left mouse button DB Choose circular shape for the plan of the pirmary contamination. Meters Key board Instructions Begin the coordinates of the first yearters in the Current Veites: input ba and press the Next Vertex Button DB Choose circular shape for the plan of DB Choose circular shape for the plan of the press the Next Vertex Button DB	Dwelling L Dwelling L Radiu 1 2 3 5 5 7 8	ocation X: 100 ocation Y: 100 e Badii and Fraction
rternal Radiation Sh	ape and Area	Factors	Current Y: 23 Line Length: meters Area: 9900 m? Begin the polygon by clicking the firm point with the left mouse button Choose circular shape for the plan of the primary contamination. Key bard Instructions Key m the coordinates of the first Key m the coordinates of the first Key may be coordinates of the first first Key may be coordinates of the first first Key may be coordinates of the first	Dwelling L Dwelling L Calculat Radiu 1 2 3 3 5 6 7 2 8 9	ocation X: 100 ocation Y: 100 e Badii and Fraction
			Current Y: 23 Line Length: meters Area: 19800 Begin the polygon by clicking the first point with the left mouse button. Drawing Instructions Begin the polygon by clicking the first point with the left mouse button. Choose circular shape for the plan of the primary contamination. Key in the coordinates of the first waters in the Cinter Versit Turton. Choose circular shape for the plan of the primary contamination.	Dwelling L Dwelling L Calculat Radiu 1 2 8 8 6 7 8 9 9 10	ocation X: 100 ocation Y: 100 e Badii and Fraction
Shape of the plan c	of the primary	y contaminati	Current Y: 23 Line Length: meters Area: 19800 Begin the polygon by clicking the first point with the felt mouse button OH Choose circular shape for the plan of the pinacy contamination. Key band Instructions Key in the coordinates of the first vertex in the Current Vertex fingular band of the pinacy contamination. Key in the coordinates of the first vertex in the Current Vertex fingular band of the pinacy contamination.	Dwelling L Dwelling L Calculat Radiu 1 2 8 9 9 9 9 9 9 9 10 11	ocation X: 100 ocation Y: 100 e Badii and Fraction
		y contaminati	Current Y: 23 Line Length: meters Area: 19800 Begin the polygon by clicking the first point with the left mouse button. Drawing Instructions Begin the polygon by clicking the first point with the left mouse button. Choose circular shape for the plan of the primary contamination. Key in the coordinates of the first waters in the Cinter Versit Turton. Choose circular shape for the plan of the primary contamination.	Dwelling L Dwelling L Calculat Radiu 1 2 8 8 6 7 8 9 9 10	ocation X: 100 ocation Y: 100 e Badii and Fraction
Shape of the plan o	of the primary ⊙ Polygon verticies of f	y contaminati nal	Current Y: 23 Line Length: meters Area: 19800 Begin the polygon by clicking the first point with the left mouse button. Drawing Instructions Begin the polygon by clicking the first point with the left mouse button. Choose circular shape for the plan of the primary contamination. Key in the coordinates of the first waters in the Cinter Versit Turton. Choose circular shape for the plan of the primary contamination.	Dwelling L Dwelling L Calculat Radiu 2 8 8 9 9 10 11 12	ocation X: 100 ocation Y: 100 e Badii and Fraction
Coordinates of the	of the primary ⊙ <u>P</u> olygon	y contaminati nal	Current Y: 23 Line Length: meters Area: 9800 meters Begin the polygon by clicking the first point with the left mouse button OH Choose circular shape for the plan of the primary contamination. Key board instructions Key in the coordinates of the first vertex in the Current Vertex input to and press the Next Vertex Button OH Choose circular shape for the plan of the primary contamination. or: Save Cancel	Dwelling L Dwelling L Calculat Radiu 2 8 8 9 9 10 11 12	Cocation X: 100 cocation Y: 100 to cocation Y: 100
Shape of the plan o	of the primary ⊙ Polygon verticies of f	y contaminati nal polygon:	Current Y: 23 Line Longth: meters Area: 3800 m ² Drawing Instructions Begin the polygon by clicking the first point with the left mouse button OB Choose circular shape for the plan of the primary contamination.	Dwelling L Dwelling L Calculat Radiu 2 8 8 9 9 10 11 12	Cocation X: 100 cocation Y: 100 to cocation Y: 100

Procedure:

 Open Shape Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. Worked as expected.



- It should have the same input boxes as the figure has. As shown in the screenshot of the Step 1).
- 3) Select Onsite tab on the right panel.
- 4) Select Circular for Shape of the primary contamination, a circle should appear in the center. Click "Calculate Radii and Fractions", and the code should calculate and list the results in the table in right panel.

	Current X: 145	Onsite Offsite
	Current Y: 191	Dwelling Location X: 100
	Line Length: meters	Dwelling Location Y: 100
	Area: 9800 m?	2
	- Drawing Instructions	Calculate Radii and Fractions
	Use the left mouse button to selec	
	change the dwelling location, and calculate the Badii and Fractions	
{		2 9.666666666 1
		3 14.5 1
		<u>4</u> 19.33333333 1
	Key board Instructions	
		<u>5</u> 24.16666666 1
	Key in the dwelling location. Then press the Calculate Radii an	
	Key in the dwelling location.	
	Key in the dwelling location. Then press the Calculate Radii an	nd <u>6</u> 29 1
	Key in the dwelling location. Then press the Calculate Radii an	rd <u>6</u> 29 <u>1</u> <u>7</u> 33.833333333 <u>1</u>
	Key in the dwelling location. Then press the Calculate Radii an	6 29 1 7 33.83333333 1 8 38.6666666666 1
Shape of the plan of the primary contamination:	Key in the dwelling location. Then press the Calculate Radii an	6 29 1 7 33.83333333 1 8 38.6666666666 1 9 43.5 1
Shape of the plan of the primary contamination:	Key in the dwelling location. Then press the Calculate Radii an Fractions button.	6 29 1 Z 33.8333333 1 B 38.66666666 1 9 43.5 1 10 48.33333333 1
⊙ <u>C</u> ircular ○ <u>Polygonal</u> Coordinates of the verticies of polygon:	Key in the dwelling location. Then press the Calculate Radii an Fractions button.	d 5 29 1 Z 33.8333333 1 B 38.66666666 1 9 43.5 1 10 46.33333333 1 11 53.166666666 1
ⓒ Circular ○ Polygonal Coordinates of the verticies of polygon: ▲ (m): ▲ (m):	Key in the dwelling location. Then press the Calculate Radii an Fractions button.	6 29 1 Z 33.83333333333333333333333333333333333

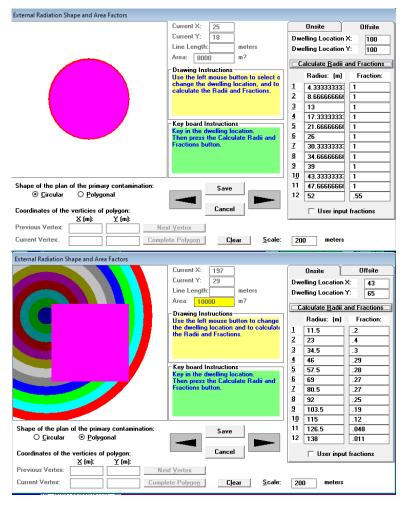
Worked as expected.

5) Click Clear. The left panel should become blank.

External Radiation Shape and Area Factors		
	Current X: 35 Current Y: 23 Line Length: meters Area: 9800 m? Drawing Instructions Begin the polygon by clicking the firs point with the left mouse button. DH Choose circular shape for the plan of the primary contamination.	Onsite Offsite Dwelling Location X: 100 Dwelling Location Y: 100 Calculate Badii and Fractions Radius: Radius: (m) 7 100 2 100 3 100
	Key board Instructions Key in the coordinates of the first vertex in the Current Vertex input bo and press the Next Vertex Button. OR Choose circular shape for the plan of the primary contamination.	4
Shape of the plan of the primary contamination: ○ <u>C</u> ircular ● Polygonal Coordinates of the verticies of polygon: × (m): Y (m):	Save Cancel	11 I2 User input fractions
	kt <u>Vertex</u> ete Polygon <u>(Cjear S</u> cale:	200 meters

6) Select Polygonal for Shape of primary contamination. Generate a polygon on the left panel using mouse. The button "Calculate Radii and Fractions" should became available upon a polygon is generated. Click it and the results should be listed in the table. Worked as expected.

External Radiation Shape and Area Factors			
	Current X: 27 Current Y: 21 Line Length: 146.23 meters Area: 8200 m? Drawing Instructions Use the left mouse button to select o change the dwelling location and to calculate the Radii and Fractions. Key in the dwelling location. Then press the Calculate Radii and Fractions button.	Onsite Dwelling Location Dwelling Location Dwelling Location Catculate Badii a Radius: 1 7.166666666 2 14.3333333 2 4 28.666666666 5 35.8333333 6 7 50.166666666 8 57.333333333 9 64.5 10 71.66666666	Y: 100
Shape of the plan of the primary contamination: O <u>C</u> ircular ③ Polygonal	Save	11 78.83333333 12 86	.045 .0094
Coordinates of the verticies of polygon: <u>X</u> (m): <u>Y</u> (m): Previous Vertex: 179 130 Ne	Cancel	🗌 User inpu	fractions
	ete Polygon Clear Scale:	200 meters	



7) Select Offsite tab on the right panel, and repeat Steps 4-6.

Worked as expected.

8) Save the form, and then save the project to Test41.rof.

9) Check the variable RAD_SHAPE in the generated input file; its value should be same as the calculated ones in the GUI.

RAD_SHAPE(1) = 11.5,	FRACA(1) = .2,
RAD_SHAPE(2) = 23,	FRACA(2) = .4,
RAD_SHAPE(3) = 34.5,	FRACA(3) = .3,
$RAD_SHAPE(4) = 46,$	FRACA(4) = .29,
RAD_SHAPE(5) = 57.5,	FRACA(5) = .28,
$RAD_SHAPE(6) = 69,$	FRACA(6) = .27,
$RAD_SHAPE(7) = 80.5,$	FRACA(7) = .27,
$RAD_SHAPE(8) = 92,$	FRACA(8) = .25,
RAD SHAPE(9) = 103.5 ,	FRACA(9) = .19,
RAD SHAPE(10) = 115 ,	FRACA(10) = .12,
	FRACA(11) = .048,
	FRACA(12) = .011,
ected.	

12.54 TEST CASE 034-030 TESTER'S REPORT

Documented in Test-034-030_report.docx of 2/20/2020 7:56 AM

Test Case 034-030 report

By cheng wang 2/18/2020

Objective: To test the functionality of Occupancy form.

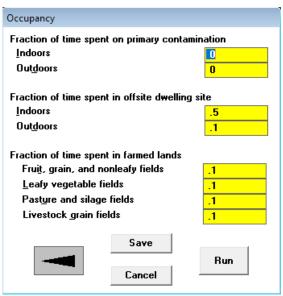
Conclusion: the code worked as expected.

Test-034-029_report

Procedure:

- 1) Select Ac-227 in the Initial Concentrations form.
- 2) Open Occupancy form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.



3) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

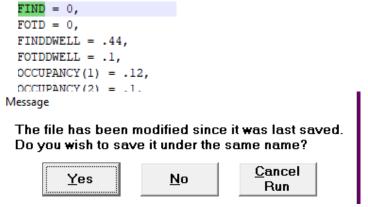
4) Modify at least three values, save the form, and then save the project as Test42.rof.

Made the following changes.

Occupancy	
Fraction of time spent on primary contamin	
<u>I</u> ndoors	0
Out <u>d</u> oors	0
Fraction of time spent in offsite dwelling si	ite
<u>I</u> ndoors	.44
Out <u>d</u> oors	.1
Fraction of time spent in farmed lands Fruit, grain, and nonleafy fields	.12
Leafy vegetable fields	.12
Pasture and silage fields	.14
Livestock grain fields	.1
Save Cancel	Run

5) Check the following variables in the generated file; they should be the same as the inputs in GUI. FIND, FOTD, FINDDWELL, FOTDDWELL, OCCUPANCY(1) -(4)

Worked as expected. If the sum of fraction is over 1, error message will pop up.



6) Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

12.55 TEST CASE 034-031 TESTER'S REPORT

Documented in Test-034-031_report.docx of 2/20/2020 7:45 AM

Test Case 034-031 report

By Cheng Wang 2/19/2020

Objective: To test the functionality of Radon form.

Conclusion: the code worked as expected.

Minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Procedure:

1) Open Radon form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Radon		
Effective radon diffusion coefficient of cover:	.000002	m?s
Effective radon diffusion coefficient of contaminated zone:	.000002	m?s
Effective radon diffusion coefficient of floor:	3.E-7	m?s
Thickness of floor and foundation:	.15	meters
Density of floor and foundation:	2.4	g/cm?
Total porosity of floor and foundation:	.1	
Volumetric water content of floor and foundation:	.03	
Depth of Foundation below ground level:	-1	meters
Vertical dimension of mixing:	2	meters
Building room height:	2.5	meters
Building air exchange rate:	.5	1/hr
Building indoor area factor:	0	
Rn-222 emanation coefficient:	.25	
Rn-220 emanation coefficient:	.15	1
Effective radon diffusion coefficient of nonleafy veg field:	.000002	m?s
Effective radon diffusion coefficient of leafy vegetable field:	.000002	m?s
Effective radon diffusion coefficient of pasture:	.000002	m?s
Effective radon diffusion coefficient of livestock grain field:	.000002	m?s
Effective radon diffusion coefficient of offsite dwelling site:	.000002	m?s
Save	-	-
Bun		
Cancel		

Worked as expected. F6 key was checked after step 4 for at this step the textboxes are not editable.

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) All the input boxes in this form should be grayed out unless a radon parent Rn-222 or Rn-220 is present in the contamination radionuclide list.

Worked as expected.

- 4) Close the form. Select U-238 from the Initial Concentrations form and then turn on Radon pathway.
- 5) Open Radon form again; it should be available for modification now.

Radon		
ladon		
Effective radon diffusion coefficient of cover:	.000002	m?s
Effective radon diffusion coefficient of contaminated zone:	.000002	m?s
Effective radon diffusion coefficient of floor:	.0000003	m?s
Thickness of floor and foundation:	.15	meter
Density of floor and foundation:	2.4	g/cm
Total porosity of floor and foundation:	.1	
Volumetric water content of floor and foundation:	.03	
Depth of Foundation below ground level:	-1	meter
Vertical dimension of mixing:	2	meter
Building <u>r</u> oom height:	2.5	meter
Building air <u>e</u> xchange rate:	.5	1/hr
Building indoor <u>a</u> rea factor:	0	
Rn-22 <u>2</u> emanation coefficient:	.25	
Rn-22 <u>0</u> emanation coefficient:	.15	
Effective radon diffusion coefficient of nonleafy veg field:	.000002	m?s
Effective radon diffusion coefficient of leafy vegetable field:	.000002	m?s
Effective radon diffusion coefficient of pasture:	.000002	m?s
Effective radon diffusion coefficient of livestock grain field:	.000002	m?s
Effective radon diffusion coefficient of offsite dwelling site:	.000002	m?s
Save		
Run		
Cancel		

worked as expected.

6) Modify at least three values, save the form, and then the project to Test43.rof.

Made the following changes.

Radon		
Effective radon diffusion coefficient of cover:	.000002	m?s
Effective radon diffusion coefficient of contaminated zone:	.000002	m?s
Effective radon diffusion coefficient of floor:	.0000003	m?s
<u>Thickness</u> of floor and foundation:	.16	meters
Density of floor and foundation:	2.5	g/cm?
Total porosity of floor and foundation:	.1	
Volumetric water content of floor and foundation:	.03	
Depth of Foundation below ground level:	-1	meters
Vertical dimension of mixing:	2	meters
Building room height:	2.7	meters
Building air <u>e</u> xchange rate:	.5	17hr
Building indoor <u>a</u> rea factor:	0	
Rn-22 <u>2</u> emanation coefficient:	.25	
Rn-220 emanation coefficient:	.15	1
Effective radon diffusion coefficient of nonleafy veg field:	.000002	m?s
Effective radon diffusion coefficient of leafy vegetable field:	.000002	m?s
Effective radon diffusion coefficient of pasture:	.000002	m?s
Effective radon diffusion coefficient of livestock grain field:	.000002	m?s
Effective radon diffusion coefficient of offsite dwelling site:	.000002	m?s
Save Run Cancel		-

7) Check the following variables in the generated file; they should be the same as the inputs in GUI. DIFCV, DIFCZ, DIFOS(1), DIFOS(2), DIFOS(3), DIFOS(4), DIFOS(5), DIFFL, FLOOR1, DENSFL, TPFL, PH2OFL, DMFL, HMIX, HRM, REXG, FAI, EMANA(1), EMANA(2)

```
DIFCV = .000002,
DIFCZ = .000002,
DIFOS(1) = .000002,
DIFOS(2) = .000002,
DIFOS(3) = .000002,
DIFOS(4) = .000002,
DIFOS(5) = .000002,
DIFFL = .0000003,
FLOOR1 = .16,
DENSFL = 2.5,
TPFL = .1,
PH2OFL = .03,
DMFL =-1,
HMIX = 2,
HRM = 2.7,
REXG = .5,
FAI = 0,
EMANA(1) = .25,
EMANA(2) = .15,
----
```

8) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

12.56 TEST CASE 034-032 TESTER'S REPORT

Documented in Test-034-032_report.docx of 2/20/2020 7:53 AM

Test Case 034-032 report

By cheng wang 2/19/2020

Objective: To test the functionality of Carbon-14 form.

Conclusion: the code worked as expected.

Procedure:

1) Open Carbon-14 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Carbon-14			
Thickness of evasion layer for C-14 in soil:	.3	meters	
⊻ertical dimension of mixing for inhalation:	2	meters	
⊻ertical dimension of mixing for vegetation:	1	meters	
C-1 <u>4</u> evasion flux rate from soil:	.0000007	1/sec	
C-12 evasion flux rate from soil:	1E-10	1/sec	
Fraction of vegetation carbon absorbed from soil:	.02		
Fraction of vegetation carbon absorbed from air:	.98		
Mass Fractions of C-12			

Worked as expected. F6 key was checked after Step 4 for the textboxes are not editable at this point.

2) It should have the same input boxes as the figure has.

Worked as expected.

 All the input boxes in this form should be grayed out unless a radon parent Rn-222 or Rn-220 is present in the contamination radionuclide list.

Worked as expected.

4) Select U-238 from the Initial Concentrations form and then turn on Radon pathway.

5) Open Carbon-14 form again; it should be available for modification now.

.3	meters		
2	meters		
1	meters		
7.E-7	1/sec		
C-12 evasion flux rate from soil: 1.E-10			
Fraction of vegetation carbon absorbed from soil:			
Fraction of vegetation carbon absorbed from <u>a</u> ir: .98			
Mass Fractions of C-12			
-			
	2 1 7.E-7 1.E-10 .02		

Worked as expected.

6) Clicking Mass fractions of C-12 should bring up Mass fractions of C-12 form.

Mass Fractions and Concentrations of Carbon-12			
Atmosphere:		.18	g/m?
Contaminated soil:		.03	g/g
Local <u>w</u> ater:		.00002	g/cm?
Frui <u>t, grain, non-leafy</u>	vegetables:	.4	i
Leafy vegetables:		.09	1
Pasture and silage		.09	1
Livestock feed grain		.4	1
Meat		.24	1
Mjilk		.07	j
	Save		
	Cancel	Run	

Worked as expected.

7) Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test44.rof.

Changed the value from 2 to 3.67. This change also updated the corresponding value in Radon form.

Radon				
Effective radon diffusion coefficier	nt of co <u>v</u> er:		.000002	m?s
Effective radon diffusion coefficier	nt of co <u>n</u> tami	nated zone:	.000002	m?s
Effective radon diffusion coefficier	nt of <u>f</u> loor:		.0000003	<mark>3 </mark> m?s
<u>Thickness</u> of floor and foundation	c		.15	meter
Density of floor and foundation:			2.4	g/cm
Total porosity of floor and foundati	ion:		.1	
Volumetric water content of floor a	nd foundatio	n:	.03	
Depth of Foundation <u>b</u> elow ground	l level:		-1	meter
Vertical dimension of mixing:			3.67	meter
Building room height:			2.5	meter
Building air <u>e</u> xchange rate:			.5	1/hr
Building indoor <u>a</u> rea factor:			0	
Rn-222 emanation coefficient:			.25	
Rn-220 emanation coefficient:			.15	
Effective radon diffusion coefficier	nt of nonleafy	veg field:	.000002	m?s
Effective radon diffusion coefficient of leafy vegetable field:			.000002	m?s
Effective radon diffusion coefficient of pasture:			.000002	m?s
Effective radon diffusion coefficier	nt of livestoc	k grain field:	.000002	m?s
Effective radon diffusion coefficie	nt of offsite d	welling site:	.000002	m?s
	Save	1		
Carbon-14				
Thickness of evasion layer for C-14	in soil:	.3		meters
$\underline{\mathbf{V}}\textsc{ertical}$ dimension of mixing for inha	alation:	3.0	67	meters
$\underline{V} ertical dimension of mixing for veg$	etation:	1		meters
C-1 <u>4</u> evasion flux rate from soil:		.0	000007	1/sec
		-10	1/sec	
Fraction of vegetation carbon absor	rbed from <u>s</u> oil	: .0	2	
Fraction of vegetation carbon absorbed from <u>air</u> :				
<u>M</u> ass Fra	actions of C-1	12		
	Save Cancel			

8) Check the following variables in the generated file; they should be the same as the inputs in GUI. DMC, HMIXV, C14EVSN, C12EVSN, CAIR, CSOIL

worked as expected.

```
HMIX = 3.67,

DMC = .3,

HMIXV = 1,

C14EVSN = .0000007,

C12EVSN = 1E-10,

CAIR = .98,

CSOIL = .02,

CLOUD = .10
```

Worked as expected.

9) Added C-14 to nuclide list and made the following changes. Save the file as Test44-C-14.rof

Carbon-14			
Thickness of evasion layer for C-14 in soil:	.31	meters	
Vertical dimension of mixing for inhalation:	3.67	meters	
Vertical dimension of mixing for vegetation:	1	meters	
C-1 <u>4</u> evasion flux rate from soil:	.0000007	1/sec	
C-12 evasion flux rate from soil:	1E-10	1/sec	
Fraction of vegetation carbon absorbed from soil:	.025		
Fraction of vegetation carbon absorbed from air:	.986	1	
Mass Fractions of C-12			
Save Cancel			

10) Check the variables mentioned in Step 8) and compare with the ones input in GUI.

```
HMIX = 3.67,

DMC = .31,

HMIXV = 1,

C14EVSN = .0000007,

C12EVSN = 1E-10,

CAIR = .975,

CSOIL = .025,
```

12.57 TEST CASE 034-033 TESTER'S REPORT

Documented in Test-034-033_report_v2.docx of 2/26/2020 12:50 PM

Test Case 034-033 report

By cheng wang 2/19/2020

Objective: To test the functionality of Mass fraction of C-12 form.

Conclusion: the code worked as expected.

Modify Step 3) of test case description to "Select C-14 from the Initial Concentrations form".

Minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Procedure

1) Open Mass fraction of C-12 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected. F6 key was checked after Step 3).

Mass Fractions and Concentrations of Carbon-12			
<u>A</u> tmosphere:	.18	g/m?	
<u>C</u> ontaminated soil:	.03	g/g	
Local <u>w</u> ater:	.00002	g/cm?	
Fruit, grain, non-leafy vegetables:	.4	1	
Leafy vegetables:	.09		
Pasture and silage	.09	1	
Livestock feed grain	.4	1	
Meat	.24		
Mjlk	.07	1	
Save	Run		
Cancel			

2) It should have the same input boxes as the figure has.

- 3) Select C-14 from the Initial Concentrations.
- 4) Open Mass fraction of C-12 form again, and change values for at least two variables.

Changed values for Atmophere textbox, Local water, and Milk to 0.28, 0.000031, and 0.072, respectively.

- 5) Save the form, and then the project to Test45.rof.
- Check the following variables in the generated file; they should be the same as the inputs in GUI. C12AIR, C12CZ, C12WTR, C12PLANT(1), C12PLANT(2), C12PLANT(3), C12PLANT(4), C12MEAT_MILK(1), C12MEAT_MILK(2)

```
C12AIR = .28,

C12CZ = .03,

C12WTR = .000031,

C12PLANT(1) = .4,

C12PLANT(2) = .09,

C12PLANT(3) = .09,

C12PLANT(4) = .4,

C12MEAT_MILK(1) = .24,

C12MEAT_MILK(2) = .072,
```

worked as expected.

7) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

12.58 TEST CASE 034-034 TESTER'S REPORT

Documented in Test-034-034_report.docx of 2/20/2020 7:58 PM

Test Case 034-034 report

By cheng wang 2/19/2020

Objective: To test the functionality of H-3 form.

Conclusion: the code worked as expected.

Minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Procedure:

- 1) Select U-238 from the Initial Concentrations.
- 2) Open H-3 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Tritium		
Humidity in <u>a</u> ir:	8	grams/m?
Mass fraction of water in:-		
Fruit, grain, non-leafy vegetables:	.8	
Leafy vegetables:	.8	
Pasture and silage	.8	
Livestock feed grain	.8	
M <u>e</u> at	.6	
Mjik	.88	
$\underline{\mathbf{V}}$ ertical dimension of mixing for inhalation:	2	meters
Save		
	Run	
Cancel		

Worked as expected.

3) It should have the same input boxes as the figure has.

Worked as expected.

4) Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test46.rof.

Changed the value to 2.78.

5) Check the following variables in the generated file; they should be the same as the inputs in GUI. HUMID, H2OPLANT(1), H2OPLANT(2), H2OPLANT(3), H2OPLANT(4), H2OMEAT_MILK(1), H2OMEAT_MILK(2), HMIX

```
HMIX = 2.78,

HUMID = 8,

H2OPLANT(1) = .8,

H2OPLANT(2) = .8,

H2OPLANT(3) = .8,

H2OPLANT(4) = .8,

H2OPLANT(4) = .6,

H2OMEAT_MILK(1) = .6,
```

Worked as expected.

Additional test. Added H-3, made the following change and checked the generated input file. The code worked as expected.

Tritium		
Humidity in <u>a</u> ir:	8	grams/m?
Mass fraction of water in:-		
Fruit, grain, non-leafy vegetables:	.81]
Leafy vegetables:	.8	ĺ
Pasture and silage	.83	1
Livestock feed grain	.8	
M <u>e</u> at	.67	1
Mjlk	.88	
Yertical dimension of mixing for inhalation:	2.78	meters
Save	Run	-
Cancel		
HMIX = 2.78,		

```
HUMID = 8,

H2OPLANT(1) = .81,

H2OPLANT(2) = .8,

H2OPLANT(3) = .83,

H2OPLANT(4) = .8,

H2OMEAT_MILK(1) = .67,

H2OMEAT_MILK(2) = .88,
```

6) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

12.59 TEST CASE 035-001 TESTER'S REPORT

Documented in Test Case 35-1-JJCheng.docx of 2/26/2020 12:29 PM

Test Case 35-1 – Test if submenus File -> New and Save work correctly

The test was conducted following the step-by-step instructions provided in the RESOFF-TEST-001, Test Cases document. The RESRAD-OFFSITE code behaved expectedly for each step performed. The File > New and Save functions were implemented successfully.

12.60 TEST CASE 035-002 TESTER'S REPORT

Documented in Test Case 35-2-JJCheng.docx of 2/14/2020 3:37 PM

Test Case 35-2 – Test if submenu File -> Open and Save As works correctly

The following procedure was used in the testing -

- 1) Launch the RESRAD-OFFSITE code.
- Click File -> Open. A new window should pop up, requesting user to select which input file to open. The default file location should be the folder from which an input file was read to run the code the last time.
- 3) Redirect the location to the QAFiles subfolder of the current version under testing. Select the QA input file "BASIC RESRAD-OFFSITE INSTALLATION QA.ROF," and click Open.
- 4) The main interface should update after loading the input file. Check to see if at the top of the interface, the input file name displayed is that of the QA file.
- 5) Click Modify Data from the left navigation panel and then the Initial Concentration tab on the 2nd panel. Check to see if the SI unit of Bq/g is shown in the Initial Concentrations input form. If not, the code does not read in the data in the QA input file correctly, and this test should be marked as "fail." If Bq/g is displayed, continue the test.
- 6) Check to see if radionuclides shown are C-14, H-3, Pb-210, Ra-226, Ra-228, and Th-228, with concentrations of 15, 200, 0, 0.01, 10, and 0, respectively.
- 7) Change the concentration of H-3 to 300 Bq/g. Close the input form.
- 8) Click File -> Save As. A new window should pop up and the default path shown at the top of the window should be the QAFiles subfolder. If not, this test should be marked as "fail."
- 9) Change the path to the UserFiles subfolder. Provide a new file name to save the input data, and click Save. A new file should be created in the UserFiles subfolder. Quit RESRAD-OFFSITE.
- 10) Open the newly saved file in the UserFiles subfolder with Notepad (or any other utility tool with similar functions) and compare it with the QA input file in the QAFiles subfolder. Except for the initial concentration of H-3, other information should be identical. If not, this test should be marked as "fail."
- 11) Repeat Steps 1-10 using the Open button (2nd from left) in the Tool bar to open the QA input file.
- 12) Repeat Steps 1-10 using the combination keys Ctrl + O to open the QA input file.
- 13) Copy the QAFiles subfolder to a USB drive and repeat Steps 1-10 to open the QA input file from there.
- The screenshots below show the QA input file and the new file created. The only difference between these two files is the initial concentration of H-3. It is 5404.405 in the QA input file but is 8108.108 in the created file.

Note: In RESRAD-OFFSITE input files, the values listed for initial concentrations of radionuclide are for the US unit, i.e., pCi/g. 200 Bq/g = 5404.405 pCi/g while 300 Bg/g = 8108.108 pCi/g.

```
BASIC RESRAD-OFFSITE INSTALLATION QA - Notepad
File Edit Format View Help
H2OPLANT(4) = .8,
H2OMEAT_MILK(1) = .6,
H2OMEAT_MILK(2) = .88,
NUCNAM = 'C-14', 'H-3', 'Pb-210+D', 'Ra-226+D', 'Ra-228+D',
'Th-228+D', 'LAST',
S = 405.4054, 5405.405, 0, .2702703, 270.2703, 0,
DCACTC = 2*0, 100, 2*70, 60000,
DCACTCM = 2*0, 100, 2*70, 60000,
DCACTDWE = 2*0, 2, 2*1, 10,
```

TEST 35-2 - Notepad

File Edit Format View Help H2OPLANT(4) = .8, H2OMEAT_MILK(1) = .6, H2OMEAT_MILK(2) = .88, NUCNAM = 'C-14', 'H-3', 'Pb-210+D', 'Ra-226+D', 'Ra-228+D', 'Th-228+D', 'LAST', S = 405.4054, 8108.108, 0, .2702703, 270.2703, 0, DCACTC = 2*0, 100, 2*70, 60000, DCACTCM = 2*0, 100, 2*70, 60000, DCACTDWE = 2*0, 2, 2*1, 10,

12.61 TEST CASE 035-003 TESTER'S REPORT

Documented in Test Case 35-3-JJCheng.docx of 2/26/2020 12:31 PM

Test Case 35-3 – Test if submenu File -> Title works correctly

The test was conducted following the step-by-step instructions provided in the RESOFF-TEST-001, Test Cases document. The RESRAD-OFFSITE code behaved expectedly for each step performed. The File > Title functions were implemented successfully.

12.62 TEST CASE 035-004 TESTER'S REPORT

Documented in Test Case 35-4-JJCheng.docx of 2/26/2020 12:37 PM

Test Case 35-4 – Test if the DCF Editor can be called successfully from the menu of GUI

The test was conducted following the step-by-step instructions provided in the RESOFF-TEST-001, Test Cases document. In addition, the RESRAD-OFFSITE code was also tested to see if the DCF Editor could be called at any time during the maneuvering of the GUI. The DCF Editor appeared whenever called. The RESRAD-OFFSITE code behaved expectedly for each step performed.

12.63 TEST CASE 035-005 TESTER'S REPORT

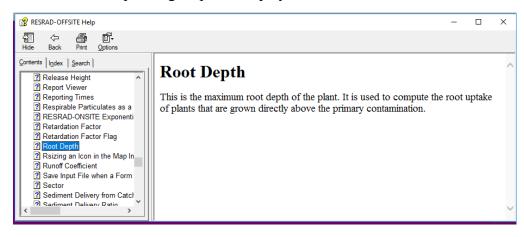
Documented in Test Case 35-5-JJCheng.docx of 2/26/2020 12:46 PM

Test Case 35-5 – Test the menu Help works appropriately.

• Tested RESRAD-OFFSITE version 4.0 following the procedure described in the Test Cases document. The code behaved as exepected. For example, placing the cursor on the Root Depth parameter for fruit, grain, and non-leafy vegetables, and then clicked "F1," the context sensitive help appeared on the screen -

We Dun Foli <u>W</u> e Foli	Effectors Coops anion of growing season (pears) anion of growing season (pears) anion of growing season (pears) anion terrestion (actor for junct) ani interception (actor for junct) ot depth (meters) Save	non-leafy v .7 1. .17 .2 .1 1 20 20 .25 .2 .25 .2 .25 .2 .25 .2	25 0 25 25		
RESRAD-OFFSTE Help Help Gotterts tydex Sarch Type intelexpositiond: [] Last Topic	Root Depth This is the maximum root of plants that are grown dit	depth of the plan		uptake	×
Select Topic to display:					~

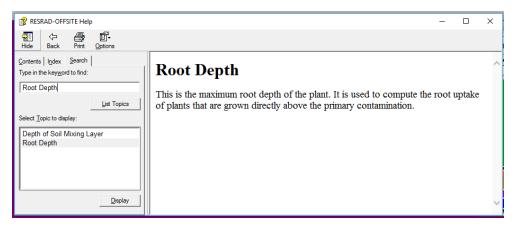
• Tested the functions of the DCF editor. Chose the "Contents" tab, selected "Root Depth," the corresponding help was displayed -



• Scrolled the contents list up to the top to show the help "A Help on Getting Help." Chose "Index," typed "Root Depth" in the input box, and then clicked the "Display" button at the bottom. The screen did not change. It seemed that a search of the help indexes was not conducted. However, this is a minor issue.

😭 RESRAD-OFFSITE Help	- 0	×
Hide Back Print Options		
Contents Index Search Type in the keyword to find:	A Help on Getting Help	^
<u> </u>	Context sensitive help is not available for the item from which you invoked help. Try the following in order:	
	 I. Click on the "contents" tab on the left to look at an alphabetic listing of all the help topics available in this help file. 2. Click on the "Search" tab to search for any word in the help file. 	
∠ 		~

• Chose "Search," typed "Root Depth" in the input box, and then clicked "List Topics." Two topics appeared for selection. Chose "Root Depth," and saw the information on "Root Depth" appeared on the screen.



• Chose to print the information on "Root Depth" to a pdf. The DCF Editor did it successfully.



12.64 TEST CASE 035-006 TESTER'S REPORT

Documented in Test Case 35-6-JJCheng.docx of 2/26/2020 12:46 PM

Test Case 35-6 – Test the functionality of Pathway menu

The RESRAD-OFFSITE code was tested for the selection of pathways via the Pathways menu in the menu bar, the buttons in the pathway bar, the Inputs & Pathways tab in the Iconic Navigator, and the Set Pathways option in the left vertical panel. All worked without any issue.

12.65 TEST CASE 035-007 TESTER'S REPORT

Documented in Test Case 35-7-JJCheng.docx of 2/17/2020 9:56 AM

Test Case 35-7 – Test the functionality of Site Data menu

- Tested entering site data via the Site Data menu in the menu bar, the Inputs & Pathways tab in the Iconic Navigator, and the Modify Data option in the left vertical panel.
- Tested entering data with and without subforms being displayed vertically and horizontally. Tested entering data to a subform with the subform tab within a major input form.
- Tested entering data to different input forms via the right and left arrow tabs in an input form.
- Observed the grayed input parameters which were associated with inactive pathways and were not required for the dose/risk calculations.
- All the different ways tried allowed data entry of input parameters without any issue.

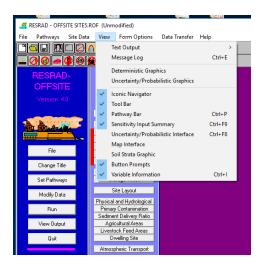
12.66 TEST CASE 035-008 TESTER'S REPORT

Documented in Test Case 35-8-JJCheng.docx of 2/17/2020 2:15 PM

Test Case 35-8 – Test the functionality of View menu

Modified the procedure described in the Test Cases document to perform the testing -

• Launch the code and click View menu. A drop down list should appear. Visually check the format, fonts, and spelling of the drop down list.



- Set cut-off to 30 days. Set the number of graphic points to 256. Select Pb-210. Choose thickness and total porosity of the contaminated zone for uncertainty analysis. Enter acceptable distribution functions and ranges. Set the number of observation to 100 and number of repetition to 1. Run the code.
- Click View -> text output to see if the following text reports are generated Parent Dose, Risk, Progeny Dose, Uncertainty/Probabilistic Dose/Risk, Uncertainty/Probabilistic Inputs, and Linear Regression reports.

The following shows the first page of the Uncertainty/Probabilistic Inputs report. There's no table of contents like the other text reports, which gives the illusion that the report is empty. Suggest to add table of contents to the first page or put the title "Latin Hypercube Sample Input" on the 2nd page and make the 2nd page the starting page of the report.

File Edit Help Font: MS LineDraw 7.4 7 B E Page: 1 7 TA TALE Page: 1 7 TALE Page: 1 7 TALE Page: 1 7 TALE PAGE: 1 7 TALE PAGE 1 Probabilistic Input Report Title: RSSRD-OFFSIT2 Default Parameters File : Site6.ROF Latin Hypercube Sample Input	~
RZSRAD-OFFSITZ, Version 4.0 Tw Limit = 30 days 02/17/2020 15:15 Page 1 Probabilistic Input Report Title : RZSRAD-OFFSITZ Default Parameters File : Site6.ROF	^
Probabilistic Input Report Title : RISRAD-OFFSITI Default Parameters File : Site6.ROF	~
Latin Hypercube Sample Input	

- Choose the Message Log option to see if OUTPUT.FIL file is available and is shown in the Viewer.
- Choose the Deterministic Graphics option to see if WRESPLOT.EXE is launched properly and the Graphics Viewer appears.
- Choose the Uncertainty/Probabilistic Graphics option to see if the Uncertainty/Probabilistic Analysis interactive Graphics Viewer appears.
- Check and uncheck the Iconic Navigator option to see if the Iconic Navigator window is turned on and off accordingly.
- Check and uncheck the tool bar option to see if the tool bar is shown or not shown accordingly.
- Check and uncheck the Pathway Bar option to see if the Pathway Bar is shown or not shown accordingly.
- Similarly, check and uncheck the Sensitivity Input Summary, the Uncertainty/Probabilistic Interface, the Map Interface, and the Soil Strata Graphics options to see if the corresponding window is shown or not shown accordingly.
- Check the Button Prompts option to see if descriptive information appears when the cursor is placed on any icon on the tool bar or on the Iconic Navigator.
- Check the Variable Information option to see if a variable information bar appears at the bottom of the interface. The variable information bar contains the name in the FORTRAN code, default value, and range of accepted input value for the input parameter that is highlighted at the moment. Try with the Area of Surface Water Body input parameter in the Surface Water Body input form. The variable information bar should display "Variable name: VLAKE Default: 150000 Range: 1 to 1E34."

The RESRAD-OFFSITE code behaved as expected.

12.67 TEST CASE 035-009 TESTER'S REPORT

Documented in Test Case 35-9-JJCheng.docx of 2/17/2020 2:56 PM

Test Case 35-9 – Test the functionality of Text Output menu

- The test focused on the generation of the Area Factors report, because the generation of the other reports was verified with the previous test case, Test Case 35-8.
- Selected Generated Area Factors option under the File menu.
- Made changes in the Area Factors input form, and then clicked on Generate Dimensions. The X-dimension vs. Y-dimension scatter plot was generated –

Area Factors	
Range of X dimension of Small Area of Elevated	Contamination:
from 1	meters to 100 meters
Range of Y dimension of Small Area of Elevated Proportional to X dimension	Contamination: O Specify Range
Ratio of Y dimension to X dimension	
Number of Points on the Dose - Area Plot	0
Distribution of X and Y dimensions	
○ Triangular skewed to the high end ○ Uniform	Triangular skewed to the low end
Location of Small Area of Elevated Contamina	tion:
O Centers of Small Areas of Elevated Contamination fix	
Small Areas of Elevated Contamination Located Unif	ormly over the Primary Contamination
Generate Dimensions Cancel	Generate Dose - Area Plot
Probabilistic / Uncertainty Outputs	
	Plot choices Input against input Histogram of Inputs
^{197.}	C Edf of inputs
· * .	X axis
	X dimension of Primary Contamination
174.	Linear C Logarthmic
	99 Percentile = 92.3 Mean = 34.
	Std. devi. = 23.5
151 -	Y axis Distance Perpendicular to aquifer flow from
	C Linear C Logarthmic
	99 Percentile = 193. Mean = 150.
128.	Std. devi. = 20.4
	Plot Settings Plot of X dimension of Primary Contamination
	against Distance Perpendicular to aquifer flow frc
105.	Repetitions Repetitions
1.31 25.1 48.8 72.6 96.3	Display
Cl <u>o</u> se	graph

- Run uncertainty/probabilistic analysis (with a cut-off of 30 days, graphic points 256, and Pb-210 as the radionuclide of concern).
- The Area Factor report was successfully generated, which is shown below -

📓 View - Al	REAFACTORTEXT.REP
File Edit H	Help
Eont: MS Li	ineDraw 🗸 7.4 🗸 🖉 📳 📴 Page: 1 🗸 🗶
RESRAD-OF	FSITE Area Factor Report
	ESRAD-OFFSITE Default Parameters
FILE : S	lite6.ROF
Area Fact	or summary table for Pb-210
Area	Area Factor
14.7	666.
33.3	291.
133.	71.9
209.	42.4
334.	28.3
607.	15.3
642.	14.7
1000.	9.2
1630.	5.8
1680.	5.58
2720.	3.5
3910.	2.48
4110.	2.38
5970.	1.64
10000.	1.0

• In the text Report Viewer, the functions of File, Edit, and Help button were tested and all worked properly. The following shows the Report Viewer instruction after clicking on the Help button -

RESRAD-OFFSITE Help	- 0	×
Hide Back Print Options		
Contents Index Search Type in the keyword to find:	Report Viewer	^
^	The report viewer is designed to allow easy viewing, printing and saving of reports generated by the model. The viewer supports full Windows printing and clipboard features.	
	Displaying the viewer : The viewer is displayed at the end of each run. It can also be displayed using the menu (View, Text Output, and then any of the available choices), the first button on the third cluster o the toolbar, the DOS Emulator (View Output button and then the command button corresponding to the desired report), or the Navigator (Results tab and click on the command button corresponding to the desired report).	
	Viewing different parts of the report: Enter a page number in the "Page" box to view a specific page of the report. Use the scroll bars to scroll through the page, or tab the cursor into the text of the report and use the cursor control keys. The "Next Page" and "Previous Page" command buttons as well as the "Page Up" and "Page Down" keys can be used to move to the next or previous page	e.
	Saving Report Files: Every time a calculation is run, the previous reports and graphics files are overwritten. The results can be saved under different names, which allow their retrieval later. All the textual reports can be saved by clicking on File followed by Save All under the Report Viewer main menu. If the input filename is xxxx.rof, the reports will be saved in the user files directory as xxxx.yyy, where the extension yyy identifies the report as follows:	
	 par = parent dose report. pro = progeny dose report. rsk = cancer risk report. prb = uncertainty and probabilistic dose and risk report. smp = uncertainty-probabilistic input report. reg = output-input regression report. 	
Display	 af = area factor report. 	~

12.68 TEST CASE 035-010 TESTER'S REPORT

Documented in Test Case 35-10-JJCheng.docx of 2/17/2020 4:50 PM

Test Case 35-10 – Test the functionality of the Form Options menu

Modified the procedure described in the Test Cases document to perform the test. The procedure after modification is listed below -

- Launch the code and click the Form Options menu. Visually check the format, fonts, and spelling.
- Open the Initial Concentration input form and select Ac-227 with the default concentration. Choose the Form Options -> Save Current Form menu. The input form should be closed. Open the input form again and check if Ac-227 is selected with a concentration of 100 pCi/g.
- In the Initial Concentration input form, click the Nuclide Specific Release button and the corresponding input form should pop up. Select "Specify the First Order Leach Rate Constant," change the value from 0 to 10, and then click the Form Option -> Cancel Current Form menu. The Radionuclide Specific Release input form should be closed. Open it again and check to see if the value of the First Order Leach Rate Constant is 0 rather than 10.
- Change the First Order Leach Rate Constant to 10, then save and close the Radionuclide Specific Release input form. Open the input form again, the value for the leach rate constant should be changed to 10 now. Click the Form Option -> Cancel Current Form menu to close the input form. Open the input form and check the value of the leach rate constant again. The value should still be 10.
- Restore the value of the leach rate constant to 0 by pressing the F6 key. Click Save to close the input form. At this time, the Initial Concentration input form should still be open.
- While the cursor highlights the input field for the concentration of Ac-227, click the Form Option -> Cancel Current Form menu. A warning message "Changes to the Initial Concentration form cannot be canceled. Changes have to be reserved manually." would pop up. Click Ok and close the message window.
- Open the Distribution Coefficients input form, move cursor to the Contaminated zone input field, which has a default value of 20. Click the Form Options -> Sensitivity Analysis (Single Parameter) menu, the Set Sensitivity Analysis Range window should pop up. Click Cancel to close the window.
- Open the Distribution Coefficients input form, move the cursor to the Unsaturated Zone 1 input field. Click the Form Options -> Uncertainty/Probabilistic Analysis menu. The Uncertainty and Probabilistic Analysis input window should pop up. Click Ok to close the window.
- Open the Physical and Hydrological input form, put cursor on the precipitation input field. Choose the Form Options -> Uncertainty/Probabilistic Analysis menu. The Uncertainty and Probabilistic Analysis input window should pop up. There is no default distribution for the precipitation parameter. Enter 0.8 as the minimum and 1.2 as the maximum so that the uniform distribution function is accepted. Click Update Parameter Stats and Distribution to update the inputs and then OK to close the window. Choose the View -> Uncertainty/Probabilistic Interface menu again. The precipitation parameter should appear in the Uncertainty and Probabilistic Analysis input window.

- Choose Primary Contamination in the Modify Data vertical panel. In the Primary Contamination input form, move the cursor to the input field of the dry bulk density of the contaminated zone. (Make sure the variable information bar appears at the bottom of the screen. If not, choose the View -> Variable Information menu to show it. The accepted range of the dry bulk density is 0.001 22.5.) Choose the Form Options -> Lower Bound menu to change the input to the minimum value of 0.001. Choose the Form Options -> Upper Bound menu to change the input to the maximum value of 22.5. Choose the Form Options -> Default menu to reset the value back to the default of 0.4.
- Repeat Steps 1-10 using the hot-keys for each of the menu option (shown below).

Form Options	Data Transfer Help			
Save Cur	Save Current Form			
Cancel C	Cancel Current Form			
Sensitivit	eter) F9			
Uncertai	Uncertainty/Probabilistic Analysis			
Multiparameter Sensitivity Analysis		sis Shift+F8		
Lower Bo	ound	F5		
Default		F6		
Upper Bo	ound	F7		

The RESRAD-OFFSITE code behaved as expected.

12.69 TEST CASE 035-011 TESTER'S REPORT

Documented in Test Case 35-11-JJCheng.docx of 2/18/2020 11:35 AM

Test Case 35-11 – Test the functionality of Data Transfer menu

Modified the procedure described in the Test Cases document to perform the test. The modified procedure is described below –

- Launch RESRAD-OFFSITE, choose ICRP 38 database, and set the cut-off half-life to 180 days in the Title & Radiological Data input form. Choose "pCi" and "mrem" as the radiological units and "Specify initial activity based on mass of contaminated medium" as the conceptualization choice for the primary contamination in the Preliminary Inputs form. Choose U-234, U-235, and U-238 each with an initial concentration of 100 pCi/g in the Initial Concentrations input form. Click on the Distribution Coefficients tab and specify a Kd of 100 cm3/g for the contaminated zone for all three uranium isotopes.
- Choose Data Transfer -> Generate Template Files from the menu bar. The selection tabs should display the specifications made in the previous step –

Formatted Data Transfer				
Click on the command buttons below to change the specifications of the template file to be generated :				
ICRP 38 Transformation Database 180 days Cutoff Half Life				
Contaminated Medium Surrounded by Clean Soil in Primary Contamination				
pCi	Specify Radionuclides at Site			

• Click on the "ICRP 38 Transformation Database" tab. The Title & Radiological Data input form should appear. Change the database from ICRP 38 to ICRP 107. Change the cut-off half-life from 180 days to 30 days. Close the input form. The tab with information on database should now show ICRP 107 as the selected transformation database, and the tab with information on cut-off half-life should now show 30 days as the selected cut-off value.

Formatted Data Transfer						
Click on the command buttons below to change the specifications of the template file to be generated :						
ICRP 107 transformation database 30 days cutoff half life						
Contaminated Medium Surrounded by C	lean Soil in Primary Contamination					
Contaminated Medium Surrounded by Cl	lean Soil in Primary Contamination Specify Radionuclides at Site					

• Click the "Contaminated Medium Surrounded by Clean Soil in Primary Contamination" tab. The Preliminary Inputs input form should appear. Change the radiological units from pCi to Bq and from mrem to mSv. Change the conceptualization choice to "Specify initial activity based on mass of entire primary contamination." Save the input form. The tab with information on conceptualization choice and radiological unit should now show the choices just made with the Preliminary Inputs input form.

Formatted Data Transfer					
Click on the command buttons below to cha be generated :	nge the specifications of the template file to				
ICRP 107 transformation database 30 days cutoff half life					
All solids in the primary contamination are contaminated					
Bq	Specify Radionuclides at Site				

• Click on the "Specify Radionuclides at Site" tab. The Initial Concentrations input form should appear. Po-210 should appear in the nuclide list and the concentration of the three uranium isotopes should be 3.7 Bq/g. Equilibrium Desorption should be the choice of conceptualization.

Initial Concentr			
Nuclide Conc List of Nuclid at the Site		0 Bq/g contaminated medium	List of ICRP107 Nuclides with half life greater than 30 days
<u>Ac-227</u> Pa-231	0	 Transfer Mechanism Equilibrium <u>D</u>esorption 	Ac-227
Pb-210 Po-210	0 0	O Equilibrium <u>S</u> olubility	Ag-108m Ag-110m
Ra-226 Th-230	0 0	O First Order <u>Rate</u> Controlled	Al-26 Am-241
U-234 U-235	3.7 3.7	<u>A</u> dd Ac-227 21.772y	Am-242m Am-243
U-238	3.7	Delete	Ar-37 No DCFs Ar-39 No DCFs
			Ar-42 No DCFs As-73

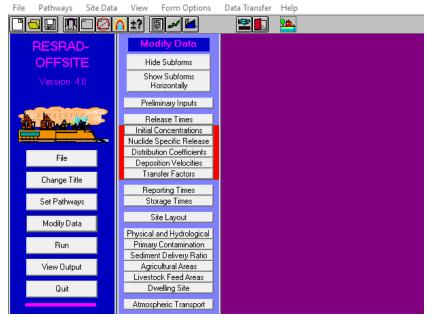
• Highlight U-235 and click the Distribution Coefficients tab. In the pop-up input form, the input field for the contaminated medium should be grayed (the value cannot be changed). Save the input form. Click the Nuclide Specific Release tab. In the pop-up input form,

change the transfer mechanism to "First Order Rate Controlled Transfer" and specify a leach rate of 0.001 /yr. Save the Radionuclide Specific Release input form. Close the Initial Concentrations input form.

Distribution Coefficients				
Radionuclide U-235	÷ Distribution		Distribution	
Location	coefficient (cm³/g)		coefficient (cm ³ /g)	
Contaminated medium:	50	Suspended sediment in surface water body	50	
<u>Contaminated</u> zone:	100	Bottom sediment in surface water body	50	
Unsaturated zone <u>1</u> :	50	Fruit, grain, nonleafy fields	50	
		<u>L</u> eafy vegetable fields	50	
		Pasture, silage growing areas	50	
		Livestock feed grain fields	50	
S <u>a</u> turated zone:	50	Dwelling site	50	
Number of unsaturated zone set in preliminary inputs form				
		Save		
		Cancel		
				1
Radionuclide Specific Relea	se			
Radionuclide	U-235	▲ Element U		
Release to ground	water	Transfer mechanism		
		First Order Rate Controlled Transfer		
		C Equilibrium Desorption Transfer		
		O Equilibrium Solubility Transfer		
	Tin	ne at which release begins or changes (ve	ars) ()	Add Next
		5 5 6		Time
Cumulativ	e fraction o	f radionuclide bearing material that is rele		
Increme	ntal fraction	linearly over of radionuclide bearing becomes releasal stepwise at	ble	
		Leach rate (1/	/year) 0.001	7
		linearly over	time	_
	Lea	ch rate of isotope changes stepwise at	time 💿	

- Click on the Generate Files tab. Provide a file name, Test 35-11-data transfer, and save the file to the UserFiles subfolder. Close the Formatted Data Transfer input form.
- In the main interface, the information displayed at the top should show "Test 35-11-data transfer.ROF" as the name of the input file. Open the Primary Contamination input form. Add a clean cover of 0.3 m and save the input form. Choose the File -> Save As menu and save the input data to a new file, "TEST 35-11." Exit from RESRAD-OFFSITE.

🚄 RESRAD - OFFSITE Test 35-11-data transfer.ROF (Unmodified)



- Go to the UserFiles subfolder. Two Excel files named "TEST 35-11-DATA TRANSFER.NID" and "TEST 35-11-DATA TRANSFER.NPD" should be generated. In addition, there should be two RESRAD-OFFSITE input files, TEST 35-11.ROF and TEST 35-11-DATA TRASFER.ROF.
- Open the two *.ROF input files separately with Notepad and compare the contents. The only difference should be the value for the "COVER0" parameter. In TEST35-11-DATA TRANSFER.ROF, the value is 0, while in TEST35-11.ROF, the value is .3.



• Open TEST35-11-DATA TRANSFER.ROF with Notepad, change the COVER0 value from 0 to 0.3, and then save and close the file. Open the Excel file TEST 35-11-DATA TRASFER.NID. In row 81, change the value for THICK0 from 2 to 2.5, and then save

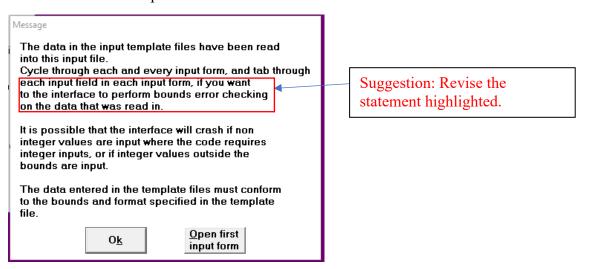
and close the file. Note that the value for COVER0 is 0; do not change it. Open the Excel file TEST 35-11-DATA TRASFER.NDD; in column D for DCACTC, change the value for U-234, U-235, and U-238 from 100 to 70; in column R for Release Opt, change the value for U-234 and U-238 from 0 to 1 to be the same as that for U-235; and in column AT for LEACH1, change the value for U-234 and U-238 from 0 to 0.001 to be the same as the value for U-235; save and close the file.

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1	NucNam	Conc	DCACTCM	DCACTC	DCACTU1	DCACTU2	DCACTU3	DCACTU4	DCACTU5	DCACTS I
2	Ac-227	0	20	20	20	20	20	20	20	20
3	Pa-231	0	50	50	50	50	50	50	50	50
4	Pb-210	0	100	100	100	100	100	100	100	100
5	Po-210	0	10	10	10	10	10	10	10	10
6	Ra-226	0	70	70	70	70	70	70	70	70
7	Th-230	0	60000	60000	60000	60000	60000	60000	60000	60000
8	U-234	3.7	50	70	50	50	50	50	50	50
9	U-235	3.7	50	70	50	50	50	50	50	50
10	U-238	3.7	50	70	50	50	50	50	50	50

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2	Ac-227	20	20	20	20		1	1		1 1	1
3	Pa-231	50	50	50	50		1	1		1 1	1
4	Pb-210	100	100	100	100		1	1		1 1	1
5	Po-210	10	10	10	10		1	1		1 1	1
6	Ra-226	70	70	70	70		1	1		1 1	1
7	Th-230	60000	60000	60000	60000		1	1		1 1	1
8	U-234	50	50	50	50		0	1		1 1	1
9	U-235	50	50	50	50		0	1		1 1	1
10	U-238	50	50	50	50		0	1		1 1	1

6	☐ ちヾ ♂ ・ ÷ TEST 35-11-DATA TRANSFER.NDP - Excel								Excel	
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2	Ac-227	0	0	0	0		0 0	0	0	0
з	Pa-231	0	0	0	0		0 0	0	0	0
4	Pb-210	0	0	0	0		0 0	0	0	0
5	Po-210	0	0	0	0		0 0	0	0	0
6	Ra-226	0	0	0	0		0 0	0	0	0
7	Th-230	0	0	0	0		0 0	0	0	0
8	U-234	0	0	0.001	0		0 0	0	0	0
9	U-235	0	0	0.001	0		0 0	0	0	0
10	U-238	0	0	0.001	0		0 0	0	0	0

- Launch RESRAD-OFFSITE again. Open and read in data from the input file TEST35-11-DATA TRANSFER.ROF. In the Title & Radiological Data input form, the transformation database should be ICRP 107 and the cut-off half-life should be 30 days. In the Initial Concentrations input form, the concentration for the uranium isotopes should be 3.7 Bq/g. In the Distribution Coefficient input form, the value of U-234, U-235, and U-238 for the contaminated zone should be 100 cm3/g. In the Radionuclide Specific Release input form, for U-234 and U-238, the transfer mechanism should be Equilibrium Desorption Transfer. For U-235, the transfer mechanism should be First Order Rate Controlled Transfer, with a leach rate of 0.001/yr. In the Primary Contamination input form, the thickness of clean cover should be 0.3 m, and the thickness of the contaminated zone should be 2 m.
- Choose Data Transfer -> Read Template Files from the menu bar. Click the "Read Files" tab in the pop-up window. Choose to open TEST 35-11-DATA TRANSFER.ROF in the UserFiles subfolder. A message window should pop up giving warnings that the interface may crash and advising the user to cycle through input forms. Click OK to read in the data in the template files. Click Close to close the Formatted Data Transfer window.



• Open the Initial Concentrations input form, then choose the Distribution Coefficients tab. The Kd of U-234, U-235, and U-238 for the contaminate zone should be changed to 70 cm3/g. Close the Distribution Coefficients input form.

Distribution Coefficients			
Radionuclide U-234			
Location	Distribution coefficient (cm³/g)		Distribution coefficient (cm³/g)
Contaminated medium:	50	Suspended sediment in surface water body	50
<u>C</u> ontaminated zone:	70	Bottom sediment in surface water body	50
Unsaturated zone <u>1</u> :	50	Frui <u>t</u> , grain, nonleafy fields	50
		<u>L</u> eafy vegetable fields	50
		Pasture, silage growing areas	50
		Livestock feed grain fields	50
S <u>a</u> turated zone:	50	Dwelling site	50
Number of unsaturated zone set in preliminary inputs form			
		Save Cancel	

• Choose the Nuclide Specific Release tab, the transfer mechanism for U-234 should be changed to First Order Rate Controlled Transfer with a leach rate of 0.001/yr. Same for U-238.

Radionuclide U-234 ★ Element U Release to ground water Transfer mechanism	Radionuclide Specific Release	
First Order Rate Controlled Transfer Equilibrium Desorption Transfer Equilibrium Solubility Transfer Time at which release begins or changes (years) O Add Next Time Cumulative fraction of radionuclide bearing material that is releasable Incremental fraction of radionuclide bearing becomes releasable Leach rate (1/year) 001	Radionuclide U-234	t Element U
linearly over time Leach rate of isotope changes	T Cumulative fraction Incremental fraction	

• Open the Primary Contamination input form. The input value for thickness of the clean cover should be reset to 0 m, and the thickness for the contaminated zone should be changed to 2.5 m.

Primary Contamination									
Area of primary contamination:									
Length of contamination paralle	el to aquifer flo	w:							
Depth of soil <u>m</u> ixing layer:									
Mass loading of all particulates:									
Deposition velocity of all partic	Deposition velocity of all particulates (to compute atmospheric release):								
Respirable particulates as a fra	action of total p	articulates							
Deposition <u>v</u> elocity of respirabl	e particulates	(to compute a	tmospheric release):						
Irrigation applied per year:									
Evapotranspiration coefficient:									
R <u>u</u> noff coefficient:									
Slope-length-steepness factor:	-								
Cover and management factor:									
Support practice factor:									
Fraction of primary contaminati	on that is subm	nerged							
Soil laver ->	Clean cover	C	inated zone						
Location relative to water table		above	below						
Thickness:	0	2.5	meters						
Soil erodibility factor:	.4	.4	tons/acre						
Dry bulk density:	1.5	.001	grams/cm³						
E <u>r</u> osion rate:	.0000115	.0172	meters/year						
Total porosity:	.4	.4							
Volumetric water content:	.05								

During the testing, the RESRAD-OFFSITE behaved as expected.

12.70 TEST CASE 035-012 TESTER'S REPORT

Documented in Test Case 35-12-JJCheng.docx of 2/26/2020 12:53 PM

Test Case 35-12 – Test the GUI's input functionality from control level

The test was performed following the instructions in the Test Cases document. The RESRAD-OFFSITE code behaved expectedly for each step. It is noted that the functions of F5, F6, and F7 (change the input value to the min., default, and max., respectively) do not apply to the input parameters in the Nuclide Specific Release, Distribution Coefficients, Deposition Velocities, and Transfer Factors input forms as designed.

12.71 TEST CASE 036-001 TESTER'S REPORT

Documented in Test Case 036-001.msg of 2/20/2020 11:14 AM

Test Case 036-001

LePoire, David J.

Thu 2/19/2020 1:46 PM

Opened Help

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2 Accept or Cancel Changes to	
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2 Ambient Temperature	
Anemometer Height Try the following in order:	
Image: Provide the second s	
2 Atmospheric Mixing Height 1. 1. Click on the "contents" tab on the left to look at an alphabetic listing of all the help	
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2 Depth of Soil Mixing Layer	
2 Diffusion Coefficient of Radior	

Help topic comes up

PRESRAD-OFFSITE Help	- D X
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ontents Index Search	
A Help on Getting Help	Contaminant Flux to Surface Water Body
Accept or Cancel Changes to	
 All Solids are Contaminated 	The following contaminant fluxes into the surface water body are considered.
Ambient Temperature	The following containmant naxes into the surface water body are considered.
Anemometer Height	From interception of ground water: The flux profile for an undisturbed uniform flow is
Annual Radiation Dose Limit	
Atmospheric Mixing Height	computed by solving the governing equation for contaminant flow. The flux is obtained by
Average Wind Speed	integrating over the region of the aquifer intercepted by the surface water body. This is
2 b - Parameter	assumed to be a rectangular region of height equal to the <u>depth of aquifer contributing to the</u>
Building Air Exchange Rate	surface water body. The width of the region is defined by the distances from the plume
Building Indoor Area Factor	centerline to the <u>near</u> and <u>far</u> edges of the surface water body.
Building Room Height	
C-12 Evasion Flux Rate from	From erosion of the primary contamination: A part of the soil that is eroded from the
C-14 Evasion Flux Rate from	primary contamination is assumed to reach the surface water body. The contaminants
Concentration of Colloids in A	associated with this soil are assumed to be delivered to the surface water body immediately
Concentration of Contaminan	upon erosion from the primary contamination.
Concentration of Contaminan	upon crosion nom die primary containination.
Consumption Rate Contaminant Flux to Surface	<i>From the deposition of contaminated dust:</i> the concentration of contaminants in dust above
Contaminant Flux to Sunace	
Contaminated media Surroun	the surface of the water body is computed by the atmospheric transport model. The flux due
Convergence Criteria for Atm	to the dry deposition of this dust is obtained by multiplying by the
Convergence Criterion	Deposition_velocity_of_nuclide.
Cover and Management Fact	
Current Vertex	
2 Darcy Velocity	
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Print ⇔ **ð**-Back Options Contents | Index | Search | A Help on Getting Help Accept or Cancel Changes to 2 All Solids are Contaminated 2 Ambient Temperature Anemometer Height Annual Radiation Dose Limit Atmospheric Mixing Height Average Wind Speed i) b - Parameter ii) Building Air Exchange Rate 2 Building Indoor Area Factor

Links work:

😤 RESRAD-OFFSITE Help

Depth of Aquifer Contributing to the Surface Water Body

In the RESRAD OFFSITE model, the part of the aquifer from the top to the specified depth is assumed to contribute to the surface water body. A zero depth indicates a situation where the surface water body does not intercept any ground water. This is used to compute the contaminant flux from the interception of ground water.

Search works:

😵 RESRAD-OFFSITE Help	- 0	×
Hide Back Print Options		
Contents Index Search Type in the keyword to find:	 Precipitation This is the average annual rainfall at the site. A single site specific value that is appropriate for the whole area (primary contamination and the farmed areas) must be used. It is used in the following calculations: The rate of infiltration into the primary contamination The rate of infiltration in the unsaturated zone. The rate of infiltration in the offsite areas. The rate of infiltration of contaminants in the agricultural fields and pastures. The ransport in the atmosphere. The release and distribution of tritium in the environment. The estimation of the radionuclide leach rate from the primary contamination if necessary. 	^
RESRAD-OFFSITE Help	- 0	×
Contents Index Search ? Number of Individuals Consur ^ ? Number of Time Points ^ ? Number of Unsaturated Zone: ? ? Occupancy ? ? Onsite Vertical Dimension of ? ? Pore Water Velocity ? ? Porosity, Total ? ? Potential Evaporation from th ? ? Primary Contamination ? ? Radiological Activity ? ? Radiological Transformation I ? ? Radionuclide Bearing Materia ? ? Radionuclide Suecome availa ? ? Radionuclides become availa ? ? Radon Dose and Slope Factor ? ? Radon Emanation Coefficient ? ? Rainfall Erosion Index ? ? Rate of (Ground Water) Trans ?	Sediment Delivery Ratio This is the fraction of the contaminated soil that was eroded from the area of primary contamination that reaches the surface water body or is deposited over a farmed land. If th area of land draining into the surface water body, i.e. the catchment, is large and if the primary contamination is situated far from the surface water body, a part of the soil eroded from the primary contamination might be deposited along the way as it is transported to the surface water body. If any of the farmed lands or dwelling are in the drainage path from the primary contamination some of the sediment might be deposited there. Thus the sediment delivery ratio could be less than one for the surface water body and more than zero for the farmed lands in these cases. The range of sediment delivery ratios that are typical for a give drainage area is shown in the Handbook of Hydrology by Maidment. It is used to compute the <u>contaminant flux to the surface water body from surface erosion</u> , and also to the farmed lands.	l e e

12.72 TEST CASE 037 TESTER'S REPORT

Documented in Test Case 037.msg of 2/20/2020 11:13 AM

Test Case 037

LePoire, David J.

Thu 2/19/2020 2:24 PM

Summary: compared 4 nuclides in DCF editor, input echo and manual. All the same after putting in the same units.

Comparison of Data

	DCF Editor & input Echo			Manual (A2.1 and A2.2)				Comparison			
	mrem/pC	i			mSv/Bq		A2.1				
	Ing	Inh	Ext_vol		Ing	Inh	Ext_vol				
Co-60	2.69E-05	2.19E-04	16.22		7.27E-06	5.92E-05	4.38	1.000037176	0.999817	1.000863878	
Ir-192	5.74E-06	2.82E-05	4.614		1.55E-06	7.62E-06	1.25	1.00087184	1.000213	0.997621622	
Ir-192m	1.57E-06	3.85E-04	0.751		4.24E-07	1.04E-04	0.203	1.000764916	1.00052	0.999866862	
H-3	6.40E-08	6.40E-08	0		1.73E-08	1.73E-08	0	0.999843774	0.999844	#DIV/0!	

Get PM scope:

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	e, Santa re, David J., O. Wang, Cheng, O. Cheng, Jing-Jy; O. Gnanapragasam, Emmanuet, O. Beckman, Kevin J.
	Country - Long and Country - Country
Yes, pick t	ypical radionuclides found at DOE and NRC sites.
Charley	
From: Kar	nboj, Sunita
	nday, February 17, 2020 11:22 AM
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	e, David J. < <u>dlepoire@anl.gov</u> >; Wang, Cheng < <u>wangcheng@anl.gov</u> >; Cheng, Jing-Jy < <u>iche</u> deckman@anl.gov>
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souleen	
Charley,	
For Test C	ases 37-40 and Test Case 42, under Procedure it mentions
Spot che	ck based on PM scope request
Can I pick	3 -5 radionuclides/elements for spot checking?
Thanks.	
Sunita	

Co-60 ICRP-38 FGR11

TABLE A.2-1 (Cont.)

		Fitting Parameters ^b						
Radionuclide	Volume Dose Coefficients* (mSw/yr per Bq/g)	CF_A	CF_B	CF_KA (cm2/g)	CF_KB (cm2/g)			
0 242	1 507 01	0.005	0.075	1.200.01	1 600-000			
Co-58	1.61E+00	0.923	0.077	9.00E-02	1.34E+00			
Co-60	4.38E+00	0.076	0.924	1.28E+00	7.80E-02			
Co-60m	6.67E-03	0.12	0.88	1.17E+00	7.90E-02			
0000	2.1.72-07	V.77	0.01	0.202.01	1.205.00			
H-3	0.00E+00	0	0	0.00E+00	0.00E+00			
11/1 1 22	< 555 A5	0.000	A 155	A 375 A1	1 005 00			
	1.072 01	0.020						
Ir-192	1.25E+00	0.931	0.069	1.08E-01	1.49E+00			
Ir-192m	2.03E-01	0.932	0.068	1.41E-01	1.61E+00			
Tr 104	1 495 01	0.010	0.090	0 705 00	1 202-00			

FGR 11 and FGR 12 based dose conversion factors and FGR 13 Morbidity based slope factors

Library Name: FGR 12, FGR 11, and FGR 13 Morbidity **Dose Factors Help** Selected Nuclide: Co-60 Co-58m Co-50m Co-60m Co-61m Co-61m Cr-48 Cr-48 Cr-49 Cr-125 Ca-126 Ca-127 Ca-128 Ca-127 Ca-128 Ca-128 Ca-130 Ca-131 Ca-131 Ca-133 Ca-133 Ca-134 Ca-1336 Ca-138 Ca-128 Ca-138 Ca-1388 Ca-1388 Ca-1388 Ca-1388 Ca-1388 Ca-1388 Ca-1388 C **Dose Conversion Factors Slope Factors** Radon **Transfer Factors** Ingestion Dose Conversion Factors Inhalation Dose Conversion Factors (mrem/pCi) Reference (mrem/pCi) Reference O FGB 11, 1_1 = 0.05 0.0000102 O FGR 11 Class = W 0.0000331 ⊙ FGR 11, 1_1 = 0.3 0.0000269 ⊙ FGR 11 Class = Y 0.000219 External Dose Conversion Factors, Volume Reference [mrem/yr]/[pCi/g] External Dose Conversion Factors, Surface O Default FGR 12 16.22 Reference (mrem/yr)/(pCi/cm^2) C Default FGB 12 2.744 Another Library **Adjustment Parameters** Exit Program

5m ^ 6m	Dose Conversion Factors	Slope Factors	Radon	Transfer Factors
7 7m 9			- Inhalation Dose Conversion Facto	(\$
9m	Reference	(mrem/pCi)	Reference	(mrem/pCi)
	Ø FGR 11, f_1 = 0.01	5.74E-06	O FGR 11 Class = D	0.0000189
ia i				
ib i			O FGR 11 Class = W	0.0000181
				0.0000282
in in its second s				
In				
m				
m				
	Estand Days Community Factory V			
i	External Dose Conversion Factors, V			
lm i im	Reference	(mrem/yr)/(pCi/g)	← External Dose Conversion Factors	. Surface
i m				CALLS AND
m	Reference	(mrem/yr)/(pCi/g)	Reference	(mrem/yr)/(pCi/cm
im V	Reference	(mrem/yr)/(pCi/g)		
i	Reference	(mrem/yr)/(pCi/g)	Reference	(mrem/yr)/(pCi/cm

	Dose Conversion Factors	Slope Factors	Radon	Transfer Factors
	Ingestion Dose Conversion Factors		Inhalation Dose Conversion Facto	ws
	Reference	(mrem/pCi)	Reference	(mrem/pCi)
		1.57E-06	O FGR 11 Class = D	0.0000548
			O FER 11 Class = W	0.000025
			Ø FGR 11 Class = Y	0.000385
	-			
	- External Dose Conversion Factors, V	olume		
	External Dose Conversion Factors, V	(mrem/yr)/[pCi/g]		
	External Dose Conversion Factors, Vi <u>Reference</u> O Default FGR 12	201 Second 201	External Dose Conversion Factors	r, Surface
	Reference	(mrem/yr)/(pCi/g)	Reference	
*	Reference	(mrem/yr)/(pCi/g)		i, Surface (mrem/yr)/(pCi/cm [*]) <mark>0,181</mark>
	Reference	(mrem/yr)/(pCi/g)	Reference	(mrem/yr)/(pCi/cm [*])

FGR 11 and FGR 12 based dose conversion factors and FGR 13 Morbidity based slope factors

6	Dose Conversion Factors	Slope Factors	Radon	Transfer Factors
7	Ingestion Dose Conversion Factors		Inhalation Dose Conversion Factor	
9 1 5	Reference	(mrem/pCi)	Reference	(mrem/pCi)
7 8 10 12 13 13 15 15 15 15 16 18 18 19 10 10 10 10 10 10 10 10 10 10 10 10 10	Ø.FGR 11, (_1 = 1	6.4E-08		6.4E-08
93 93m 94	External Dose Conversion Factors, V	olume (mrem/yi)/[pCi/g]		
95 95m	Reference			
95 95m 97 97m 99m	O Default FER 12	0	External Dose Conversion Factors, Reference	Surface (mrem/yr)/(pCi/cm^

RESRAD-OFFSITE, Version 4.0 Th Lim Parent Dose Report Title : RESRAD-OFFSITE Default Parameters File : SATURATED FLUXIN KD 10_test.ROF 02/15/2020 15:52 Page 2 The Limit = 30 days

Dose Conversion Factor (and Related) Parameter Summary Current Library: FGR 12 Default Library: FGR 12

Menu	1	Parameter	Current Value	Default	Paramet Name	er
DCSF	DCF's for	r external ground radiation, (mrem/yr)/(pCi/g)				
DCSF	Co-60	(Source: FGR 12)	1.6222+01	1.6222+01	DCFEXT (1)
DCSF	H-3	(Source: FGR 12)	0.0002+00	0.000E+00	DCFEXT (2)
DCSF	Ir-192	(Source: FGR 12)	4.6142+00	4.6142+00	DCFEXT (3)
DCSF	Ir-192m	(Source: FGR 12)	7.5102-01	7.5102-01	DCFEXT (4)
	i		i	i	i č	

Current Library: FGR 11 Default Library: FGR 11

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	Dose conversion factors for inhalation, mrem/pCi:	1		
DCSF	Co-60	2.1902-04	2.1902-04	DCF2(1)
DCSF	H-3	6.400Z-08	6.400Z-08	DCF2 (2)
DCSF	Ir-192	2.8202-05	2.8202-05	DCF2 (3)
DCSF	Ir-192m	3.8502-04	3.8502-04	DCF2 (4)
DCSF	Dose conversion factors for ingestion, mrem/pCi:		9	1
DCSF	Co-60	2.6902-05	2.6902-05	DCF3(1)
DCSF	H-3	6.4002-08	6.400Z-08	DCF3(2)
DCSF	Ir-192	5.7402-06	5.7402-06	DCF3 (3)
DCSF	Ir-192m	1.5702-06	1.5702-06	DCF3(4)

12.73 TEST CASE 038 TESTER'S REPORT

Documented in Test Case 038.msg of 2/20/2020 11:13 AM

Test Case 038

LePoire, David J.

Thu 2/20/2020 6:52 AM

Summary: compared the slope factors for a number of radionuclides with data from the DCF editor, the input echo, and the manual. All were consistent.

	DCF Edito	r & input E	cho	Manual (N	I-1 morbid	ity)	Comparison		
	Risk/Bq			risk/Bq		A2.1			
	Ing	Inh	Ext_vol	Ing (food)	Inh	Ext_vol			
Co-60	6.03E-10	2.73E-09	3.35E-04	6.03E-10	2.73E-09	3.35E-04	1.00E+00	1.00E+00	1.00E+00
lr-192	2.89E-10	6.51E-10	9.19E-05	2.89E-10	6.51E-10	9.19E-05	1.00E+00	1.00E+00	1.00E+00
lr-192m	3.57E-11	2.76E-09	1.46E-05	3.57E-11	2.76E-09	1.46E-05	9.99E-01	9.99E-01	9.98E-01
H-3	3.89E-12	2.30E-11	0	3.89E-12	2.30E-11	0	1.00E+00	1.00E+00	#DIV/0!



Dose Factors Help

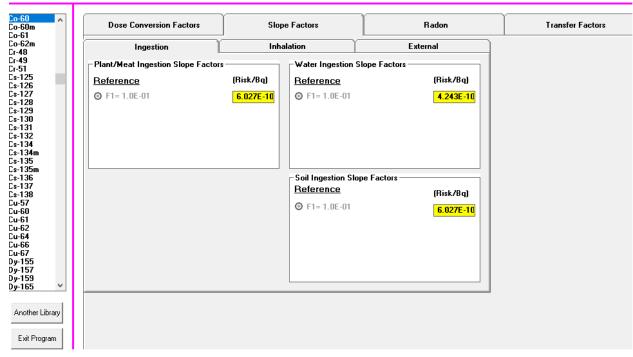


Table N-1 (Cont.)

					Ingestion					
	External (risk	/yr per Bq/g)	Inhalation	(risk/Bq)	Food (r	isk/Bq)	Water (1	risk/Bq)	Soil ^b (r	isk/Bq)
Radionuclide [*]	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality
Cf-248	1.28E-09	7.54E-10	6.92E-07	6.57E-07	1.68E-09	1.03E-09	1.20E-09	7.46E-10	1.68E-09	1.03E-09
Cf-249	3.70E-05	2.50E-05	1.31E-06	1.08E-06	4.41E-09	3.27E-09	3.43E-09	2.60E-09	4.41E-09	3.27E-09
Cf-250	1.21E-09	7.16E-10	9.95E-07	9.43E-07	3.03E-09	2.15E-09	2.33E-09	1.70E-09	3.03E-09	2.15E-09
Cf-251	1.02E-05	6.92E-06	1.33E-06	1.10E-06	4.59E-09	3.41E-09	3.57E-09	2.67E-09	4.59E-09	3.41E-09
Cf-252	2.34E-09	1.49E-09	7.03E-07	2.12E-06	4.86E-09	1.46E-08	4.86E-09	1.46E-08	4.86E-09	1.46E-08
C1-36	4.70E-08	3.22E-08	2.73E-09	2.58E-09	1.20E-10	7.92E-11	8.92E-11	5.95E-11	1.20E-10	7.92E-11
Cm-241	5.24E-05	3.57E-05	3.30E-09	3.11E-09	1.90E-10	1.06E-10	1.31E-10	7.32E-11	1.90E-10	1.06E-10
Cm-242	2.09E-09	1.29E-09	5.43E-07	5.16E-07	1.48E-09	8.65E-10	1.04E-09	6.16E-10	1.48E-09	8.65E-10
Cm-243	1.13E-05	7.70E-06	9.92E-07	9.38E-07	3.32E-09	2.30E-09	2.56E-09	1.81E-09	3.32E-09	2.30E-09
Cm-244	1.31E-09	7.76E-10	9.62E-07	9.08E-07	2.92E-09	2.02E-09	2.26E-09	1.59E-09	2.92E-09	2.02E-09
Cm-245	6.43E-06	4.38E-06	1.03E-06	8.81E-07	3.65E-09	2.57E-09	2.81E-09	2.02E-09	3.65E-09	2.57E-09
Cm-246	1.24E-09	7.35E-10	1.02E-06	8.81E-07	3.54E-09	2.51E-09	2.76E-09	1.98E-09	3.54E-09	2.51E-09
Cm-247+D	3.69E-05	2.51E-05	9.43E-07	7.86E-07	3.53E-09	2.45E-09	2.70E-09	1.93E-09	3.53E-09	2.45E-09
Cm-248	9.24E-10	5.49E-10	4.05E-06	2.23E-05	3.51E-08	1.84E-07	3.51E-08	1.84E-07	3.51E-08	1.84E-07
Co-56	4.86E-04	3.32E-04	6.92E-10	5.73E-10	3.86E-10	2.35E-10	2.73E-10	1.67E-10	3.86E-10	2.35E-10
Co-57	9.59E-06	6.54E-06	1.01E-10	8.73E-11	4.03E-11	2.43E-11	2.81E-11	1.70E-11	4.03E-11	2.43E-11
Co-58	1.21E-04	8.27E-05	2.15E-10	1.81E-10	1.13E-10	6.81E-11	7.97E-11	4.84E-11	1.13E-10	6.81E-11
Co-60	3.35E-04	2.28E-04	2.73E-09	2.32E-09	6.03E-10	3.89E-10	4.24E-10	2.76E-10	6.03E-10	3.89E-10
Ce 124	1.028.04	1 210 04	1 900 00	1.660.00	1 2012 00	0.578 10	1.140.00	7 022 10	1 202 00	0.570 10

RESRAD-OFFSITE, Version 4.0 TH Limit = 30 days 02/20/2020 08:48 Page 2

Risk Report Title : RISRAD-OFFSITE Default Parameters File : Site5.ROF

Cancer Risk Slope Factors Summary Table Current library: FGR 13 Morbidity Default library: FGR 13 Morbidity

	I	Current	I	Parameter
Menu	Parameter	Value	Default	Name
DCSF	Ground external radiation slope factors, l/yr per (Bq/g):			
DCSF	Co-60	3.35E-04	3.35E-04	SLPF(1,1)
DCSF	Н-3	0.00E+00	0.002+00	SLPF(2,1)
DCSF	Ir-192	9.19E-05	9.19 <u>2</u> -05	SLPF(3,1)
DCSF	Ir-192m	1.462-05	1.462-05	SLPF(4,1)
DCSF	Inhalation, slope factors, 1/(Bg):			1
DCSF	Co-60	2.73E-09	2.73E-09	SLPF(1,2)
DCSF	Н-3	2.30E-11	2.30E-11	SLPF(2,2)
DCSF	Ir-192	6.51E-10	6.51E-10	SLPF(3,2)
DCSF	Ir-192m	2.762-09	2.762-09	SLPF(4,2)
DCSF	Food ingestion, slope factors, 1/(Bg):			
DCSF	Co-60	6.03E-10	6.03E-10	SLPF(1,3)
DCSF	H-3	3.89E-12	3.892-12	SLPF(2,3)
DCSF	Ir-192	2.89E-10	2.89E-10	SLPF(3,3)
DCSF	Ir-192m	3.572-11	3.572-11	SLPF(4,3)
DCSF	Water ingestion, slope factors, 1/(Bg):			
DCSF	Co-60	4.242-10	4.242-10	SLPF(1,4)
DCSF	H-3	3.03E-12	3.03E-12	SLPF(2,4)
DCSF	Ir-192	1.992-10	1.992-10	SLPF(3,4)
DCSF	Ir-192m	2.652-11	2.652-11	SLPF(4,4)
DCSF	Soil ingestion, slope factors, 1/(Bg):			1
DCSF	Co-60	6.03E-10	6.032-10	SLPF(1,5)
DCSF	H-3	3.89E-12	3.89E-12	SLPF(2,5)
DCSF	Ir-192	2.892-10	2.892-10	SLPF(3,5)
DCSF	II-192m	3.572-11	3.572-11	SLPF(4,5)
				1

12.74 TEST CASE 039 TESTER'S REPORT

Documented in Test Case 39.msg of 2/20/2020 11:13 AM

Test Case 39

LePoire, David J.

Thu 2/20/2020 7:32 AM

Transfer factors were compared based on input form, input echo, and V&V table. Co-60 and Ir-192 matched. The H-3 form and input echo showed that the non-aquatic transfer factors are calculated. They match.

	Fish	Crust	Plant	Meat	Milk
Co-60	3.00E+02	2.00E+02	0.08	0.02	2.00E-03
Ir-192	1.00E+01	2.00E+02	0.03	0.002	2.00E-06
Ir-192m	1.00E+01	2.00E+02	0.03	0.002	2.00E-06

The H-3 factors are calculated for plant, meat, milk. They are the same for Fish and crustacea (1).

q/kg)
q/kg)
q/kg)
q/kg)
(Bq/d)
lq/d)
(Bq/L)
(Bq/L)

Transfer Factors								
Radionuclide: Ir-192 🔺	Eler	nent Ir						
Soil to plant transfer factor								
Frui <u>t</u> , grain, nonleafy vegetables	0.03	(Bq/kg)/(Bq/kg)						
<u>L</u> eafy vegetables:	0.03	(Bq/kg)/(Bq/kg)						
Past <u>u</u> re, silage:	0.03	(Bq/kg)/(Bq/kg)						
Livestock feed grain:	0.03	(Bq/kg)/(Bq/kg)						
Intake to animal product transfer factor								
M <u>e</u> at:	0.002	(Bq/kg)/(Bq/d)						
M <u>i</u> lk:	0.000002	(Bq/L)/(Bq/d)						
Water to aquatic food transfer	factor							
<u>F</u> ish:	10	(Bq/kg)/(Bq/L)						
<u>C</u> rustacea:	200	(Bq/kg)/(Bq/L)						
	ncel							

ransfer Factors		
Radionuclide: Ir-192m 🔺	Elerr	ient Ir
Soil to plant transfer factor		
Frui <u>t</u> , grain, nonleafy vegetables	0.03	(Bq/kg)/(Bq/kg)
<u>L</u> eafy vegetables:	0.03	(Bq/kg)/(Bq/kg)
Past <u>u</u> re, silage:	0.03	(Bq/kg)/(Bq/kg)
Livestock feed grain:	0.03	(Bq/kg)/(Bq/kg)
Intake to animal product transf	ier factor	
M <u>e</u> at:	0.002	(Bq/kg)/(Bq/d)
M <u>i</u> lk:	0.000002	(Bq/L)/(Bq/d)
Water to aquatic food transfer	factor	
<u>F</u> ish:	10	(Bq/kg)/(Bq/L)
<u>C</u> rustacea:	200	(Bq/kg)/(Bq/L)
Sar Can		

RZSRAD-OFFSITZ, Version 4.0 T4 Limit = 30 days Parent Dose Report Title : RISRAD-OFFSITZ Default Parameters File : Site5.ROF

Dose Conversion Factor (and Related) Parameter Summary (continued) Current Library: RESRAD Default Transfer factors Default Library: RESRAD Default Transfer factors

		Current	I	Parameter
Menu	Parameter	Value	Default	Name
	Soil to plant transfer factors: Co-60 , plant/soil concentration ratio, dimensionless	8.0002-02	8 0007-02	
	Co-60 , plant/soil concentration ratio, dimensionless	8.0002-02	•	
	Co-60 , plant/soil concentration ratio, dimensionless	8.0002-02		
	Co-60 , plant/soil concentration ratio, dimensionless	8.0002-02		
TF	CO-60 , plant/soli Concentration fatio, dimensionless	0.0002-02	8.0002-02	KIE (1,4)
	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2.1)
	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	•	•
TF	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2,3)
TF	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2,4)
TF		i	i	i
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,1)
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,2)
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,3)
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,4)
TF		- I	I	I
TF	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	3.0002-02	RTF(4,1)
	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	•	•
	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	•	•
TF	Ir-192m , plant/soil concentration ratio, dimensionless	3.0002-02	3.0002-02	RTF(4,4)
TF	intake to meat/milk transfer factors:			
TF	Co-60 , beef/livestock-intake ratio, (Bg/kg)/(Bg/d)	2.000E-02	2.000E-02	I M(1,1)
TF	Co-60 , milk/livestock-intake ratio, (Bg/L)/(Bg/d)	2.000E-03	2.0002-03	I M(1,2)
TF		i	i	i – .
TF	H-3 , beef/livestock-intake ratio, (Bg/kg)/(Bg/d)	5.742E-03	1.200E-02	I_M(2,1)
TF	H-3 , milk/livestock-intake ratio, (Bg/L)/(Bg/d)	4.312E-03	1.000E-02	I_M(2,2)
TF		Í	l l	
TF	Ir-192 , beef/livestock-intake ratio, (Bg/kg)/(Bg/d)	2.000E-03	2.000E-03	I_M(3,1)
TF	<pre>Ir-192 , milk/livestock-intake ratio, (Bq/L)/(Bq/d)</pre>	2.000E-06	2.0002-06	I_M(3,2)
TF			I	1
TF	Ir-192m , beef/livestock-intake ratio, (Bg/kg)/(Bg/d)	2.000E-03	2.000E-03	I_M(4,1)
TF	II-192m , milk/livestock-intake ratio, (Bq/L)/(Bq/d)	2.0002-06	2.0002-06	I_M(4,2)
TF	Bioaccumulation factors, fresh water, L/kg:	i	i	i
TF	Bioaccumulation factors, fresh water, L/kg:	i i	i	
TF	Co-60 , fish	3.0002+02 3	.000E+02 BI	OFA(1,1)
	Co-60 , crustacea and mollusks	2.0002+02 2	.000E+02 BI	OFA(1,2)
TF	l	1	- I	
	H-3 , fish	1.0002+00 1		-
	H-3 , crustacea and mollusks	1.0002+00 1	.000E+00 BI	OFA(2,2)
TF TF	Tr-162 fich	1 1 0007401	0007401	053 (2 1)
	II-192 , fish II-192 , crustacea and mollusks	1.000E+01 1 2.000E+02 2		
TF	II ISE , CINDUACEA ANN MUITUDAD			ora (0, 1)
TF	Ir-192m , fish	1.000E+01		
TF	Ir-192m , crustacea and mollusks	2.000E+02 :		

Compare to data in V&V Data Verification> transfer Factor verification (Plant Transfer Factor Comparison.xlsx is below)

Basis) with Those from Other References							
	PNNL Fresh Weight (Staven et al. 2003) ^a) ^a		
Element	RESRAD (default)	NCRP (1999)	Leafy Vegetables	Fruits Gra	ins Root Veg	etables	
Ac	2.5×10^{-3}	1.0×10^{-3}	9.4 × 10 ⁻⁵	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}	
Ag	1.5×10^{-1}		5.4 × 10 ⁻⁵	1.4×10^{-4}	2.3×10^{-1}	3.3 × 10 ⁻⁴	
Al	4.0×10^{-3}	4.0×10^{-3}	NA ^b	NA	NA	NA	
Am	1.0 × 10 ⁻³	1.0×10^{-3}	9.4 × 10 ⁻⁵	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}	
Ar							
As	8.0×10^{-2}	8.0×10^{-2}	8.0×10^{-3}	1.1×10^{-3}	5.5×10^{-3}	1.5×10^{-3}	
At	2.0×10^{-1}	2.0×10^{-1}	NA	NA	NA	NA	
Au	1.0×10^{-1}	1.0×10^{-1}	2.0×10^{-3}	2.5×10^{-3}	2.3×10^{-1}	4.5×10^{-3}	
В	NA	1.0×10^{-2}	NA	NA	NA	NA	
Ba	5.0×10^{-3}	1.0×10^{-2}	3.0×10^{-2}	2.7×10^{-3}	1.4×10^{-2}	3.8×10^{-3}	
Be	4.0×10^{-3}	4.0×10^{-3}	2.0×10^{-3}	2.7×10^{-4}	1.8×10^{-3}	3.8×10^{-4}	
Bi	1.0×10^{-1}	1.0×10^{-1}	1.0×10^{-1}	9.0×10^{-2}	4.6×10^{-1}	1.3×10^{-1}	
Bk	1.0×10^{-3}	1.0×10^{-3}	NA	NA	NA	NA	
Br	7.6×10^{-1}	4.0×10^{-1}	3.0×10^{-1}	2.7×10^{-1}	1.4×10^0	3.8×10^{-1}	
С	$5.5 imes 10^0$	NA	1.4×10^{-1}	1.3×10^{-1}	6.4×10^{-1}	1.8×10^{-1}	
Ca	5.0×10^{-1}	5.0×10^{-1}	7.0×10^{-1}	6.3×10^{-2}	3.2×10^{-1}	8.8×10^{-2}	
Cd	3.0×10^{-1}	5.0×10^{-1}	1.1 × 10 ⁻¹	2.7×10^{-2}	1.4×10^{-1}	3.8×10^{-2}	
Ce	2.0×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}	
Cf	1.0×10^{-3}	1.0×10^{-3}	9.4×10^{-5}	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}	
Cl	2.0×10^{1}	2.0×10^1	$1.4 imes 10^1$	$1.3 imes 10^1$	6.4×10^{1}	1.8×10^1	
Cm	1.0 × 10 ⁻³	1.0×10^{-3}	1.5×10^{-4}	2.7×10^{-6}	1.9×10^{-5}	1.1×10^{-4}	

TABLE 6.3.10 Comparison of RESRAD Default Plant Transfer Factors (Fresh-WeightBasis) with Those from Other References

Со	8.0×10^{-2}	8.0×10^{-2}	4.6 × 10 ⁻²	1.3×10^{-3}	3.4×10^{-3}	1.7×10^{-2}
Cr	2.5×10^{-4}	1.0×10^{-2}	1.5×10^{-3}	8.1×10^{-4}	4.1×10^{-3}	1.1×10^{-3}
Cs	4.0×10^{-2}	4.0×10^{-2}	9.2×10^{-2}	4.0×10^{-2}	2.4×10^{-2}	3.3×10^{-2}
Cu	1.3 × 10 ⁻¹	5.0×10^{-2}	8.0×10^{-2}	4.5×10^{-2}	2.3×10^{-1}	6.3×10^{-2}
Dy	2.0×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Er	2.0×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Es	1.0×10^{-3}	1.0×10^{-3}	NA	NA	NA	NA
Eu	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	$5. \times 10^{-3}$
F	2.0×10^{-2}	2.0×10^{-2}	1.2×10^{-2}	1.1×10^{-3}	5.5×10^{-3}	1.5×10^{-3}
Fe	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-2}	9.0×10^{-3}	4.6×10^{-2}	1.3×10^{-2}
Fm	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Fr	3.0×10^{-2}	3.0×10^{-2}	NA	NA	NA	NA
Ga	3.0×10^{-3}	3.0×10^{-3}	8.0×10^{-4}	7.2×10^{-5}	3.6×10^{-4}	1.0×10^{-4}
Gd	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Ge	4.0×10^{-1}	4.0×10^{-1}	NA	NA	NA	NA
Н	4.8×10^{0}	NA	NA	NA	NA	NA
He						
Hf	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-4}	1.8×10^{-4}	9.1 × 10 ⁻⁴	2.5×10^{-4}
Hg	3.8×10^{-1}	3.0×10^{-1}	1.7×10^{-1}	6.7×10^{-2}	4.5×10^{-1}	5.0×10^{-2}
Ho	2.6×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Ι	2.0×10^{-2}	2.0×10^{-2}	NA	NA	NA	NA
In	3.0×10^{-3}	3.0×10^{-3}	8.0×10^{-4}	7.2×10^{-5}	3.6×10^{-4}	1.0×10^{-4}
Ir	3.0×10^{-2}	3.0×10^{-2}	8.0×10^{-3}	7.2×10^{-3}	3.6×10^{-2}	1.0×10^{-2}
K	3.0×10^{-1}	3.0×10^{-1}	2.0×10^{-1}	9.9 × 10 ⁻²	5.0×10^{-1}	1.4 × 10 ⁻¹
Kr						
La	2.5×10^{-3}	2.0×10^{-3}	1.0×10^{-3}	7.2×10^{-4}	3.6×10^{-3}	8.8×10^{-5}
Li	NA	1.0×10^{-3}	NA	NA	NA	NA

Lu	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Md	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Mg	3.0×10^{-2}	3.0×10^{-2}	2.0×10^{-1}	9.9 × 10 ⁻²	5.0×10^{-1}	1.4×10^{-1}
Mn	3.0×10^{-1}	3.0×10^{-1}	1.4×10^{-1}	9.0×10^{-3}	2.7×10^{-1}	5.0×10^{-2}
Mo	1.3×10^{-1}	1.0×10^{-1}	1.6×10^{-1}	9.0×10^{-3}	7.3×10^{-1}	2. 0× 10 ⁻¹
N	7.5×10^{0}	NA	1.1×10^{-2}	5.4×10^{-3}	1.2×10^{-1}	1.2×10^{-2}
Na	5.0×10^{-2}	5.0×10^{-2}	6.0×10^{-2}	5.4×10^{-2}	2.7×10^{-1}	7.5×10^{-2}
Nb	1.0×10^{-2}	1.0×10^{-2}	5.0×10^{-3}	4.5×10^{-3}	2.3×10^{-2}	6.3×10^{-3}
Nd	2.4×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Ne						
Ni	5.0 × 10 ⁻²	5.0×10^{-2}	5.6×10^{-2}	1.1×10^{-2}	2.7×10^{-2}	1.5×10^{-2}
No	NA	2.0×10^{-3}	NA	NA	NA	NA
Np	2.0×10^{-2}	2.0×10^{-2}	6.4×10^{-3}	1.8×10^{-3}	2.5×10^{-3}	3.3×10^{-3}
0	6.0×10^{-1}	NA	NA	NA	NA	NA
Os	3.0×10^{-2}	3.0×10^{-2}	3.0×10^{-3}	8.1×10^{-3}	3.2×10^{-3}	$8.8 imes 10^{-4}$
Р	$1.0 imes 10^{0}$	$1.0 imes 10^0$	7.0×10^{-1}	6.3×10^{-1}	3.2×10^{0}	8.8×10^{-1}
Pa	1.0×10^{-2}	1.0×10^{-2}	9.4×10^{-5}	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}
Pb	1.0×10^{-2}	4.0×10^{-3}	2.0×10^{-3}	1.8×10^{-3}	4.3×10^{-3}	1.5×10^{-3}
Pd	1.0×10^{-1}	1.0×10^{-1}	3.0×10^{-2}	7.2×10^{-3}	3.6×10^{-2}	1.0×10^{-2}
Pm	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Po	1.0×10^{-3}	1.0×10^{-3}	2.4×10^{-4}	2.2×10^{-4}	2.1×10^{-3}	1.8×10^{-3}
Pr	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Pt	1.0×10^{-1}	1.0×10^{-1}	NA	NA	NA	NA
Pu	1.0×10^{-3}	1.0×10^{-3}	1.2×10^{-5}	8.1×10^{-6}	7.8×10^{-6}	2.8×10^{-4}
Ra	4.0×10^{-2}	4.0×10^{-2}	9.8×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	5.0×10^{-4}
Rb	1.3 × 10 ⁻¹	2.0×10^{-1}	1.8×10^{-1}	1.6×10^{-1}	8.2×10^{-1}	2.3×10^{-1}
Re	2.0×10^{-1}	2.0×10^{-1}	3.0×10^{-1}	6.3×10^{-2}	3.2×10^{-1}	8.8×10^{-2}
Rh	1.3 × 10 ⁻¹	3.0×10^{-2}	3.0×10^{-2}	7.2×10^{-3}	3.6×10^{-2}	1.0×10^{-2}

Ru	3.0×10^{-2}	3.0×10^{-2}	8.0×10^{-3}	7.2×10^{-3}	4.6×10^{-3}	1.0×10^{-2}
S	6.0×10^{-1}	6.0×10^{-1}	3.0×10^{-1}	2.7×10^{-1}	1.4×10^0	3.8×10^{-1}
Sb	1.0×10^{-2}	1.0×10^{-2}	2.6×10^{-5}	1.4×10^{-5}	2.7×10^{-2}	1.4×10^{-4}
Sc	2.0×10^{-3}	2.0×10^{-3}	1.2×10^{-3}	1.8×10^{-4}	9.1 × 10 ⁻⁴	2.5×10^{-4}
Se	1.0×10^{-1}	1.0×10^{-1}	5.0×10^{-2}	9.0×10^{-3}	2.3×10^{-1}	1.3×10^{-2}
Si	2.0×10^{-2}	2.0×10^{-2}	7.0×10^{-2}	1.3×10^{-2}	6.4×10^{-2}	1.8×10^{-2}
Sm	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Sn	2.5×10^{-3}	3.0×10^{-1}	6.0×10^{-3}	1.1×10^{-3}	5.5×10^{-3}	1.5×10^{-3}
Sr	3.0×10^{-1}	3.0×10^{-1}	6.0×10^{-1}	3.6×10^{-2}	1.9×10^{-1}	1.3×10^{-1}
Ta	2.0×10^{-2}	2.0×10^{-3}	5.0×10^{-3}	4.5×10^{-3}	2.3×10^{-2}	6.3×10^{-3}
Tb	2.6×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Тс	5.0×10^{0}	5.0×10^{0}	4.2×10^1	2.7×10^{-1}	6.6×10^{-1}	6.0×10^{-2}
Те	6.0×10^{-1}	1.0×10^{-1}	5.0×10^{-3}	7.2×10^{-4}	3.6×10^{-3}	1.0×10^{-3}
Th	1.0×10^{-3}	1.0×10^{-3}	3.6×10^{-4}	4.5×10^{-5}	3.1×10^{-5}	8.3×10^{-5}
Ti	1.0×10^{-3}	5.0×10^{-4}	NA	NA	NA	NA
T1	2.0×10^{-1}	2.0×10^{-1}	8.0×10^{-4}	7.2×10^{-5}	3.6×10^{-4}	1.0×10^{-4}
Tm	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
U	2.5×10^{-3}	2.0×10^{-3}	1.7×10^{-3}	7.2×10^{-4}	1.2×10^{-3}	3.0×10^{-3}
V	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
W	1.8 × 10 ⁻²	8.0×10^{-1}	6.0×10^{-1}	5.4×10^{-1}	2.7×10^{0}	7.5×10^{-1}
Xe						
Y	2.5×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	1.8×10^{-3}	9.1 × 10 ⁻³	2.5×10^{-3}
Yb	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Zn	4.0×10^{-1}	4.0×10^{-1}	2.6×10^{-1}	1.6×10^{-1}	$1.5 imes 10^{0}$	8.8×10^{-2}
Zr	1.0×10^{-3}	1.0×10^{-3}	2.0×10^{-4}	1.8×10^{-4}	9.1 × 10 ⁻⁴	2.5×10^{-4}

I

	eef/livestock-intake ratio, ilk/livestock-intake ratio,	
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	<u> </u>
Transfer Factors	
– Radionuclide: H-3 🛛 🌲	Element H
Soil to plant transfer factor	
Fruit, grain, nonleafy vegetables	4 (Bq/kg)/(Bq/kg)
Leafy vegetables:	4 (Bq/kg)/(Bq/kg)
Past <u>u</u> re, silage:	4 (Bq/kg)/(Bq/kg)
Livestock feed grain:	4 (Bq/kg)/(Bq/kg)
Intake to animal product transf	er factor
Meat:	0.005742 (Bq/kg)/(Bq/d)
M <u>i</u> lk:	0.004312 (Bq/L)/(Bq/d)
Water to aquatic food transfer	factor
<u>F</u> ish:	1 (Bq/kg)/(Bq/L)
<u>C</u> rustacea:	1 (Bq/kg)/(Bq/L)
San Can	

12.75 TEST CASE 040 TESTER'S REPORT

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Test Case 40

LePoire, David J.

Thu 2/20/2020 7:47 AM

Data was compared from V&V table below and the .CHN file for C0-60, Cs-137, and Ra-226. All matched

Extract from R:_QA_Files\OFFSITE\V&V\Data Verification\Nuclide decay and ingrowth verification.xlsx > ICRP38-comparion tab:

Principal Rad	lionuclide ^a		Terminal Nuclide or Radionuclide					
Species	Half-Life (yı	Associated Decay Chain ^b	Species	Half-life (yr)	Fraction			
00-00	1.741-01		1.6-20					
Co-60	5.27E+00) —	Ni-60	*				
Cs-134	2.06E+00	—	Ba-134, Xe-	*				
Cs-135	2.30E+06	i —	Ba-135	*				
Cs-137+D	3.00E+01	(Ba-137m 0.946)	Ba-137	*				
D 150	0.05T 01		71.150	<u>ا</u> ي ا				
Ra-226+D	1.60E+03	Rn-222,Po-218, (Pb-214 9.9980E-01), Bi-214, (Po 214 9.9980E-01), (Tl-210 2.0000E-04), (At-218 2.0000E-04)	Pb-210	2.23E+01				
B 440.B			TH	4.047.00				
Pb-210+D	2.23E+01		Po-210	3.79E-01				
Po-210	3.79E-01	<u> </u>	Рb-206	*	-			
D4 102	5 00T 101		T., 102	*				

Table A.1-1 Principal and Associated Radionuclides with a Cutoff Half-Life of 30 Day in ICRP-38 Dat

Chain file for CO-60, Cs-137, and Ra-226:

All data in Nukes(), order matches NUCNAM list in .ROF file: # Nuclide Half-Life AtWt Kd Def Fraction nNuc Decay Chain 001 Co-60 5.27100E+00 059.9338 1.000E+03 1.000000E+00 01 Co-60 002 Cs-137+D 3.00000E+01 136.9071 4.600E+03 1.000000E+00 01 Cs-137+D 003 Pb-210+D 2.23000E+01 209.9842 1.000E+02 1.000000E+00 02 Pb-210+D Po-210 004 Po-210 3.78864E-01 209.9829 1.000E+01 1. Cs-137+D : (Ba-137m 9.4600E-01) Pb-210+D : Bi-210000000E+00 01 Po-210 005 Ra-226+D 1.60000E+03 226.0254 7.000E+01 1.000000E+00 03 Ra-226+D Pb-210+D Po-210 ------ DPlusAll() data:

Ra-226+D : Rn-222 Po-218 (Pb-214 9.9980E-01) Bi-214 (Po-214 9.9980E-01) (Tl-210 2.0000E-04) (At-218 2.0000E-04)

Decay Chain: Co-60 First Branch Second Branch Third Branch Fourth Branch

_____ # Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction 001 Co-60 5.271E+00 000 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 All Threads In Decay Chain: Co-60 # Fraction Nuclides: 001 1.0000E+00 Co-60 Total Thread Fractions: 1.0000E+00 1 - Total Thread Fractions: 0.0000E+00 Condensed Threads In Decay Chain: Co-60 Fix Level = 0 # Fraction Nuclides: 001 1.0000E+00 Co-60 Decay Chain: Cs-137 Second Branch Third Branch Fourth Branch First Branch _____ # Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction 001 Cs-137 3.000E+01 000 EOCB 5.4000E-02 002 Ba-137m 9.4600E-01 000 0.0000E+00 000 0.0000E+00 002 Ba-137m 4.852E-06 000 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 All Threads In Decay Chain: Cs-137 # Fraction Nuclides: 001 5.4000E-02 Cs-137 002 9.4600E-01 Cs-137 Ba-137m Total Thread Fractions: 1.0000E+00 1 - Total Thread Fractions: 0.0000E+00 Condensed Threads In Decay Chain: Cs-137 Fix Level = 0 # Fraction Nuclides: 002 1.0000E+00 Cs-137+D Decay Chain: Ra-226 Second Branch Third Branch Fourth Branch First Branch ------# Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction 001 Ra-226 1.600E+03 002 Rn-222 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 002 Rn-222 1.047E-02 003 Po-218 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 003 Po-218 5.799E-06 004 Pb-214 9.9980E-01 005 At-218 2.0000E-04 000 0.0000E+00 000 0.0000E+00 004 Pb-214 5.095E-05 006 Bi-214 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00

005 At-218 6.338E-08 006 Bi-214 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 006 Bi-214 3.784E-05 007 Po-214 9.9980E-01 008 TI-210 2.0000E-04 000 0.0000E+00 000 0.0000E+00 007 Po-214 5.206E-12 009 Pb-210 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 008 TI-210 2.472E-06 009 Pb-210 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 009 Pb-210 2.230E+01 010 Bi-210 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 010 Bi-210 1.372E-02 011 Po-210 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00 011 Po-210 3.789E-01 000 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000 0.0000E+00

All Threads In Decay Chain: Ra-226 # Fraction Nuclides: 001 9.9960E-01 Ra-226 Rn-222 Po-218 Pb-214 Bi-214 Po-214 Pb-210 Bi-210 Po-210 002 1.9996E-04 Ra-226 Rn-222 Po-218 Pb-214 Bi-214 Tl-210 Pb-210 Bi-210 Po-210 003 1.9996E-04 Ra-226 Rn-222 Po-218 At-218 Bi-214 Po-214 Pb-210 Bi-210 Po-210 004 4.0000E-08 Ra-226 Rn-222 Po-218 At-218 Bi-214 Tl-210 Pb-210 Bi-210 Po-210 Total Thread Fractions: 1.0000E+00 1 - Total Thread Fractions: 0.0000E+00

Condensed Threads In Decay Chain: Ra-226 Fix Level = 0 # Fraction Nuclides: 003 1.0000E+00 Ra-226+D Pb-210+D Po-210

12.76 TEST CASE 041 TESTER'S REPORT

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Test Case 41

LePoire, David J.

Thu 2/20/2020 7:59 AM

Summary: compared external pathway results with the two input files to Table 1 in the V&V folder. Results are the same.

				Source area	i = 1000000 m ² ,		Source radi	us = 100 m², tl	hickness = 5
				thickness =	50 cm		cm		
		decay	Yearly average	Yearly dose		ANL/EA D/TM- 84,	Yearly dose		ANL/EAD/
Radion uclide	Half-life, yr	constant (/yr)	concentra tion, pCi/g	(Code), mrem/yr	Calculated, mrem/yr	mrem/ yr	(Code), mrem/yr	Calculated , mrem/yr	TM-84, mrem/yr
AI-26	7.16E+05	9.68E-07	1.00E+00	1.73E+01	1.73E+01	1.73E+ 01	5.82E+00	5.92E+00	5.92E+00
Co-57	7.42E-01	9.35E-01	6.50E-01	3.31E-01	3.26E-01	5.01E- 01	1.87E-01	1.84E-01	2.83E-01
Co-60	5.27E+00	1.32E-01	9.37E-01	1.51E+01	1.52E+01	1.62E+ 01	5.20E+00	5.20E+00	5.55E+00
Cs-137	3.00E+01	2.31E-02	9.89E-01	3.37E+00	3.37E+00	3.41E+ 00	1.32E+00	1.31E+00	1.33E+00
Mn-54	8.56E-01	8.10E-01	6.85E-01	3.57E+00	3.54E+00	5.16E+ 00	1.34E+00	1.32E+00	1.93E+00
U-234	2.45E+05	2.83E-06	1.00E+00	4.01E-04	4.02E-04	4.02E- 04	2.71E-04	2.86E-04	2.86E-04
U-235	7.04E+08	9.85E-10	1.00E+00	7.57E-01	7.57E-01	7.57E- 01	3.90E-01	3.85E-01	3.85E-01

Note: Used high Kd in contaminated zone (atleast 1,000 cm3/g), very less erosion (support practice factor = 0.001)

Compare fifth column to results from External-1: results are the same

RESRAD-OFFSITE, Version 4.0 T+ Limit = 30 days Parent Dose Report Title : RESRAD-OFFSITE Default Parameters File : EXTERNAL-1_test.ROF

Total Dose Contributions TDOSZ(i,p,t) for Individual Radionuclides (i) and Pathways (p) in mrem/yr and as a Percentage of Total Dose at t = 0 years

From	releases	to	around	water	and	to	surface	water
F I OII	Tetegses	60	ground	water	anu	60	Buildre	waver

	Ground	1	Fish		Radon	ı I	Plant		Meat		Milk		Soil		Water	:
Radio- Nuclide	Dose	8	Dose	÷	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8
A1-26	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Co-57	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Co-60	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Cs-137	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Mn-54	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
U-234	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
U-235	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
																_
Total	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0

 $\label{eq:contributions TDOS2(i,p,t) for Individual Radionuclides (i) and Pathways (p) \\ in mrem/yr and as a Percentage of Total Dose at t = 0 years$

Directly from primary contamination and from release to atmosphere (Inhalation excludes radon)

D = 44 =	Ground	ı	Inhalati	.on	Radon	L.	Plant		Meat		Milk		Soil		All Pathu	аув*
Radio- Nuclide	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8
A1-26	1.73E+01	43	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.732+01	43
Co-57	3.31E-01	1	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.312-01	1
Co-60	1.51E+01	37	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.512+01	37
Cs-137	3.372+00	8	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.372+00	8
Mn-54	3.57E+00	9	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.572+00	9
0-234	4.01E-04	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	4.012-04	0
0-235	7.57E-01	2	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	7.572-01	2
						_						_				_
Total	4.05E+01	100	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	4.052+01	100

*Sum of dose from all releases and from primary contamination.

Compare eighth column to results from External-2: results are the same

RZSRAD-OFFSITZ, Version 4.0 T4 Lin Parent Dose Report Title : RZSRAD-OFFSITZ Default Parameters File : ZXTERNAL-2_test.ROF T4 Limit = 30 days

02/20/2020 09:56 Page 44

Total Dose Contributions TDOS2(i,p,t) for Individual Radionuclides (i) and Pathways (p) in mrem/yr and as a Percentage of Total Dose at t = 0 years

					Fro	m re	leases to	grou	ind water a	and t	o surface	wate	r			
	Ground	ı	Fish		Rador	ı.	Plant		Meat		Milk		Soil		Water	r
Radio- Nuclide	Dose	÷	Dose	÷	Dose	8	Dose	8	Dose	÷	Dose	8	Dose	8	Dose	-
A1-26	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Co-57	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Co-60	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Cs-137	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Mn-54	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
U-234	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
U-235	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
				_										_		
Total	0.002+00	0	0.002+00	0	0.00E+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0

Total Dose Contributions TDOSZ(i,p,t) for Individual Radionuclides (i) and Pathways (p) in mrem/yr and as a Percentage of Total Dose at t = 0 years

Directly from primary	contamination	and fr	om release	to atmosphere	(Inhalation excludes r	adon)
-----------------------	---------------	--------	------------	---------------	------------------------	-------

	Ground	i	Inhalati	.on	Radon		Plant		Meat		Milk		Soil		All Pathw	ays*
Radio- Nuclide	Dose	÷	Dose	8	Dose	÷	Dose	8								
A1-26	5.82E+00	41	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	5.82E+00	41
Co-57	1.87E-01	1	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.872-01	1
Co-60	5.20E+00	36	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	5.20E+00	36
Cs-137	1.322+00	9	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.322+00	9
Mn-54	1.342+00	9	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.34E+00	9
U-234	2.71E-04	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	2.71E-04	0
U-235	3.90E-01	3	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.90E-01	3
·	_															
Total	1.43E+01	100	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.432+01	100

*Sum of dose from all releases and from primary contamination.

12.77 TEST CASE 042 TESTER'S REPORT

Documented in Test Case 42.msg of 2/20/2020 11:13 AM

Test Case 42

LePoire, David J.

Thu 2/20/2020 9:02 AM

Summary : Compared 5 distributions. Four were the same as what was reported in the new parameter report. The Kd value in the softwar for Ra-266 was not consistent with the parameter report but was consistent with the latest Data Collection handbook (snippets below).

2-12 K_d Distributions Values for Different Elements (cont.)

Element	Sourcea	Exp(µ) ^b	hc	σ^{d}
A 1		F	4.64	0.00
i u	1 1	1 10	0.01	1.00
Ra	1	2,500	7.82	2.56
DL	4	040	E 0E	4.4

 TABLE 2.13.10
 RESRAD Default

 Value and Distribution for the K_d

 Parameter for Different Elements

			ormal bution ^a
	Kd (cm ³ /g		
Element	or L/kg)	μ	σ
Ac	20	6.72	3.22
Ag	0	5.38	2.1
Al	0	6.45	3.22
Am	20	7.28	3.15
As	114	NAb	NA
At	0	NA	NA
Au	0	4.65	3.22
Ba	50	6.33	3.22
Be	810	NA	NA
Bi	0	4.65	3.22
Bk	70	NA	NA
Br	49	NA	NA
С	0	2.4	3.22
Ca	50	1.4	0.78
Cd	0	3.52	2.99
Ce	1,000	7.6	2.08
Cf ^c	1,380	7.23	3.22
Cl	0.1	1.68	3.22
Cm ^c	1,380	8.82	1.82
Co	1,000	5.46	2.53
Cr	30	4.63	2.76
Cs	4.600	6.1	2.33
	2,000	0.00	
Ra	70	8.17	1.7
Ph	125	NIA	NA

Uncertainty and Probabilistic Analysis			
· · · · · ·	Related inputs	Post run regression	
Sample specifications Param	eter distributions	Input rank correlations	Output specifications
Variable Description Kd of Ra-226 in Unsaturated zone Depth of soil mixing layer in area Wind speed class 3 Cover and management factor of External gamma penetration factor	Kd of Ra-226 in U Distribution TR	tain or probabilistic paramete	v ormal 8.17 ormal 1.7 antile .001
	Previous paramete Next parameter <u>R</u> emove parame	Update Paramete	er stats and distribution Restore Parameter stats and distribution
Sort alphabetically before run	Suppress u	uncertainty analysis this sessi	ion <u>O</u> K

C.3.12 Depth of Soil Mixing Layer

Applicable Code: RESRAD-ONSITE and RESRAD-OFFSITE

Previous
Replace with

Description: The depth of soil mixing layer parameter is used in calculating the depth factor for the dust inhalation and soil ingestion pathways and for foliar deposition for the ingestion pathway.

Units: meters (m)

Probabilistic Input:

Distribution: triangular

Defining Values for Distribution:

Minimum: 0.0 Maximum: 0.6 Most likely: 0.15

Uncertainty and Probabilistic Analysis			
Step by step analysis	Related inputs	Post run regression]
Sample specifications Param	eter distributions	Input rank correlations	Output specifications
Variable Description Kd of Ra-226 in Unsaturated zone Depth of soil mixing layer in area Wind speed class 3 Cover and management factor of External gamma penetration factor	Statistics of uncer Depth of soil mixin	tain or probabilistic parameto g layer in area of primary co ANGULAR Min Mar	er —
Sort alphabetically before run	Suppress u	ncertainty analysis this sess	ion <u>O</u> K

Table C-40	Uniform	Distribution	Limits	for	the	Wind	Speed	Intervals	in	RESRAD-
	OFFSITE						-			

Wind Speed Interval	Minimum (m/s)	Maximum (m/s)
1	0.514	1.80
2	1.81	3.34
3	3.35	5.40
4	5.41	8.49
5	8.50	11.1
6	11.2	14.1

Uncertainty and Probabilistic Analysis	
Step by step analysis	Related inputs Post run regression
Sample specifications Param	eter distributions Input rank correlations Output specifications
Variable Description Kd of Ra-226 in Unsaturated zone Depth of soil mixing layer in area Wind speed class 3 Cover and management factor of External gamma penetration factor	Statistics of uncertain or probabilistic parameter Wind speed class 3 Distribution UNIFORM Minimum 3.35 Maximum 5.4
Sort alphabetically before run	Suppress uncertainty analysis this session

Table C-24	Cumulative Distribution for the Cover and Management Factor

Cover and Management	Cumulative		
Factor	Probability		
0.00001	3.17E-06		
0.020	0.327		
0.085	0.421		
0.149	0.519		
0.284	0.845		
0.400	0.961		
0.550	0.991		
1.00	1.00		

Uncertainty and Probabilist	ic Analysis			
Step by step analysi	s	Related inputs	Post run regressior	<u>۱</u>
Sample specifications	Para	ameter distributions	neter distributions I Input rank correlations	
Variable Descript Kd of Ra-226 in Unsatur Depth of soil mixing laye Wind speed class 3 Cover and management External gamma penetral	ated zone r in area factor of	Cover and manager Distribution CON Number of er	Value cdf D01 0 .327 5 .421 9 .519 4 .845 .961 .391 1	
Sort alphabetically be	efore run	Suppress u	ncertainty analysis this s	ession <u>O</u> K
8				
		For		The penetration factor

External gamma penetration factor P 0.7 For deterministic run, base value selected is the code d default. For probabilistic run, distribution from NUREG/CR- 0607 is used1.3 0.	0.59 0.044 1 factor statistical factor describes the effect of the building structure on the level of gamma radiation existing indoors. Specifically, the penetration of outdoor gamma radiation that will be available indoors.
--	--

Uncertainty and Probabilistic Analysis			
Step by step analysis	Related inputs	Post run regression	
Sample specifications Para	meter distributions	Input rank correlations	Output specifications
Variable Description Kd of Ra-226 in Unsaturated zone Depth of soil mixing layer in area Wind speed class 3 Cover and management factor of External gamma penetration factor	External gamma po	UNDED LOGNORMAL-N Mean (Mu) of underlying n iation (Sigma) of underlying n Min Max	▼ ormal -1.3
Sort alphabetically before run	🗌 Suppress u	uncertainty analysis this sessi	on OK

12.78 TEST CASE 044 TESTER'S REPORT

Documented in Results_ Test Case 044.msg of 2/13/2020 7:13 AM

Results: Test Case 044

LePoire, David J.

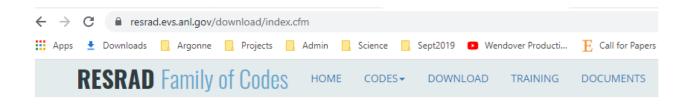
Thu 2/13/2020 7:13 AM

Summary: The 4 steps of Test Case 044 were successfully completed and documented (below).

1. Go through download registration process on website.

RESRAD Fa	mily of Codes Home codes- Down	VLOAD TRAINING	DOCUMENTS	O FAQS @ E-N	IAIL UST
Downloa	d				
	Gormation below to download RESRAD Codes.				
First Name	David				
Last Name	LePoire				
Organization	Argonne National Laboratory				
Country	United States of America	•			
E-mail	david.lepoire@gmail.com				
	Send me e-mail about RESRAD releases, training, & ne	tws			
	Submit				

Result of "Submit"



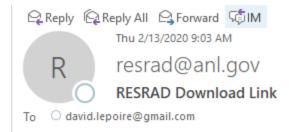
Download

You should receive an email shortly with a download link that will be valid for 24 hours.

About Us Contact Us Privacy & Security
Argonne National Laboratory | Environmental Science Division

2. Verify receipt of email for access to download

Email received minutes later:



~

RESRAD Family of Codes - Download Link

Thank you for your interest in downloading the RESRAD family of codes. Please use the link below to download the codes.

http://resrad.evs.anl.gov/download/index.cfm?id=76B70CD5-3048-5F0A-510ABB0F2AB295E2

This link will be available for 24 hours. After that time, you may complete the form on the <u>Download</u> page to request a new link.

3. Verify email link allows access

Result of clicking link:

resrad.evs.anl.gov/download/index.cfm?id=76B70CD5-3048-5F0A-510ABB0F2AB295E2												Q
Downloads	📙 Argonne	Projects	📙 Admin	Science	Sept2	2019 🗈 W	'endover Pro	oducti E	Call for Papers	- Els 🦻	Fun with Physics	
	F	RESRAD Fa	amily of Co	des номе	CODES +	DOWNLOAD	TRAINING	DOCUMENTS	G FAQS	🖾 E-MAIL LIST		

Download

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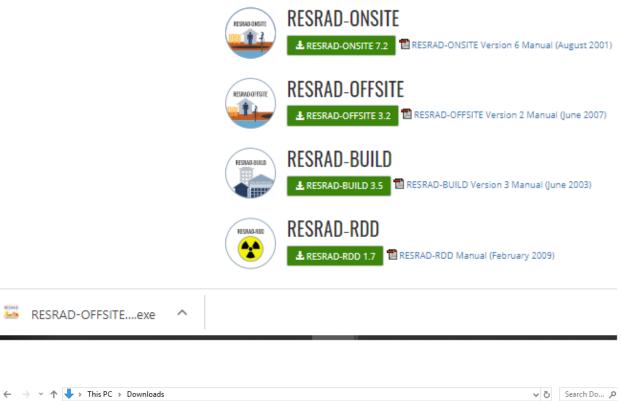
Additional User Quality Assurance Requirements: Although the RESRAD family of codes is provided free to users through the RESRAD website hosted by Argonne. individual users are not exempted from following their organization's quality assurance processes for the acquisition and use of Information Technology (IT) such as cyber security testing, inclusion on IT inventory lists, inclusion on the safety software inventory, site-specific safety software procedures or instructions, and approval by the applicable Design Authority for use in support of a specific nuclear facility.

Note: The RESRAD family of codes is Safety Management and Administrative Control Software (SMACS) and Quality Level C according to Argonne National Laboratory's U.S. Department of Energy-approved Quality Assurance Program Plan.



4. Verify download

Result of clicking RESRAD-OFFSITE 3.2



← → ∽ ↑ 🕂 > This PC > Downloads				5 V	Search Do
✓	Name	Date modified	Туре	Size	
> 🧊 3D Objects	setup.exe	2/13/2020 9:06 AM	Application	70,855 KB	
> 📃 Desktop	RESOFF-FORM-001-ID0001 OFFSITE 4.0.3	2/13/2020 8:58 AM	Microsoft Excel W	25 KB	

12.79 TEST CASE 047 TESTER'S REPORT

Documented in Tase Case 47.msg of 2/20/2020 11:14 AM

Tase Case 47
LePoire, David J. Thu 2/20/2020 6:25 AM
Dose for wide area
I View - SUMMARY.REP
File Edit Help
Eont: MS LineDraw 7.4 - B E Page: 34 - VA
RESRAD-OFFSITE, Version 4.0 T4 Limit = 30 days 02/19/2020 17
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters File : Site4.ROF
File : Site4.ROF
Contaminated Zone Dimensions Initial Soil Concentrations, pCi
Area: 10000.00 square meters Co-60 1.0002+02
Thickness: 2.00 meters
Cover Depth: 0.00 meters
Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E
Total Mixture Sum $M(t)$ = Fraction of Basic Dose Limit
t (years): 0.0002+00 1.0002+00 3.0002+00 6.0002+00 1.2002+01 3.0002+
TDOSE(t): 4.012E+00 3.518E+00 2.704E+00 1.823E+00 8.276E-01 7.747E-
M(t): 1.6052-01 1.4072-01 1.0822-01 7.2902-02 3.3102-02 3.0992-
Maximum TDOSE(t): 4.012 ± 00 mrem/yr at t = 0 years

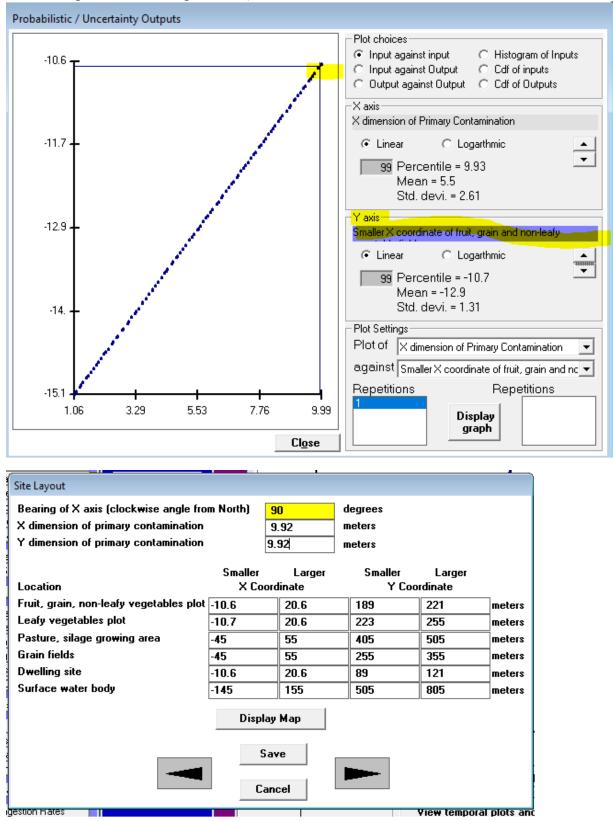
Area Factor (consider up to 10 x 10 centered):

Area Factors
Range of X dimension of Small Area of Elevated Contamination:
from 1 meters to 10 meters
Range of Y dimension of Small Area of Elevated Contamination:
Proportional to X dimension O Specify Range
Ratio of Y dimension to X dimension 1
Number of Points on the Dose - Area Plot 100
Distribution of X and Y dimensions
○ Triangular skewed to the high end
Location of Small Area of Elevated Contamination: Centers of Small Areas of Elevated Contamination fixed at the Center of the Primary Contamination Small Areas of Elevated Contamination Located Uniformly over the Primary Contamination
Generate Dimensions Cancel Generate Dose - Area Plot

Summary: Area factor run for 10x10 centered case. Then doses for the full 100x100 are compared to the dose for the adjusted layout for the 10x10 area. The area factor agree to about

📓 View - Area	FactorText.REP
File Edit Hel	р
Eont: MS Line	Draw 🔻 7.4 💌 🗿 🗐 🗎
RESRAD-OFFS	ITE Area Factor Report
TITLE : RES	RAD-OFFSITE Default Paramete:
FILE : Sit	e4.ROF
11	summary table for Co-60
Area	Area Factor
1.29	8720.
3.08	3640.
4.03	2780.
7.77	1440.
7.9	1420.
12.4	902.
15.1	744.
20.9	537.
22.9	485.
33.9	411. 331.
38.4	292.
44.2	254.
48.	234.
57.6	195.
63.4	177.
69.	162.
78.5	143.
88.1	127.
99.7	112.
10000.	1.0





Set up deterministic setting for largest area. Find coordinates based on uncertainty distributions for related parameters example below):

Dose for small area:

📓 View - SUMMAR	Y.REP						
File Edit Help							
Font: MS LineDraw	v 7.4 ▼	ð		Page: 🛨	₹₹		
RESRAD-OFFSITE	•	. 0	TH Limit =	30 days	02/20/	2020 08:21	Page
Parent Dose Rep	port						
Title : RESRAD	-OFFSITE De	fault Param	eters				
File : Site4.	ROF						
Contamina	ted Zone Di	mensions	In	nitial Soil	Concentrati	ons, pCi/g	
			_				
	-	uare meters		Co-60	1.0002	+02	
Cover Depth:	0.00 me	ters					
					TDOSE(t), m	-	
	_			Radiation D			
	1	otal Mixtur	e Sum M(t)	= Fraction	of Basic Do	se Limit Re	ceived a
t (years):	0.000 2+0 0	1.0002+00	3.0002+00	6.000E+00	1.2002+01	3.000E+01	7.500E+
TDOSE(t):	3.520E-02	3.087E-02	2.374E-02	1.600E-02	7.272E-03	6.820E-04	1.836E-
M(t):	1.408E-03	1.235E-03	9.495E-04	6.401E-04	2.909E-04	2.728E-05	7.346E-
Maximum TDOSE(t): 3.520E	-02 mrem/vr	att = 0	/ears			

Calculated area factor = 4.012/3.52e-2=113

12.80 TEST CASE 048 TESTER'S REPORT

Documented in Test Case 48-JJCheng.docx of 2/18/2020 3:07 PM

Test Case 48 – Tests OFFSITE's generation of template files tool

Base on instructions of the Test Cases document, the following procedure was performed -

- Launched RESRAD-OFFSITE. Selected Ac-227 as the radionuclide of concern with an initial conc. of 100 Bq/g. Chose the Data Transfer -> Generate templet files menu to generate template files. The inputs were save to file SITE9-DATA TRANSFER.ROF.
- Opened the Excel files, SITE9-DATA TRANSFER-NDP and SITE9-DATA TRANSFER-NIP. Made changes. The following screenshots compare the values before and after the changes.

After the changes -

E	∃ ∱ • ⊂	₹ -					2	SITE9-DATA	TRANSFER.N	DP - Excel				
F	ile Ho	ome Ins	ert Pag	e Layout	Formulas	Data	Review	View	Developer	∑ Tell	me what you	u want to do.		
Nor	mal Page Br Previe	eak Page	Custom	 ✓ Ruler ✓ Gridlines 	✓ Formula ✓ Heading	_		Zoom to Selection		ange Freeze		🖾 Sync	r Side by Side hronous Scr t Window Pe	olling S
	Workb	ook Views		:	Show		Zoom					Window		
A1	L			-	\times \checkmark	f _x	NucNam							
	А	В	с	D	E	F	G	н	1	J	к	L	м	N
1	NucNam	Conc	DCACTCM	DCACTC	DCACTU1	DCACTU2	DCACTU3	DCACTU4	DCACTU5	DCACTS	DCACTSW	DCACTSW	DCACTV1	DCACTV2
2	Ac-227	110	22	22	22	22	22	2 22	2 22	22	22	22	22	22

Before the changes -

2	1	NucNam	Conc	DCACTCM	DCACTC	DCACTU1	DCACTU2	DCACTU3	DCACTU4	DCACTU5	DCACTS	DCACTSW	DCACTSW	DCACTV1	DCACTV2
3	2	Ac-227	100	20	20	20	20	20	20	20	20	20	20	20	20

After the changes -

E	SITE9-DATA TRANSFER.NDP - Excel													
Fi	ile Ho	ome Ins	ert Pag	e Layout	Formulas	Data	Review	View	Developer	∑ Tell i	me what you	u want to do		
Nor	mal Page Bi Previe	reak Page		✓ Ruler ✓ Gridlines	✓ Formula ✓ Heading	7		Zoom to Selection		ange Freeze	Split Hide	EB] Sync	r Side by Side thronous Scr t Window Pe	olling
_	Workt	book Views		2	show		Zoom					Window		
A1				•	× v	$f_{\mathcal{K}}$	NucNam							
	А	0	Р	Q	R	S	т	U	v	w	x	Y	Z	AA
1	NucNam	DCACTL1	DCACTL2	DCACTDW	ReleaseO	RelFrac1	RelFrac2	RelFrac3	RelFrac4	RelFrac5	RelFrac6	RelFrac7	RelFrac8	RelFrac9
2	Ac-227	22	22	22	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9

Before the changes -

1	NucNam	DCACTL1	DCACTL2	DCACTDW	ReleaseO	RelFrac1	RelFrac2	RelFrac3	RelFrac4	RelFrac5	RelFrac6	RelFrac7	RelFrac8	RelFrac9
2	Ac-227	20	20	20	1	1	1	1	1	1	1	1	1	1

After the changes -

	⊟ চ∙	¢- ∓						s	ITE9-DATA T	RANSFER.N	DP - Excel
	File H	ome Ins	ert Pag	e Layout	Formulas	Data		Review	View	Developer	♀ Tell n
				Ruler	✓ Formula	a Bar (Q	→ 100	Q	2	
No	rmal Page E Previ	2	Custom Views	Gridlines	✓ Heading	gs Z	loom		Zoom to Selection \		ange Freeze All Panes≖
	Work	book Views		:	Show			Zoom			
A	1			•	$\times \checkmark$	f_{x}	N	ucNam			
	А	AT	AU	AV	AW	AX		AY	AZ	BA	BB
1	NucNam	LEACH1	LEACH2	LEACH3	LEACH4	LEACH5	LE	ACH6	LEACH7	LEACH8	LEACH9
2	Ac-227	0.001	0.002	0.003	0.004	0.0	05	0.006	0.007	0.008	0.009

Before the changes -

	Α	AT	AU	AV	AW	AX	AY	AZ	BA	BB
1	NucNam	LEACH1	LEACH2	LEACH3	LEACH4	LEACH5	LEACH6	LEACH7	LEACH8	LEACH9
2	Ac-227	0	0	0	0	0	0	0	0	0

After the changes –

_			-8-8						
E	SITE9-DATA TRANSFER.NID - Excel								
F	ile Ho	ome Insert	Page Layout	Formulas	Data	Review	View	Developer	♀ Tell m
Pas	ste	Calibri B I U -	• 11 • A* A		_	e* -	General → \$ → % >		itional Forma at as Table * tyles *
Clip	pboard 🖓	Fon	t i	rs A	lignment	5	Number 7	5 .	Styles
D1	18		• i	× ✓	fx	Number o	of times at v	which the r	elease prop
	Α	E	j .	С	D	E	F	G	н
1	Index	Variable		Value	Descriptio	Lower bo	u Upper bou	Form nam	e
2	1	BRDL		0.25	Basic Rad	1.00E-34	1.00E+34	FSTINFRM	
3	2	ED		30	Exposure	1	1000	FSTINFRM	
4	3	NS		1	Number o) 5	FSTINFRM	
5	4	MULTIFORM		0	Multiform) 1	FSTINFRM	
6	5	PCOPTION		1	Conceptu) 3	FSTINFRM	
7	6	SUBMERGEDF		0	Fraction o) 1	FSTINFRM	
8	7	SOLUBITERL		5	Maximum	1 1	10	FSTINFRM	
9	8	RELTIME(1)		0	Time at w	(100000	RELTIMEF	RM
10	9	RELTIME(2)		100	Time at w	(100000	RELTIMEF	RM
11	10	RELTIME(3)		200	Time at w	(100000	RELTIMEF	RM
12	11	RELTIME(4)		300	Time at w	(100000	RELTIMEF	RM
13	12	RELTIME(5)		400	Time at w	(100000	RELTIMEF	RM
14	13	RELTIME(6)		500	Time at w	(100000	RELTIMEF	RM
15	14	RELTIME(7)		600	Time at w	(100000	RELTIMEF	RM
16	15	RELTIME(8)		700	Time at w	0	100000	RELTIMEFI	RM
17	16	RELTIME(9)		800	Time at w		100000	RELTIMEFI	RM
18	17	RELTPTST		9	Number o	: 1	i 9	RELTIMEFI	RM
19		NXBEARING			Bearing o	í (LAYOUTER	

Before the changes -

	A	в	с	D	E	F	G	н
1	Index	Variable	Value	Descriptic	Lower bou	Upper bou	Form nam	e
2	1	BRDL	0.25	Basic Radi	1.00E-34	1.00E+34	FSTINFRM	
3	2	ED	30	Exposure	1	1000	FSTINFRM	
4	3	NS	1	Number o	0	5	FSTINFRM	
5	4	MULTIFORM	0	Multiform	0	1	FSTINFRM	
6	5	PCOPTION	1	Conceptu	0	3	FSTINFRM	
7	6	SUBMERGEDF	0	Fraction o	0	1	FSTINFRM	
8	7	SOLUBITERL	5	Maximum	1	10	FSTINFRM	
9	8	RELTIME(1)	0	Time at w	0	100000	RELTIMEFE	RM
10	9	RELTIME(2)	0	Time at w	0	100000	RELTIMEFE	RM
11	10	RELTIME(3)	0	Time at w	0	100000	RELTIMEFE	RM
12	11	RELTIME(4)	0	Time at w	0	100000	RELTIMEFE	RM
13	12	RELTIME(5)	0	Time at w	0	100000	RELTIMEFE	RM
14	13	RELTIME(6)	0	Time at w	0	100000	RELTIMEFE	RM
15	14	RELTIME(7)	0	Time at w	0	100000	RELTIMEF	RM
16	15	RELTIME(8)	0	Time at w	0	100000	RELTIMEF	RM
17	16	RELTIME(9)	0	Time at w	0	100000	RELTIMEF	RM
18	17	RELTPTST	1	Number o	1	9	RELTIMEF	RM
19	18	NXBEARING	90	Bearing of	0	360	LAYOUTER	M

• Launched RESRAD-OFFSITE and opend input file, SITE9-DATA TRANSFER.ROF. The inputs of radionuclide release and Kds were -

Times at which Release Properties are Specifed	(years)	
1st time at which release begins	Insert new 1st time and shift down existing	Delete 2nd time and associated release data
2nd time at which release changes	times and associated release data	and shift up existing data
<u>3rd time at which release changes</u>		
4th time at which release changes		
5th time at which release changes		
<u>6</u> th time at which release changes		
<u>7</u> th time at which release changes		
<u>8</u> th time at which release changes		
9th time at which release changes	Add new 2nd time at t	which release changes
Number of times at which the release properties are specified	1	-
	Claur	
Times are in ascending order	Close	
Radionuclide Specific Release		
Radionuclide Ac-227	🚔 Element Ac	
	•	
	· · ·	
There are an area in a literation	ansfer mechanism First Order Bate Controlled Terrefer	
	First Order Rate Controlled Transfer	
0	Equilibrium Desorption Transfer	
C	Equilibrium Solubility Transfer	
		1
Time	at which release begins or changes (years) 0	Add Next Time
Cumulative fraction of r	dionuclide bearing material that is releasable 1	
	linearly over time	• • • • • • • • • • • • • • • • • • •
Incremental fraction o	radionuclide bearing becomes releasable	
	stepwise at time 💿	
Distribution	coefficient in primary contamination (cm³/g) 20	
Distibution		
Release from surface layer	Radionuclide becomes available for release	
	In the same manner as for release to groundwater	
	O Beginning at time zero	
L		
	Save	
	Cancel	
Distribution Coefficients		
Radionuclide Ac-227 🛄		
		Dist factor
Distrib Location coeffi		Distribution coefficient
(c		(cm³/g)
Contaminated medium: 20	Suspended sediment in surface water body	20
<u>C</u> ontaminated zone: 20	Bottom sediment in surface water body	20
	Sector seament in surdee mater body	20
Unsaturated zone <u>1</u> : 20	Fruit, grain, nonleafy fields	20
	Leafy vegetable fields	20
	Pasture, silage growing areas	
		20
	Livestock feed <u>a</u> rain fields	20
Saturated zone: 20	Dwelling site	20

S<u>a</u>turated zone:

Number of unsaturated zones: set in preliminary inputs form

20

1

Save Cancel • Chose Data Transfer -> Read Template Files to read in the template files associated with the input file that were changed. After reading in data in the template files, the concentration of Ac-227 changed to 110 Bq/g, the Kds changed to 22 cm3/g, the number of release times changed to 9, and the transfer mechanism changed to First Order Rate Controlled Transfer, as shown in the screen shots below –

Times at which Release Properties are Specif	ed (years)				
1st time at which release begins	0 Incort now	v 2nd time and shift do	we ovisting	elete 1st time and asso	sisted release data
2nd time at which release changes		and associated releas		and shift up exi	
<u>3</u> rd time at which release changes	200				
4th time at which release changes	300				
5th time at which release changes	400				
<u>6</u> th time at which release changes	500				
<u>7</u> th time at which release changes	600				
8th time at which release changes	700				
9th time at which release changes	800	Add new	umb time at which	release changes	
Number of times at which the release properties are specified	9	<u>Dag non</u>		Toroavo onangoo	
Times are in ascending order		Close			
r					
Radionuclide Specific Release					
Radionuclide Ac-227 🌲 Element	Ac				
Release to ground water Transfer mechania ③ First Order Rat ○ Equilibrium De: ○ Equilibrium Sol	e Controlled Transfer sorption Transfer				
Time at which calculate	e begins or changes (years) 0	100 200	300 400	500 600	700 800
Cumulative fraction of radionuclide bea					
Incremental fraction of radionuclide be	linearly over time	.2 .3 Image: Constraint of the second	.4 .5 © © 0	.6 .7 © 0 0	.8 .9 .9 .9 .9 .9 .9 .9 .9 .0 .9 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0
	Leach rate (1/year) .001	.002 .003	.004 .005	.006 .007	.008 .009
Leach rate of isotope	linearly over time changes stepwise at time ©		• • • •	© © 0	
	ecomes available for release manner as for release to ground w ater				
O Beginning a	t time zero				
	-	Save Cancel			
Distribution Coefficients					
Distribution	ation	Distribution coefficient (cm²/a)			

Location	coefficient (cm³/g)	Location	coefficient (cm³/g)
Contaminated medium:	22	Suspended sediment in surface water body	22
<u>C</u> ontaminated zone:	22	Bottom sediment in surface water body	22
Unsaturated zone <u>1</u> :	22	Frui <u>t,</u> grain, nonleafy fields	22
		<u>L</u> eafy vegetable fields	22
		Past <u>u</u> re, silage growing areas	22
		Livestock feed grain fields	22
S <u>a</u> turated zone:	22	Dwelling site	22
Number of unsaturated zone set in preliminary inputs form			
		Save Cancel	

The Data Transfer Template files were generated and the data in them were read in successfully.

12.81 TEST CASE 049 TESTER'S REPORT

Documented in Results for Test Case 049.msg of 2/14/2020 3:06 PM

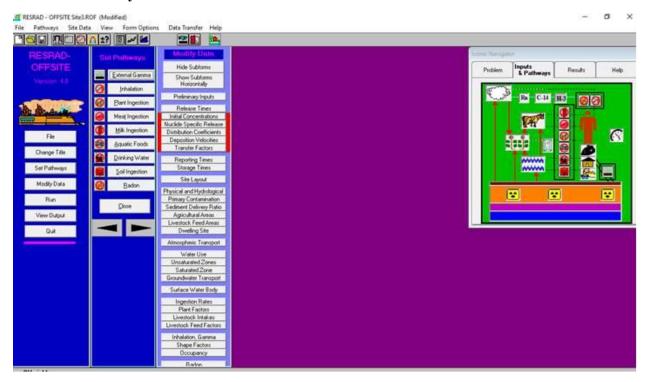
Results for Test Case 049

LePoire, David J.

Fri 2/14/2020 3:06 PM

Added Co-60 to the default case.

External Pathway:



Water use by livestock is not used:

Water Use					
.			Fraction	of water from	Number of individuals to
Description of water usage	Quantity		Surface boo	dy Well	compute well water needs
Consumption per person	510	Liters/year	0	1	4
Use indoors of dwelling per person	225	Liters/day	0	1	• •
Beef cattle per animal	50	Liters/day	0	1	2
Dairy cows per animal	160	Liters/day	0	1	2
Irrigation applied to:					Area of Plot
Fruit, grain, non-leafy vegetables	.2	m per year	0	1	(square meters)
Leafy vegetables		m per year	0		
	.2			1	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.2	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000
Well pumping rate:			5100	cubic meters/ye	ar
Well pumping rate needed to suppor	t specified wa	ater use: 🛛	4600.9	cubic meters/ye	ar
		Save			
	-	1		-	
	_	Cancel			
Plant Factors					

All ingestion disabled:

Ingestion Rates							
	Consumption rate		Fraction from affected area				
<u>D</u> rinking water	510	Liters/year	1				
<u>F</u> ish	5.4	kg/year	.5				
<u>C</u> rustacea and mollusks	.9	kg/year	.5				
Fruit, grain, non-leafy vegetables	160	kg/year	.5				
Leafy <u>v</u> egetables	14	kg/year	.5				
M <u>e</u> at	63	kg/year	1				
M <u>i</u> lk	92	Liters/year	1				
<u>S</u> oil (incidental)	36.5	grams/year					
Plant Factors							
Lives	tock Feed Fac	tors					
	Save Cancel						

Inhalation parameters disabled:

Inhalation and External Gamma			
Respirable particulates as a	fraction at offsite locations	8400 .0001 1	m³/year grams/m³
Indoor to outdoor <u>d</u> ust conce E <u>x</u> ternal gamma penetration f		<u>.4</u> _7	

Ran the case. Looked at input echo:

No ingestion pathway parameters used:

	2SRAD-OFFSITE, Version 4.0 TH Limit = 30 days 02/13/2020 10:32 Page 27					
	t Dose Report					
	: RESRAD-OFFSITE Default Parameters					
File	: Site3.ROF					
	Site-Specific Para					
	Site-Specific Para	ameter Summa:	ry (continue)	a)		
		User	I	RESRAD	Parameter	
Menu	Parameter	Input	Default	computed	Name	
INGE	Leafy vegetable consumption (kg/yr)	not used	1.4002+01		DVI(2)	
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01		FVEG(2)	
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	•	DMI(1)	
INGE	Fraction of meat lfrom affected area	not used	1.0002+00	i	FMEMI(1)	
INGE	Milk consumption (L/yr)	not used	9.2002+01		DMI(2)	
INGE	Fraction of milk from affected area	not used	1.0002+00		FMEMI(2)	
INGE	Soil ingestion rate (q/yr)	not used	3.650E+01		SOIL	
			i	i	i	
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.0002-01		YIELD(1)	
	Growing Season for Non-Leafy (years)	not used	1.7002-01	•	GROWTIME(1)	
	Translocation Factor for Non-Leafy	not used	1.0002-01	•	FOLI F(1)	
	Weathering Removal Constant for Non-Leafy	not used	2.000E+01	•	RWEATHER(1)	
	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	•	FINTCEPT(1,	
	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	•	FINTCEPT(1,	
	Depth of roots for Non-Leafy (m)	not used	1.2002+00	•	DROOT (1)	
VEGE	Wet weight crop yield for Leafy (kg/m**2)	•	1.5002+00	•	YIELD(2)	
VEGE	Growing Season for Leafy (years)	not used	2.500E-01		GROWTIME (2)	
VEGE	Translocation Factor for Leafy	not used	1.0002+00	•	FOLI F(2)	
	Weathering Removal Constant for Leafy	not used	2.000E+01	•	RWEATHER(2)	
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.5002-01	•	FINTCEPT(2,	
VEGE	Foliar Interception Fraction for dust heary Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.5002-01	•	FINTCEPT(2,	
VEGE	Depth of roots for Leafy (m)	not used	9.0002-01	•	DROOT (2)	
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.1002+00	•	YIELD(3)	
VEGE	Growing Season for Pasture (years)	not used	8.0002-02	•	GROWTIME (3)	
VEGE	Translocation Factor for Pasture	not used	1.0002+00	•	FOLI F(3)	
	Weathering Removal Constant for Pasture	not used	2.0002+01		RWEATHER(3)	
	Foliar Interception Fraction for dust Pasture	not used	2.5002-01		FINTCEPT(3,	
	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01	•	FINTCEPT(3,	
VEGE	Depth of roots for Pasture (m)		9.000E-01	•	DROOT (3)	
VEGE	Wet weight crop yield for Grain (kg/m**2)	•	7.000E-01	•	YIELD(4)	
VEGE	Growing Season for Grain (years)	not used	1.7002-01	•	GROWTIME (4)	
VEGE	Translocation Factor for Grain	not used	1.0002-01	•	FOLI F(4)	
VEGE	Weathering Removal Constant for Grain	not used	2.0002+01	•	RWEATHER(4)	
	Foliar Interception Fraction for dust Grain	not used	2.5002-01	•	FINTCEPT(4.	
VEGE	Foliar Interception Fraction for dust Grain Foliar Intercept-n Fract-n for irrigation Grain	not used	2.5002-01	•	FINTCEPT(4,	
			1.2002+00	•	DROOT(4)	
VEGE	Depth of roots for Grain (m)	not used	1.2002+00		DROOT (4)	

No inhalation parameters used: RESRAD-OFFSITE, Version 4.0 T4 Lim Parent Dose Report Title : RESRAD-OFFSITE Default Parameters File : Site3.ROF The Limit = 30 days 02/13/2020 10:32 Page 28

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
menu	Falametel	Input	Deraurt	compared	Hame
INHE	Inhalation rate (m**3/yr)	not used	8.4002+03		INHALR
INHE	Mass loading of all particulates from Primary contam		1.0002-04		MLFD
INHE	Respirable particulates as a fraction of total	not used	1.0002+00		RESPFRACEC
INHE		not used			SAMEMLRF
INHE	Total mass loading at agricultural area 1 (g/m**3)	not used	1.0002-04		MLTOTOF (1)
INHE	Respirable fraction at agricultural area 1	not used	1.0002+00	i i	RESPFRACOF(1)
INHE	Total mass loading at agricultural area 2 (g/m**3)	not used	1.0002-04		MLTOTOF (2)
INHE	Respirable fraction at agricultural area 2	not used	1.0002+00	1	RESPERACOF(2)
INHE	Total mass loading at agricultural area 3 (g/m**3)	not used	1.000E-04	i i	MLTOTOF (3)
INHE	Respirable fraction at agricultural area 3	not used	1.0002+00	i i	RESPFRACOF(3)
INHE	Total mass loading at agricultural area 4 (g/m**3)	not used	1.0002-04	i i	MLTOTOF (4)
INHE	Respirable fraction at agricultural area 4	not used	1.0002-04	i i	RESPFRACOF(4)
INHE	Total mass loading at offsite dwelling(g/m**3)	not used	1.000E-04	i i	MLTOTDWELL
INHE	Respirable fraction at offsite dwelling(g/m**3)	not used	1.0002+00	i i	RESPFRACDWELL
INHE	Indoor dust filtration factor, inhalation	not used	4.0002-01	i i	SHF3
INHE	Shielding factor, external gamma	7.000E-01	7.000E-01	i	SHF1
INHE	Shape factor flag, external gamma	-1.000E+00	1.000E+00	noncircular	FS
SEXT	Onsite shape factor array (used if non-circular):		i	i i	
SEXT	Radii of shape factor array (used if non-circular):		i i	i i	
SEXT	Outer annular radius (m), ring 1:	6.000E+00	6.000E+00	i	RAD SHAPE(1)
SEXT	Outer annular radius (m), ring 2:	1.200E+01	1.200E+01	i i	RAD SHAPE (2)
SEXT	Outer annular radius (m), ring 3:	1.800E+01	1.800E+01		RAD_SHAPE(3)
SEXT	Outer annular radius (m), ring 4:	2.400E+01	2.400E+01		RAD_SHAPE(4)
SEXT	Outer annular radius (m), ring 5:	3.000E+01	3.000E+01		RAD_SHAPE(5)
SEXT	Outer annular radius (m), ring 6:	3.600E+01	3.600E+01	i i	RAD_SHAPE(6)
SEXT	Outer annular radius (m), ring 7:	4.200E+01	4.200E+01		RAD_SHAPE(7)
SEXT	Outer annular radius (m), ring 8:	4.800E+01	4.800E+01		RAD_SHAPE(8)
SEXT	Outer annular radius (m), ring 9:	5.400E+01	5.400E+01		RAD_SHAPE(9)
SEXT	Outer annular radius (m), ring 10:	6.000E+01	6.000E+01		RAD_SHAPE(10)
SEXT	Outer annular radius (m), ring ll:	6.6002+01	6.6002+01		RAD_SHAPE(11)
SEXT	Outer annular radius (m), ring 12:	7.200E+01	7.200E+01		RAD_SHAPE(12)
SEXT	Fractions of annular areas within AREA:				
SEXT	Ring 1	1.000E+00	1.000E+00		FRACA(1)
SEXT	Ring 2	1.0002+00	1.000E+00		FRACA (2)
SEXT	Ring 3	1.0002+00	1.0002+00	i i	FRACA (3)
SEXT	Ring 4	1.000E+00	1.000E+00		FRACA (4)
SEXT	Ring 5	1.0002+00	1.0002+00		FRACA(5)

No Radon or c-14 parameters used:

EXT Ring 61 0.0002400 FRACk(61) EXT Ring 63 6.1542-02 FRACk(62) EXT Ring 63 6.1542-02 FRACk(62) EXT Ring 64 5.5112-02 5.5112-02 FRACk(62) EXT Ring 65 5.6772-02 5.6772-02 FRACk(64) EXT Ring 67 5.2687-02 5.0127-02 FRACk(65) EXT Ring 69 4.3827-02 4.7812-02 FRACk(65) EXT Ring 70 4.6332-02 4.7812-02 FRACk(70) EXT Ring 71 4.6332-02 4.7812-02	INO F	kadon or c-14 parameters used:				
SING 63 6.1542-02	SEXT	Ring 61	0.0002+00	0.0002+00		FRACA (61)
SETT Ring 64 5.5112-02 5.5112-02 FPACA (64) SETT Ring 65 5.677-02 5.677-02 FPACA (66) SETT Ring 66 5.1062-02 5.2662-02 FPACA (66) SETT Ring 69 5.1062-02 5.1062-02 FPACA (67) SETT Ring 70 4.7812-02 4.7812-02 FPACA (70) SETT Ring 70 4.7812-02 4.7812-02 FPACA (70) SETT Ring 70 4.7812-02 4.7812-02 FPACA (70) SETT Ring 72 2.2702-02 2.2702-02 FPACA (71) SETT Ring 72 2.2702-02 2.2702-01 FPACA (72) OCCU Fraction of time spent outdoors in offsite Duelling 5.0002-01 FDTDDWELL OCCU Fraction of time spent outdoors in agri. area 2 1.0002-01 OCCUEANCY (1) OCCU Fraction of time spent outdoors in agri. area 3 1.0002-01 OCCUEANCY (2) OCCU Fraction of time spent outdoors in agri.	SEXT	Ring 62	3.172E-02	3.172E-02	i	FRACA(62)
SIXI Aing 65 5.6072-02 5.6072-02 5.6072-02 5.7072-02 <	SEXT	Ring 63	6.154E-02	6.154E-02		FRACA (63)
SITT Ring 66 5.4792-02 5.4792-02 FRACA(66) SITT Ring 65 5.1062-02 5.1062-02 FRACA(65) SITT Ring 70 4.7812-02 4.7812-02 FRACA(70) SITT Ring 70 4.7812-02 4.7812-02 FRACA(70) SITT Ring 71 4.6332-02 4.6332-02 FRACA(70) SITT Ring 71 4.6332-02 4.6332-02 FRACA(70) SITT Ring 72 2.2702-02 2.2702-02 FRACA(71) SITT Ring 72 1.0002+00 0.0002400 FRACA(72) SITT Ring 72 1.0002+01 1.0002+01 FRACA(72) CCU Fraction of time spent outdoors in agri.area 1 1.0002-01 FOIDWELL CCU Fraction of time spent outdoors in agri.area 3 1.0002-01 CCUERANCY(1) CCU Fraction of time spent outdoors in agri.area 4 1.0002-01 CCUERANCY(2) CCU Fraction of time spent outdoors in agri.area 3	SEXT	Ring 64	5.911E-02	5.911E-02	i	FRACA(64)
SITT Ring 67 5.262-02 5.262-02 FRACA (67) SITT Ring 69 4.5382-02 4.5382-02 FRACA (68) SITT Ring 70 4.7812-02 4.5382-02 FRACA (67) SITT Ring 70 4.6332-02 4.6332-02 FRACA (70) SITT Ring 71 4.6332-02 4.6332-02 FRACA (71) SITT Ring 72 2.2702-02 2.2702-02 FRACA (71) SITT Ring 72 2.2702-02 2.2702-02	SEXT	Ring 65	5.687E-02	5.687E-02		FRACA (65)
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SEXT Ring 76 4.5382-02 4.5382-02 FRACA(65) SEXT Ring 70 4.6333-02 4.6333-02 FRACA(70) SEXT Ring 72 2.270Z-02 2.270Z-02 FRACA(71) SEXT Ring 72 2.270Z-02 2.270Z-02 FRACA(72) DCCU Fraction of time spent indoors on contaminated site 0.000Z+00 0.002Z+00 FOID DCCU Fraction of time spent outdoors in offfite Dwelling 1.000Z-01 1.000Z-01 FOID DCCU Fraction of time spent outdoors in agri. area 1 1.000Z-01 1.000Z-01 FOIDDWELL DCCU Fraction of time spent outdoors in agri. area 3 1.000Z-01 1.000Z-01 OCCUPANCY(2) DCCU Fraction of time spent outdoors in agri. area 4 1.000Z-01 OCCUPANCY(2) DCCU Fraction of time spent outdoors in agri. area 4 1.000Z-01 OCCUPANCY(2) DCCU Fraction of time spent outdoors in agri. area 4 1.000Z-01 DTCV NDM in cover material not used 2.	SEXT	Ring 68	5.106E-02	5.106E-02		FRACA (68)
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NADNDiffusion coefficient for radon gas (m/sec):XADNin cover materialXADNin contaminated zone soilXADNin contaminated zone soilNaDNin fruit, grain and non-leafy vegetable fieldXADNin fruit, grain and non-leafy vegetable fieldXADNin faity vegetable fieldXADNin largy vegetable fieldXADNin largy vegetable fieldXADNin patureXADNin livestock grain fieldXADNin foundation materialNaDNin foundation materialNADNin foundation foundation (m)XADNbulk density of building foundation (g/cm**3)XADNnot usedXADNrot usedXADNrot usedNot used2.0002-06PH2OFLDIFOS(5)XADNin foundation feotundation (g/cm**3)XADNnot usedXADNrot usedXADNrot usedXADNrot usedNot used1.0002-01PH2OFLXADNPH2OFLXADNNot usedXADNBuilding depth below ground surface (m)Not used2.0002+00XADNRadon vertical dimension of mixing (m)XADNNet usedXADNAverage building air exchange rate (1/hr)XADNAverage building air exchange rate (1/hr)XADNAverage building air exchange rate (1/hr)XADNAverage building air exchange rate (1/hr)XADNEmanating power of Rn-222 gasXAD	DCCD	Fraction of time spent outdoors in agri. area 3	1.0002-01	1.0002-01	i	OCCUPANCY (3)
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RADNin fruit, grain and non-leafy vegetable fieldnot used2.0002-06DIFOS(1)RADNin leafy vegetable fieldnot used2.0002-06DIFOS(2)RADNin paturenot used2.0002-06DIFOS(3)RADNin livestock grain fieldnot used2.0002-06DIFOS(4)RADNin offsite dwelling sitenot used2.0002-06DIFOS(4)RADNin foundation materialnot used3.0002-07DIFOS(5)RADNThickness of building foundation (m)not used1.5002-01DIFNIRADNBulk density of building foundationnot used1.0002-01DIFNIRADNTotal porosity of the building foundationnot used1.0002-01PH20FILRADNBuilding depth below ground surface (m)not used2.0002+00PH20FILRADNRadon vertical dimension of mixing (m)not used2.0002+00PH20FILRADNHeight of the building (room) (m)not used2.0002+00PH20FILRADNAverage building air exchange rate (1/hr)not used5.0002+00PH20FILRADNEmanating power of Rn-222 gasnot used1.5002+01FAIRADNEmanating power of Rn-220 gasnot used1.5002+01EMANA(1)RADNEmanating power of Rn-220 gasnot used1.5002+01EMANA(2)C14	RADN	in cover material	not used	2.0002-06	i	DIFCV
RADNin leafy vegetable fieldnot used2.0002-06DIFOS(2)RADNin paturenot used2.0002-06DIFOS(3)RADNin livestock grain fieldnot used2.0002-06DIFOS(4)RADNin offsite dwelling sitenot used2.0002-06DIFOS(5)RADNin foundation materialnot used3.0002-07DIFOS(5)RADNThickness of building foundation (m)not used1.5002-01FLOORIRADNTotal porosity of the building foundationnot used1.0002-01TPFLRADNVolumetric water content of the foundationnot used3.0002-02PH2OFLRADNBuilding depth below ground surface (m)not used2.0002+00PH2OFLRADNHeight of the building (room) (m)not used2.0002+00PH2OFLRADNBuilding interior area factornot used2.0002+00PH2OFLRADNBuilding interior area factornot used2.0002+00PH2OFLRADNBuilding interior area factornot used2.0002+00PH2OFLRADNEmanating power of Rn-220 gasnot used1.5002-01FAIRADNZmanating power of Rn-220 gasnot used1.0002+00ZMANA(1)RADNZmanating power of mixing for vegetation (m)not used1.0002+00ZMANA(2)C14Vertical dimension of	RADN	in contaminated zone soil	not used	2.000E-06		DIFCZ
RADNin paturenot used2.0002-06DIFOS(3)RADNin livestock grain fieldnot used2.0002-06DIFOS(4)RADNin offsite dwelling sitenot used2.0002-06DIFOS(5)RADNin foundation materialnot used3.0002-07DIFSI(5)RADNThickness of building foundation (m)not used1.5002-01FLOORIRADNBulk density of building foundation (g/cm**3)not used1.5002-01FLOORIRADNVolumetric water content of the foundationnot used3.0002-02PH2OFLRADNBuilding depth below ground surface (m)not used3.0002-02PH2OFLRADNRadon vertical dimension of mixing (m)not used2.0002+00HMIXRADNAverage building interior area factornot used5.0002+01FAIRADNBuilding interior area factornot used1.5002-01FAIRADNEmanating power of Rn-222 gasnot used1.5002+01FAIRADNEmanating power of Rn-220 gasnot used1.5002-01FAIC14C-14 evasion layer thickness in soil (m)not used1.0002+00EMANA(2)C14Vertical dimension of mixing for vegetation (m)not used1.0002+00EMANA(2)	RADN	in fruit, grain and non-leafy vegetable field	not used	2.0002-06		DIFOS(1)
RADNin livestock grain fieldnot used2.0002-06DIFOS(4)RADNin offsite dwelling sitenot used2.0002-06DIFOS(5)RADNin foundation materialnot used3.0002-07DIFTRADNThickness of building foundation (m)not used1.5002-01DIFTLRADNBulk density of building foundation (g/cm**3)not used2.4002+00DENSFLRADNTotal porosity of the building foundationnot used1.0002-01TPFLRADNVolumetric water content of the foundationnot used3.0002-02PH20FLRADNRadon vertical dimension of mixing (m)not used2.0002+00PH2FLRADNHeight of the building (room) (m)not used2.5002+00HMIXRADNAverage building air exchange rate (1/hr)not used5.0002-01RZCGRADNEmanating power of Rn-222 gasnot used2.5002-01ZMANA(1)RADNEmanating power of Rn-220 gasnot used1.5002-01ZMANA(2)C14Vertical dimension of mixing for vegetation (m)not used3.0002-01ZMANA(2)RADNEmanating not information of mixing for vegetation (m)not used1.0002+00ZMANA(2)	RADN	in leafy vegetable field	not used	2.0002-06	i	DIFOS(2)
RADNin offsite dwelling sitenot used2.0002-06DIFOS(5)RADNin foundation materialnot used3.0002-07DIFFLRADNThickness of building foundation (m)not used1.5002-01DIFFLRADNThickness of building foundation (g/cm**3)not used1.5002-01FLOORLRADNTotal porosity of the building foundationnot used1.0002-01TPFLRADNVolumetric water content of the foundationnot used3.0002-02PH2OFLRADNBuilding depth below ground surface (m)not used-1.0002+00HMIXRADNRadon vertical dimension of mixing (m)not used2.5002+00HMIXRADNHeight of the building (room) (m)not used2.5002+00HRMRADNAverage building air exchange rate (1/hr)not used0.0002+00FAIRADNEmanating power of Rn-222 gasnot used1.5002-01EMANA(1)RADNEmanating power of Rn-220 gasnot used1.5002-01EMANA(2)Image: Diff Colored C	RADN	in pature	not used	2.0002-06	i	DIFOS(3)
RADNin foundation materialnot used $3.0002-07$ DIFFLRADNThickness of building foundation (m)not used $1.5002-01$ FLOORIRADNBulk density of building foundation (g/cm**3)not used $2.4002+00$ FLOORIRADNTotal porosity of the building foundationnot used $1.0002-01$ TPFLRADNVolumetric water content of the foundationnot used $3.0002-02$ PH2OFLRADNBuilding depth below ground surface (m)not used $3.0002-02$ PH2OFLRADNRadon vertical dimension of mixing (m)not used $2.5002+00$ HRMRADNHeight of the building (room) (m)not used $2.5002+00$ HRMRADNAverage building air exchange rate (1/hr)not used $5.0002-01$ FAIRADNEmanating power of Rn-222 gasnot used $1.5002-01$ FAIMANA(1)RADNEmanating power of Rn-220 gasnot used $1.5002-01$ FMANA(2)C14C-14 evasion layer thickness in soil (m)not used $3.0002-01$ FMCC14Vertical dimension of mixing for vegetation (m)not used $1.0002+00$ FMIXXV	RADN	in livestock grain field	not used	2.000E-06	i	DIFOS(4)
RADNThickness of building foundation (m)not used1.500Z-01FLOORIRADNBulk density of building foundation (g/cm**3)not used2.400Z+00DENSFLRADNTotal porosity of the building foundationnot used1.000Z-01TPFLRADNVolumetric water content of the foundationnot used3.000Z-02PH2OFLRADNBuilding depth below ground surface (m)not used-1.000Z+00DMFLRADNRadon vertical dimension of mixing (m)not used2.500Z+00HMIXRADNHeight of the building (room) (m)not used5.000Z-01RZXGRADNAverage building air exchange rate (1/hr)not used5.000Z-01RZXGRADNEmanting power of Rn-222 gasnot used1.500Z-01FAIRADNEmanating power of Rn-220 gasnot used1.500Z-01EMANA(1)RADNZmanating power of Rn-220 gasnot used1.500Z-01EMANA(2)C14C-14 evasion layer thickness in soil (m)not used1.000Z+00EMANA(2)	RADN	in offsite dwelling site	not used	2.0002-06		DIFOS(5)
RADNBulk density of building foundation (g/cm**3)not used2.4002+00DENSFLRADNTotal porosity of the building foundationnot used1.0002+01TPFLRADNVolumetric water content of the foundationnot used3.0002-02PH20FLRADNBuilding depth below ground surface (m)not used-1.002400PH20FLRADNRadon vertical dimension of mixing (m)not used2.0002+00HMIXRADNHeight of the building (room) (m)not used2.5002+00HRMRADNAverage building air exchange rate (1/hr)not used5.0002-01RZKGRADNBuilding interior area factornot used2.5002-01FAIRADNEmanating power of Rn-222 gasnot used1.5002-01EMANA(1)RADNEmanating power of Rn-220 gasnot used1.5002-01EMANA(2)C14Vertical dimension of mixing for vegetation (m)not used1.0002+00EMANA(2)	RADN	in foundation material	not used	3.000E-07	i	DIFFL
RADNTotal porosity of the building foundationnot used1.0002-01TPFLRADNVolumetric water content of the foundationnot used3.0002-02PH20FLRADNBuilding depth below ground surface (m)not used-1.0002+00PH20FLRADNRadon vertical dimension of mixing (m)not used2.0002+00HMIXRADNHeight of the building (room) (m)not used2.5002+00HRMRADNAverage building air exchange rate (1/hr)not used5.0002+01RZXGRADNBuilding interior area factornot used0.0002+00FAIRADNEmanating power of Rn-222 gasnot used1.5002-01ZMANA(1)RADNEmanating power of Rn-220 gasnot used3.0002-01ZMANA(2)C14Vertical dimension of mixing for vegetation (m)not used1.0002+00HMIXV	RADN	Thickness of building foundation (m)	not used	1.500E-01		FLOOR1
RADN Volumetric water content of the foundation not used 3.0002-02 PH2OFL RADN Building depth below ground surface (m) not used -1.0002400 DMFL RADN Radon vertical dimension of mixing (m) not used 2.0002400 HMIX RADN Height of the building (room) (m) not used 2.0002400 HRM RADN Average building air exchange rate (1/hr) not used 5.0002-01 RZXG RADN Building interior area factor not used 0.0002+00 FAI RADN Emanating power of Rn-222 gas not used 1.5002-01 EMANA(1) RADN Emanating power of Rn-220 gas not used 1.5002-01 EMANA(2) Image: thickness in soil (m) not used 3.0002-01 EMANA(2) Image: thickness in soil (m) not used 3.0002-01 EMANA(2) Image: thickness in soil (m) not used 1.0002+00 EMANA(2)	RADN	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	i	DENSFL
RADNBuilding depth below ground surface (m)not usedDMFLRADNRadon vertical dimension of mixing (m)not used2.0002+00HMIXRADNHeight of the building (room) (m)not used2.5002+00HRMRADNAverage building air exchange rate (1/hr)not used5.0002+00HRMRADNBuilding interior area factornot used0.0002+00FAIRADNEmanating power of Rn-222 gasnot used2.5002-01EMANA(1)RADNEmanating power of Rn-220 gasnot used1.5002-01EMANA(2)C14C-14 evasion layer thickness in soil (m)not used3.0002-01DMCC14Vertical dimension of mixing for vegetation (m)not used1.0002+00HMIXV	RADN	Total porosity of the building foundation	not used	1.000E-01		TPFL
RADN Radon vertical dimension of mixing (m) not used 2.0002+00 HMIX RADN Height of the building (room) (m) not used 2.5002+00 HRM RADN Average building air exchange rate (1/hr) not used 5.0002-01 RZKG RADN Building interior area factor not used 0.0002+00 FAI RADN Emanating power of Rn-222 gas not used 2.5002-01 EMANA(1) RADN Emanating power of Rn-220 gas not used 1.5002-01 EMANA(2) Image: Color of the color of mixing for vegetation (m) not used 3.0002-01 EMANA(2)	RADN	Volumetric water content of the foundation	not used	3.000E-02		PH2OFL
RADN Height of the building (room) (m) not used 2.5002+00 HRM RADN Average building air exchange rate (1/hr) not used 5.0002-01 RZXG RADN Building interior area factor not used 0.0002+00 FAI RADN Emanating power of Rn-222 gas not used 2.5002-01 FAIANA(1) RADN Emanating power of Rn-220 gas not used 1.5002-01 FMANA(2) Image: Color of Rn-220 gas Image: Root used 3.0002-01 FMANA(2) Image: Root used Image: Root used 3.0002-01 FMANA(2) Image: Root used Image: Root used 3.0002-01 FMANA(2) Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used Image: Root used	RADN	Building depth below ground surface (m)	not used	-1.000E+00		DMFL
RADN Average building air exchange rate (1/hr) not used 5.0002-01 REXG RADN Building interior area factor not used 0.0002+00 FAI RADN Emanating power of Rn-222 gas not used 2.5002-01 EMANA(1) RADN Emanating power of Rn-220 gas not used 1.5002-01 EMANA(2) C14 C-14 evasion layer thickness in soil (m) not used 3.0002-01 DMC C14 Vertical dimension of mixing for vegetation (m) not used 1.0002+00 HMIXV	RADN	Radon vertical dimension of mixing (m)	not used	2.000E+00		HMIX
RADN Building interior area factor not used 0.0002+00 FAI RADN Emanating power of Rn-222 gas not used 2.5002-01 EMANA(1) RADN Emanating power of Rn-220 gas not used 1.5002-01 EMANA(2) I C-14 evasion layer thickness in soil (m) not used 3.0002-01 DMC C14 Vertical dimension of mixing for vegetation (m) not used 1.0002+00 HMIXV	RADN	Height of the building (room) (m)	not used	2.500E+00		HRM
RADN Emanating power of Rn-222 gas not used 2.500Z-01 EMANA(1) RADN Emanating power of Rn-220 gas not used 1.500Z-01 EMANA(2) I I C-14 evasion layer thickness in soil (m) not used 3.000Z-01 DMC C14 Vertical dimension of mixing for vegetation (m) not used 1.000Z+00 HMIXV	RADN	Average building air exchange rate (l/hr)	not used	5.000E-01		REXG
RADN Image: State in the st	RADN	Building interior area factor	not used	0.0002+00		FAI
Cl4 C-14 evasion layer thickness in soil (m) not used 3.000Z-01 DMC Cl4 Vertical dimension of mixing for vegetation (m) not used 1.000Z+00 HMIXV	RADN	Emanating power of Rn-222 gas	not used	2.500E-01		EMANA(1)
214 Vertical dimension of mixing for vegetation (m) not used 1.0002+00 HMIXV	RADN	Emanating power of Rn-220 gas	not used	1.500E-01		EMANA(2)
214 Vertical dimension of mixing for vegetation (m) not used 1.0002+00 HMIXV	i			1	1	Î
	214	C-14 evasion layer thickness in soil (m)	not used	3.000E-01		DMC
Cl4 C-l4 evasion flux rate from soil (l/sec) not used 7.000Z-07 Cl4ZVSN	214	Vertical dimension of mixing for vegetation (m)	not used	1.000E+00		HMIXV
	214	C-14 evasion flux rate from soil (1/sec)	not used	7.0002-07		C14EVSN

No tritium parameters used.

Reports correct Pathway selections: RESRAD-OFFSITE, Version 4.0 T+ Limit = Parent Dose Report Title : RESRAD-OFFSITE Default Parameters File : Site3.ROF T4 Limit = 30 days 02/13/2020 10:32 Page 33

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.0002-10		C12EVSN
C14	Fraction of vegetation carbon from air	not used	9.800E-01		CAIR
C14	Fraction of vegetation carbon from soil	not used	2.0002-02		CSOIL
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.8002-01		C12AIR
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02		C12CZ
C12	C-12 concentration in water (g/cm**3)	not used	2.000E-05		C12WTR
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01		C12MEAT_MILK(1)
C12	C-12 concentration in milk (g/g)	not used	7.000E-02		C12MEAT_MILK(2)
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01		C12PLANT(1)
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02		C12PLANT(2)
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02		C12PLANT(3)
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.0002-01		C12PLANT(4)
нз	Humidity in air (g/cm**3)	not used	8.0002+00		HUMID
H3	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01		H2OMEAT_MILK(1)
H3	Mass fraction of water in milk (g/g)	not used	8.800E-01		H2OMEAT_MILK(2)
H3	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01		H2OPLANT(1)
H3	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01		H2OPLANT (2)
H3	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01		H2OPLANT (3)
нз	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01		H2OPLANT (4)

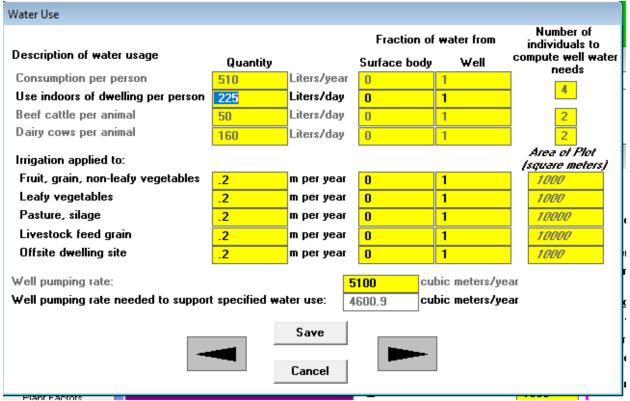
Summary of Pathway Selections

Pathway	User Selection	
1 external gamma	active	
2 inhalation (w/o radon)	suppressed	
3 plant ingestion	suppressed	
4 meat ingestion	suppressed	
5 milk ingestion	suppressed	
6 aquatic foods	suppressed	
7 drinking water	suppressed	
8 soil ingestion	suppressed	

Now look at inhalation only pathway:

I RESRAD - OFFSITE Site3.ROF (Modified)		- 0 ×
	D . T	
File Pathways Site Data View Form Option		
RESRAD- Set Pathways	Modify Data	Iconic Navigator
OFFSITE	Hide Subforms	Problem Inputs Results Help
Version 4.0	Show Subforms Horizontally	
Inhalation	Preliminary Inputs	
Plant Ingestion	Release Times	
Meat Ingestion	Initial Concentrations Nuclide Specific Release	
File Milk Ingestion	Distribution Coefficients Deposition Velocities	
Change Title	Transfer Factors	
Drinking Water	Reporting Times	
Set Pathways	Storage Times Site Layout	
Modify Data	Physical and Hydrological	
Run	Primary Contamination	
View Output	Sediment Delivery Ratio Agricultural Areas	
View Output	Livestock Feed Areas	
Quit	Dwelling Site	
	Atmospheric Transport	
	Water Use	
	Unsaturated Zones	
	Saturated Zone Groundwater Transport	
	Surface Water Body	
	Ingestion Rates Plant Factors	
	Livestock Intakes	
	Livestock Feed Factors	
	Inhalation, Gamma	
	Shape Factors	
	Occupancy	
	Badon	

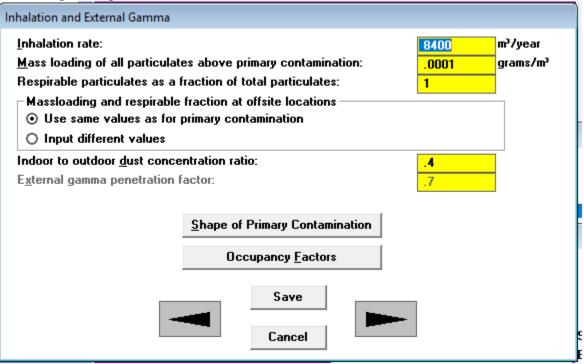
Livestock pathway still off:



Ingestion still off

Ingestion Rates			
	Consumption rate	I	Fraction from affected area
<u>D</u> rinking water	510	Liters/year	1
<u>F</u> ish	5.4	kg/year	.5
<u>C</u> rustacea and mollusks	.9	kg/year	.5
Fruit, grain, non-leafy vegetables	160	kg/year	.5
Leafy <u>v</u> egetables	14	kg/year	.5
M <u>e</u> at	63	kg/year	1
Milk	92	Liters/year	1
<u>S</u> oil (incidental)	36.5	grams/year	
	Plant Factors		
	ivestock Facto	rs	
Liv	estock Feed Fa	ctors	
	Save	-	
	Cancel		
	5	aturated zone:	111

External gamma penetration factor is off:



Ran the case:

Look at Dose report:

No use of ingestion parameters:

File Edit Help

Eont:	AS LineDraw 🗸 7.4 🖌 🗿 📳 📴 Page: 🛃 🗸	₹			
RESRAI	-OFFSITE, Version 4.0 T4 Limit = 30 days	02/13/20	20 10: 4 2 Pa	age 27	
Parent	Dose Report			-	
Title	: RESRAD-OFFSITE Default Parameters				
File	: Site3.ROF				
	Site-Specific Para	ameter Summa:	ry (continued	i)	
1		User		RESRAD	Parameter
Menu	Parameter	Input	Default	computed	Name
		Input	Derudity	compared	
INGE	Leafy vegetable consumption (kg/yr)	not used	1.4002+01		DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01		FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.3002+01		DMI(1)
INGE	Fraction of meat lfrom affected area	not used	1.0002+00		FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01		DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00		FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01		SOIL
		1			1
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01		YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.7002-01		GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01		FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01		RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01		FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01		FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	not used	1.2002+00		DROOT (1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.5002+00		YIELD(2)
VEGE	Growing Season for Leafy (years)	not used	2.5002-01		GROWTIME (2)
VEGE	Translocation Factor for Leafy	not used	1.0002+00		FOLI_F(2)
VEGE	······································	not used	2.000E+01		RWEATHER(2)
VEGE VEGE	Foliar Interception Fraction for dust Leafy Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500Z-01 2.500Z-01		FINTCEPT(2,1)
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01		FINTCEPT(2,2) DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00		YIELD(3)
VEGE	Growing Season for Pasture (vears)	not used	8.000E-02		GROWTIME (3)
VEGE	Translocation Factor for Pasture	not used	1.0002+00		FOLI F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.0002+01		RWEATHER (3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01		FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01		FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.0002-01		DROOT (3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01		YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.7002-01		GROWTIME (4)
VEGE	Translocation Factor for Grain	not used	1.000E-01		FOLI F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01		RWEATHER (4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.5002-01		FINTCEPT(4,1)
VECE	Woliar Intercent-n Wract-n for irrigation Grain	not used	2 5007-01	i	ETNTCRDT (4 2)

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Inhalation parameters now used:

File Edit Help

Eont:	4S LineDraw 🗸 7.4 🔽 🗿 📄 📔 Page: 28 🗸	¥			
	Site-Specific Para	ameter Summa:	ry (continue	d)	
Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INHE INHE	Inhalation rate (m**3/yr) Mass loading of all particulates from Primary contam		8.400E+03 1.000E-04		INHALR MLFD
INHE INHE INHE	Respirable particulates as a fraction of total Offsite mass loading same as onsite mass loading? Total mass loading at agricultural area 1 (g/m**3)	1.0002+00 0.0002+00 1.0002-04	1.000E+00		RESPFRACPC SAMEMLRF MLTOTOF(1)
INHE INHE	Respirable fraction at agricultural area 1 Total mass loading at agricultural area 2 (g/m^{**3})	1.000E+00 1.000E-04	1.000E+00 1.000E-04		RESPFRACOF(1) MLTOTOF(2)
INHE INHE INHE	Respirable fraction at agricultural area 2 Total mass loading at agricultural area 3 (g/m**3) Respirable fraction at agricultural area 3	1.000E+00 1.000E-04 1.000E+00	1.0002+00 1.0002-04 1.0002+00	 	RESPFRACOF(2) MLTOTOF(3) RESPFRACOF(3)
INHE INHE INHE	Total mass loading at agricultural area 4 (g/m**3) Respirable fraction at agricultural area 4 Total mass loading at offsite dwelling(g/m**3)	1.0002-04 1.0002+00 1.0002-04	1.000E-04 1.000E-04 1.000E-04	 	MLTOTOF (4) RESPFRACOF (4) MLTOTDWELL
INHE INHE	Respirable fraction at offsite dwelling(g/m**3) Indoor dust filtration factor, inhalation	1.000E+00 4.000E-01	1.000E+00 4.000E-01		RESPFRACDWELL SHF3
INHE INHE SEXT	Shielding factor, external gamma Shape factor flag, external gamma Onsite shape factor array (used if non-circular):	not used not used	7.0002-01 1.0002+00	 noncircular	SHF1 FS
SEXT SEXT SEXT	Radii of shape factor array (used if non-circular): Outer annular radius (m), ring 1: Outer annular radius (m), ring 2:	not used not used	6.000E+00	 	RAD_SHAPE(1) RAD_SHAPE(2)
SEXT	Outer annular radius (m), fing 2: Outer annular radius (m), ring 3:	not used	1.8002+01		RAD_SHAPE(2) RAD_SHAPE(3)

External parameters not used:

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Eont:	4S LineDraw 🔻 7.4 💌 🖉 📳 📴 Page: 2 💌	₹ ≾				
RESRAL	-OFFSITE, Version 4.0 T4 Limit = 30 days	02/13/20	20 10:42 Pa	age 29		\neg
	Dose Report			- -		- 1
Title	: RESRAD-OFFSITE Default Parameters					- 11
File	: Site3.ROF					- 11
						- 11
	Site-Specific Para	ameter Summa:	ry (continue)	i)		- 1
						- 1
	-	User		RESRAD	Parameter	- 11
Menu	Parameter	Input	Default	computed	Name	- 1
SEXT	Shape factor array from offsite dwelling:					- 1
SEXT	Radii of shape factor array (used if non-circular):				1	- 1
SEXT	Outer annular radius (m), ring 13:	not used	1.3252+01		RAD SHAPE(13)	- 1
SEXT	Outer annular radius (m), ring 14:	not used	2.6502+01		RAD SHAPE (14)	- 1
SEXT	Outer annular radius (m), ring 15:	not used	3.975E+01		RAD SHAPE (15)	- 1
SEXT	Outer annular radius (m), ring 16:	not used	5.300E+01		RAD SHAPE (16)	- 1
SEXT	Outer annular radius (m), ring 17:	not used	6.6252+01		RAD SHAPE (17)	- 1
SEXT	Outer annular radius (m), ring 18:	not used	7.950E+01		RAD SHAPE (18)	- 1
SEXT	Outer annular radius (m), ring 19:	not used	9.275E+01	i	RAD SHAPE (19)	- 1
SEXT	Outer annular radius (m), ring 20:	not used	1.0602+02	i	RAD SHAPE (20)	- 1
SEXT	Outer annular radius (m), ring 21:	not used	1.1922+02	i	RAD SHAPE (21)	- 1
SEXT	Outer annular radius (m), ring 22:	not used	1.3252+02	i	RAD SHAPE (22)	- 1
SEXT	Outer annular radius (m), ring 23:	not used	1.458E+02	i	RAD SHAPE (23)	- 1
SEXT	Outer annular radius (m), ring 24:	not used	1.590E+02	i	RAD SHAPE (24)	- 1
SEXT	Fractions of annular areas within AREA:			i i	i =	- 1
SEXT	Ring 13	not used	0.0002+00		FRACA(13)	- 1
SEXT	Ring 14	not used	0.0002+00		FRACA(14)	- 1
SEXT	Ring 15	not used	0.0002+00		FRACA(15)	- 1
SEXT	Ring 16	not used	2.400E-02		FRACA(16)	- 1
SEXT	Ring 17	not used	1.900E-01		FRACA(17)	- 1
SEXT	Ring 18	not used	2.400E-01		FRACA(18)	- 1
SEXT	Ring 19	not used	2.000E-01		FRACA(19)	- 1
SEXT	Ring 20	not used	1.7002-01		FRACA(20)	- 1
SEXT	Ring 21	not used	1.500E-01		FRACA(21)	- 1
SEXT	Ring 22	not used	1.300E-01		FRACA (22)	- 1
SEXT	Ring 23	not used	1.200E-01		FRACA (23)	- 1
SEXT	Ring 24	not used	5.200E-02		FRACA (24)	- 1
SEXT	Shape factor array from offsite area 1:			1	I	- 11
SEXT	Radii of shape factor array (used if non-circular):					
SEXT	Outer annular radius (m), ring 25:	not used	1.500E+02		RAD_SHAPE(25)	
SEXT	Outer annular radius (m), ring 26:	not used	1.581E+02		RAD_SHAPE(26)	- 1
SEXT	Outer annular radius (m), ring 27:	not used	1.6832+02		RAD_SHAPE(27)	- 1
SEXT	Outer annular radius (m), ring 28:	not used	1.7852+02		RAD_SHAPE(28)	- 1
SEXT	Outer annular radius (m), ring 29:	not used	1.8872+02		RAD_SHAPE(29)	
SEXT	Outer annular radius (m), ring 30:	not used	1.9902+02	I	RAD_SHAPE(30)	

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Tritium and C-14 not used

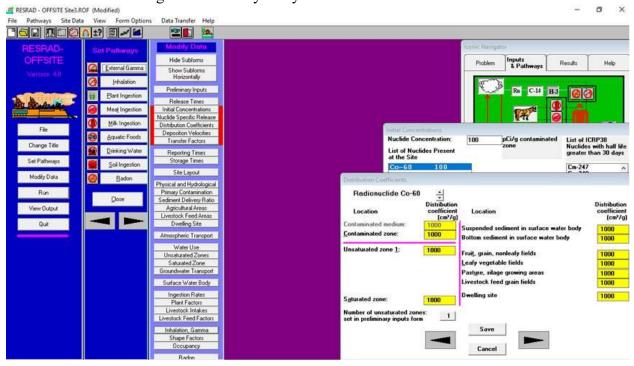
Summary Pathway selections is correct

RESERAD-OFFSITZ, Version 4.0 T* Limit = 30 days 02/13/2020 10:42 Page 33 Parent Dose Report Title : RESRAD-OFFSITZ Default Parameters File : Site3.ROF Site-Specific Parameter Summary (continued) Menu Parameter User Parameter Input Default C14 C-12 evasion flux rate from soil (l/sec) not used 1.0002-10 C14 Fraction of vegetation carbon from air not used 9.8002-01 C14 Fraction of vegetation carbon from soil not used 1.8002-01 C12 C-12 concentration in the atmosphere (g/m**3) not used 1.8002-01 C12 C-12 concentration in water (g/cm**3) not used 2.0002-02 C12 C-12 concentration in main tark (g/g) not used 2.0002-02 C12 C-12 concentration in mater (g/gm**3) not used 2.0002-02 C12 C-12 concentration in milk (g/g) not used 2.0002-02 C12 C-12 concentration in wegetable 1 (g/g) not used 4.0002-01 C12 C-12 concentrati	Parameter Name Cl2ZVSN CAIR
Menu Parameter User RESRAD C14 C-12 evasion flux rate from soil (1/sec) not used 1.000Z-10 C14 Fraction of vegetation carbon from air not used 1.000Z-10 C14 Fraction of vegetation carbon from air not used 5.800Z-01 C14 Fraction of vegetation carbon from soil not used 1.800Z-01 C12 C-12 concentration in the atmosphere (g/m**3) not used 1.800Z-01 C12 C-12 concentration in water (g/cm**3) not used 3.000Z-02 C12 C-12 concentration in meat 1 (g/g) not used 2.400Z-01 C12 C-12 concentration in milk (g/g) not used 7.000Z-02 C12 C-12 concentration in milk (g/g) not used 7.000Z-02 C12 C-12 concentration in milk (g/g) not used 7.000Z-01 C12 C-12 concentration in water 1 (g/g) not used 7.000Z-01	Name C12EVSN CAIR
Menu Parameter Input Default computed C14 C-12 evasion flux rate from soil (1/sec) not used 1.0002-10 C14 Fraction of vegetation carbon from air not used 5.8002-01 C14 Fraction of vegetation carbon from air not used 5.8002-01 C14 Fraction of vegetation carbon from soil not used 5.8002-01 C12 C-12 concentration in the atmosphere (g/m**3) not used 1.8002-01 C12 C-12 concentration in water (g/cm**3) not used 3.0002-02 C12 C-12 concentration in water (g/cm**3) not used 2.4002-05 C12 C-12 concentration in matel (g/q) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in water (g/cm*) not used 7.0002-01	Name C12EVSN CAIR
C14 Fraction of vegetation carbon from air not used 9.8002-01 C14 Fraction of vegetation carbon from soil not used 2.0002-02 C12 C-12 concentration in the atmosphere (g/m**3) not used 1.8002-01 C12 C-12 concentration in contaminated soil (g/g) not used 1.8002-01 C12 C-12 concentration in water (g/cm**3) not used 2.0002-05 C12 C-12 concentration in meat 1 (g/g) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in milk (g/g) not used 1.0002-01 C12 C-12 concentration in milk (g/g) not used 1.0002-01 C12 C-12 concentration in vegetable 1 (g/g) not used 4.0002-01	CAIR
C14 Fraction of vegetation carbon from soil not used 2.0002-02 C12 C-12 concentration in the atmosphere (g/m**3) not used 1.8002-01 C12 C-12 concentration in contaminated soil (g/g) not used 3.0002-02 C12 C-12 concentration in water (g/cm**3) not used 2.0002-05 C12 C-12 concentration in meat 1 (g/g) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in milk (g/g) not used 4.0002-01 C12 C-12 concentration in vegetable 1 (g/g) not used 4.0002-01	•
C12 C-12 concentration in the atmosphere (g/m**3) not used 1.8002-01 C12 C-12 concentration in contaminated soil (g/g) not used 3.0002-02 C12 C-12 concentration in water (g/cm**3) not used 2.0002-05 C12 C-12 concentration in meat 1 (g/q) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in milk (g/g) not used 4.0002-01 C12 C-12 concentration in vegetable 1 (g/g) not used 4.0002-01	
C12 C-12 concentration in contaminated soil (g/g) not used 3.0002-02 C12 C-12 concentration in water (g/cm**3) not used 2.0002-05 C12 C-12 concentration in meat 1 (g/g) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in vegetable 1 (g/g) not used 4.0002-01	CSOIL
C12 C-12 concentration in water (g/cm**3) not used 2.0002-05 C12 C-12 concentration in meat 1 (g/g) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in wilk (g/g) not used 4.0002-01 C12 C-12 concentration in vegetable 1 (g/g) not used 4.0002-01	C12AIR
C12 C-12 concentration in meat 1 (g/g) not used 2.4002-01 C12 C-12 concentration in milk (g/g) not used 7.0002-02 C12 C-12 concentration in vegetable 1 (g/g) not used 4.0002-01	C12CZ
C12 C-12 concentration in milk (g/g) not used 7.000Z-02 C12 C-12 concentration in vegetable 1 (g/g) not used 4.000Z-01	C12WTR
C12 C-12 concentration in vegetable 1 (g/g) not used 4.000Z-01	C12MEAT_MILK(1)
	C12MEAT_MILK(2)
C12 C-12 concentration in vegetable 2 (g/g) not used 9.000Z-02	C12PLANT(1)
	C12PLANT(2)
C12 C-12 concentration in livestock feed 1 (g/g) not used 9.000Z-02	C12PLANT(3)
C12 C-12 concentration in livestock feed 2 (g/g) not used 4.0002-01	C12PLANT(4)
H3 Humidity in air (g/cm**3) not used 8.0002+00	HUMID
H3 Mass fraction of water in meat 1 (g/g) not used 6.0002-01	H2OMEAT_MILK(1)
H3 Mass fraction of water in milk (g/g) not used 8.8002-01	H2OMEAT_MILK(2)
H3 Mass fraction of water in vegetable 1 (g/g) not used 8.0002-01	H2OPLANT(1)
H3 Mass fraction of water in vegetable 2 (g/g) not used 8.0002-01	H2OPLANT(2)
H3 Mass fraction of water in livestock feed 1 (g/g) not used 8.0002-01	H2OPLANT (3)
H3 Mass fraction of water in livestock feed 2 (g/g) not used 8.0002-01	

Summary of Pathway Selections

Pathway	User Selection
l external gamma	suppressed
2 inhalation (w/o radon)	active
3 plant ingestion	suppressed
4 meat ingestion	suppressed
5 milk ingestion	suppressed
6 aquatic foods	suppressed
7 drinking water	suppressed
8 soil ingestion	suppressed

Now Switch to Plant Ingestion Pathways only:



Livestock fields not used:

Сгорз	Pasture, silage	Grain
<u>Area (square meters):</u>	10000	10000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
<u>R</u> unoff coefficient:	.2	.2
Depth of soil <u>m</u> ixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Ero <u>si</u> on rate (meters/year):	1.147E-5	1.147E-5
<u>D</u> ry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>p</u> orosity	.4	.4
Sediment from primary contamination delivery ratio	U	0

Crops	Fruit, grain, non-leafy	Leafy vegetables
Area (square meters):	1000	1000
raction of area directly over primary contamination:	0	0
rrigation (m) applied per year:	.2	.2
vapotranspiration coefficient:	.5	.5
Lunoff coefficient:	.2	.2
)epth of soil <u>m</u> ixing layer or plow layer (meters):	.15	.15
/olumetric <u>w</u> ater content:	.3	.3
Ero <u>si</u> on rate (meters/year):	1.147E-5	1.147E-5
<u>)</u> ry bulk density of soil (grams/cm³):	1.5	1.5
oil erodibility factor (tons/acre):	.4	.4
lope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
otal <u>p</u> orosity	.4	.4
ediment from primary contamination delivery ratio	0	0
Save		

However, agricultural (human plant food) parameters are sued:

Same split in water use	(plant on, livestock off)
-------------------------	---------------------------

Use indoors of dwelling per person Beef cattle per animal	Quantity 510 225 50	Liters/year Liters/day	Fraction of Surface body		Number of individuals to compute well wate needs
Consumption per person Use indoors of dwelling per person Beef cattle per animal	510 225	-	0	Well 1	
Use indoors of dwelling per person Beef cattle per animal	225	-		1	neeus
Beef cattle per animal		Liters/day	-		
· · · ·	50		0	1	4
Dairu cowe per animal		Liters/day	0	1	2
Daily COms per animai	160	Liters/day	0	1	2
Irrigation applied to:		•			Area of Plot (square meters)
Fruit, grain, non-leafy vegetables	.2	m per year	0	1	1000
Leafy vegetables	.2	m per year	0	1	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.2	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000
√ell pumping rate:		5	100 cul	bic meters/yea	ar
¥ell pumping rate needed to support :	specified wa	ter use: 4	00.9 cu l	bic meters/yea	76
		•			
		Save	-		
-		Cancel			

Inhalation and External pathways off.

Inhalation and External Gamma		
Respirable particulates as a	tes above primary contamination: fraction of total particulates: e fraction at offsite locations primary contamination	8400 m³/year .0001 grams/m³ 1
Indoor to outdoor <u>d</u> ust conc E <u>x</u> ternal gamma penetration		. <u>4</u> .7
-	Occupancy <u>Factors</u> Save Cancel	

Ran the case

Plant fields used, livestock and dwelling site not used:

View - SUMMARY.REP

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RESRAD-OFFSITE, Version 4.0 Parent Dose Report Fitle : RESRAD-OFFSITE Default File : Site3.ROF	T4 Limit : Parameters	= 30 days	c	02/13/2020	10:51	Page	4
		Site-Sp	pecific Pa	arameter Su	mmary		

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk		3.000E+01		ΞD
FSTI	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01		BRDL
RELT	lst release time (years)	0.0002+00			RelTime(1)
CONC	Initial concentration of Co-60 (pCi/g)	1.0002+02	0.0002+00		S1(1)
VDEP	Deposition velocity of Co-60 on total particulates	1.000E-03	1.000E-03		DEPVEL(1)
VDEP	Dep. velocity of Co-60 on respirable particulates	1.000E-03	1.000E-03		DEPVELT(1)
DCLR	Distribution coefficients for Co-60				i
DCLR	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03		DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03		DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	1.000E+03	1.000E+03		DCNUCS (1)
DCLR	Bottom sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03		DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03		DCNUCSWS(1)
DCLR	Agricultural area 1 (cm**3/g)	1.000E+03	1.000E+03		DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	1.0002+03	1.000E+03		DCNUCOF(1,2)
DCLR	Agricultural a <mark>rea 3 (c</mark> m**3/g)	not used	1.000E+03		DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	n <mark>ot used</mark>	1.000E+03		DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	1.000E+03		DCNUCDWE(1)
DCLR	Leach rate constant of Co-60 (/yr)	0.0002+00	0.0002+00	1.6662-04	Rleach(1,1)
					Í
LYOT	Bearing of X axis (clockwise angle N>X in degrees)	9.000E+01	9.000E+01		DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.000E+02		SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.000E+02		SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	3.438E+01	3.438E+01		AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	6.5622+01	6.562E+01		AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	2.340E+02	2.340E+02		AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	2.6602+02	2.660E+02		AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	3.438E+01	3.438E+01		AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	6.562E+01	6.562E+01		AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	2.6802+02	2.680E+02		AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	3.000E+02	3.000E+02		AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	not used	0.000E+00		AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	not used	1.000E+02		AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	not used	4.500E+02		AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	not used	5.500E+02		AGRIXY(4,3)

Plant fields used:

PSDRSediment Delivery Ratio, SDR	i	i i i i i i i i i i i i i i i i i i i	i	i	i	i
PEDRfrom primary contamination to non-leafy veg. field0.0024000.0002400SDROF(1)PSDRfrom primary contamination to leafy veg. field0.00024000.0002400SDROF(2)PSDRfrom primary contamination to feed grain fieldnot used0.0002400SDROF(3)PSDRfrom primary contamination to feed grain fieldnot used0.0002400SDROF(4)PSDRfrom primary contamination to surface water body1.00024001.0002400SDRACRIAreal extent of Agricultural Area 1(m**2)1.00024001.0002400RUROF(1)ACRIFraction of Agri. Area 1directly over the c.z.0.0002-015.0002-01RUROF(1)ACRIMater filled porosity of soil in Agri. Area 15.0002-011.5002-01RUROF(1)ACRIMater filled porosity of soil in Agri. Area 11.5002-011.5002-01RUROF(1)ACRIComputed erosion rate of soil in Agri. Area 11.5002-011.6002-01RUROF(1)ACRIDry Bulk Density of soil in Agricultural Area 14.0002-014.0002-01RUROF(1)ACRIComputed erosion rate of Agricultural Area 13.0002-033.0002-03RURDF(1)ACRIDry Bulk Density of soil in Agricultural Area 14.0002-014.0002-01RURDF(1)ACRIComputed erosion practice factor of Agricultural Area 11.00024031.0002400RURDF(1)ACRI <td>PSDR</td> <td>Sediment Delivery Ratio, SDR</td> <td></td> <td></td> <td></td> <td></td>	PSDR	Sediment Delivery Ratio, SDR				
BEDRfrom primary contamination to leafy veg. field0.0002+000.0002+00SDROF(2)PSDRfrom primary contamination to feed grain fieldnot used0.0002+00SDROF(3)PSDRfrom primary contamination to sufface water body1.0002+001.0002+00SDROF(4)PSDRfrom primary contamination to sufface water body1.0002+001.0002+00SDROF(4)AGRIAreal extent of Agricultural Area 1(m**2)1.0002+031.0002+03AREAO(1)AGRIFraction of Agri. Area 1(m**2)1.0002+01FAREA EXENT(1)AGRIRunoff coefficient in Agricultural Area 15.0002-015.0002-01DTHMIXG(1)AGRIMater filled porosity of soil in Agri. Area 11.5002-011.5002-01DTHMIXG(1)AGRIState filled porosity of soil in Agri. Area 11.5002-011.5002-01TROF(1)AGRISlope-length-steepness factor, Agricultural Area 11.5002-011.0002-01TROF(1)AGRISlope-length-steepness factor, Agricultural Area 11.0002-033.0002-03TROF(1)AGRITotal porosity of soil in Agricultural Area 11.0002+00TROF(1)AGRISlope-length-steepness factor of Agricultural Area 11.0002+00TROF(1)AGRIConservatin practice factor of Agricultural Area 11.0002+00TROF(1)AGRISlope-length-steepness factor, Agricultural Area 2	PSDR	from primary contamination to surface water body	not used	0.0002+00		SDRDWELL
PSDRfrom primary contamination to pasturenot used0.0002+00SDROT(3)PSDRfrom primary contamination to fued grain fieldnot used0.0002+00SDROT(4)PSDRfrom primary contamination to surface water body1.0002+001.0002+00SDROT(4)AGRIAreal extent of Agricultural Area 1(m**2)1.0002+001.0002+00SDROT(1)AGRIFraction of Agri. Area 1directly over the c.r.0.0002+001.0002+00RAEAO(1)AGRIRunoff coefficient in Agricultural Area 12.0002-012.0002-01RUNOF(1)AGRIMater filled porosity of soil in Agri. Area 11.5002-011.5002-01RUNOF(1)AGRIComputed erosion rate of soil in Agri. Area 11.5002-011.0002-00RHOB(1)AGRISoil erodibility factor of Agricultural Area 11.5002-014.0002-01RHOB(1)AGRISoil erodibility factor of Agricultural Area 11.0002+001.0002+00RHOB(1)AGRIComputed erosiny practice factor of Agricultural Area 13.0002-01RHOB(1)AGRIComputed erosity of soil in Agricultural Area 11.0002+001.0002+00RHOB(1)AGRIComputed erosity of soil in Agricultural Area 11.0002+001.0002+00RHOB(1)AGRIComputed erosity of soil in Agricultural Area 11.0002+001.0002+00RHOB(1)AGRIAgreave factor of Agricult	PSDR	from primary contamination to non-leafy veg. field	0.0002+00	0.0002+00		SDROF(1)
PSDRfrom primary contamination to feed grain fieldnot used0.0002+00SDROF(4)PSDRfrom primary contamination to surface water body1.0002+001.0002+00SDRAGRIAreal extent of Agricultural Area 1(m**2)1.0002+031.0002+03ARIAO(1)AGRIFraction of Agri. Area 1directly over the c.r.0.0002+000.0002+00FAREA_PLANT(1)AGRIRunoff coefficient in Agricultural Area 15.0002-015.0002-01FAREA_PLANT(1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01FUNDF(1)AGRIWater filled porosity of soil in Agri. Area 13.0002-013.0002-01TMOF(1)AGRISobe erosion rate of soil in Agricultural Area 11.5002+011.5002+00FROB(1)AGRISobe erosion rate of solgricultural Area 14.0002+014.0002+01FROB(1)AGRIComputed erosion rate of Agricultural Area 13.0002+033.0002+03FROB(1)AGRIComputed erosion rate of Agricultural Area 14.0002+014.0002+01FROB(1)AGRIComping-management factor of Agricultural Area 11.0002+033.0002+03CONVPRAC(1)AGRIComping-management factor of Agricultural Area 11.0002+001.0002+00FROB(1)AGRIAreal extent of Agricultural Area 2(m*2)1.0002+03CONVPRAC(1)AGRIFraction of	PSDR	from primary contamination to leafy veg. field	0.0002+00	0.0002+00		SDROF(2)
PSDRfrom primary contamination to surface water body1.0002+00SDRAGRIAreal extent of Agricultural Area 1(m**2)1.0002+03ARZAO(1)AGRIFraction of Agri. Area 1directly over the c.z.0.0002+000.0002+00FRAEA_PLANT(1)AGRIRunoff coefficient in Agricultural Area 15.0002-015.0002-01FVAPTRN(1)AGRIMusing depth/plow layer of Agricultural Area 11.5002-011.5002-01DPTHMIXG(1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-013.0002-01DPTHMIXG(1)AGRIComputed erosion rate of soil in Agri. Area 11.1472-051.1472-05EROS(1)AGRIDry Bulk Density of soil in Agricultural Area 11.5002+014.0002-01RHOB(1)AGRISolpe-length-steepness factor, Agricultural Area 11.0002+001.5002+00SLPLENSTP(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00RHOB(1)AGRITotal porosity of soil in Agricultural Area 11.0002+001.0002+00REDAMAG(1)AGRIAreal extent of Agricultural Area 2(m*2)1.0002+00REDAMAG(1)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00REDAMAG(2)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00REDAMAG(2)AGRITotal porosity of soil in Agricu	PSDR	from primary contamination to pasture	not used	0.0002+00		SDROF (3)
AGRIAreal extent of Agricultural Area 1(m**2)1.0002+031.0002+03AREAO(1)AGRIFraction of Agri. Area 1directly over the c.z.0.0002+000.0002+00FAREA_PLANT(1)AGRIEvapotranspiration coefficient in Agri. Area 15.0002-015.0002-01FXEAPTRN(1)AGRIMunoff coefficient in Agricultural Area 11.5002-012.0002-01FXEAPTRN(1)AGRIMater filled porosity of soil in Agri. Area 11.5002-011.5002-01FXEAPTRN(1)AGRIComputed erosion rate of soil in Agri. Area 11.6002-011.5002-01FXEORING(1)AGRIDry Bulk Density of soil in Agricultural Area 11.0002-011.5002+00FRODIBLITY(1)AGRISolpe-length-steepness factor, Agricultural Area 14.0002-014.0002-01FRODIBLITY(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00FRODIBLITY(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00FRANG(1)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00FRANG(1)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00FRANG(1)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00FRANG(2)AGRIStapotranspiration coefficient in Agri. Area 21.0002+001.0002+00FRA	PSDR	from primary contamination to feed grain field	not used	0.0002+00		SDROF (4)
AGRIFraction of Agri. Area 1 directly over the c.z.0.0002+000.0002+00FAREA PLANT (1)AGRIEvapotranspiration coefficient in Agri. Area 15.0002-015.0002-01ZVAPTAN (1)AGRIRunoff coefficient in Agricultural Area 11.5002-015.0002-01RUNOF (1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01RUNOF (1)AGRIComputed erosion rate of soil in Agri. Area 11.5002-013.0002-01RHOB (1)AGRIComputed erosion rate of soil in Agri. Area 11.5002+001.5002+00RHOB (1)AGRISoil erodibility factor of Agricultural Area 11.5002+001.5002+00RHOB (1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01COMVPAC(1)AGRICropping-management factor of Agricultural Area 11.0002+033.0002-03COMVPAC(1)AGRICropping-management factor of Agricultural Area 11.0002+031.0002+03COMVPAC(1)AGRIFraction of Agricultural Area 2(m*2)1.0002+03REAC(2)AGRIAGRIFraction of Agricultural Area 20.0002+010.0002+03REAC(2)AGRIFraction of Agricultural Area 21.0002+031.0002+03REAC(2)AGRIFraction of Agricultural Area 21.0002+031.0002+03REAC(2)AGRIFraction of Agricultural Area 21.0002+0	PSDR	from primary contamination to surface water body	1.000E+00	1.000E+00		SDR
AGRIFraction of Agri. Area 1 directly over the c.z.0.0002+000.0002+00FAREA PLANT (1)AGRIEvapotranspiration coefficient in Agri. Area 15.0002-015.0002-01ZVAPTAN (1)AGRIRunoff coefficient in Agricultural Area 11.5002-015.0002-01RUNOF (1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01RUNOF (1)AGRIComputed erosion rate of soil in Agri. Area 11.5002-013.0002-01RHOB (1)AGRIComputed erosion rate of soil in Agri. Area 11.5002+001.5002+00RHOB (1)AGRISoil erodibility factor of Agricultural Area 11.5002+001.5002+00RHOB (1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01COMVPAC(1)AGRICropping-management factor of Agricultural Area 11.0002+033.0002-03COMVPAC(1)AGRICropping-management factor of Agricultural Area 11.0002+031.0002+03COMVPAC(1)AGRIFraction of Agricultural Area 2(m*2)1.0002+03REAC(2)AGRIAGRIFraction of Agricultural Area 20.0002+010.0002+03REAC(2)AGRIFraction of Agricultural Area 21.0002+031.0002+03REAC(2)AGRIFraction of Agricultural Area 21.0002+031.0002+03REAC(2)AGRIFraction of Agricultural Area 21.0002+0						i i i i i i i i i i i i i i i i i i i
AGRIEvapotranspiration coefficient in Agri. Area 15.0002-015.0002-01EVAPTRN(1)AGRIRunoff coefficient in Agricultural Area 12.0002-012.0002-01RUNOF(1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01RUNOF(1)AGRIWater filled porosity of soil in Agri. Area 13.0002-013.0002-01TMOF(1)AGRIComputed erosion rate of soil in Agri. Area 11.1472-051.1472-05EROSN(1)AGRIDry Bulk Density of soil in Agricultural Area 11.5002-001.5002+00RHOB(1)AGRISoil erodibility factor of Agricultural Area 14.0002-014.0002-01SLPLENSTP(1)AGRIConperdement factor of Agricultural Area 11.0002+001.0002+00SLPLENSTP(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CONVPRAC(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01FVAPTRN(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+00FVAPTRN(2)AGRIFraction of Agricultural Area 21.0002+01FVAPTRN(2)AGRISupotranspiration coefficient in Agri. Area 22.0002-01FVAPTRN(2)AGRIFactor of Agricultural Area 21.0002+00FVAPTRN(2)AGRIComputed erosion rate of soil in Agri. Area 21.5002-01FVAPTRN(2)	AGRI	Areal extent of Agricultural Area 1 (m**2)	1.000E+03	1.000E+03		AREAO(1)
AGRIRunoff coefficient in Agricultural Area 12.0002-012.0002-01RUNOF(1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01DPTRHIXG(1)AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01DPTRHIXG(1)AGRIComputed erosion rate of soil in Agri. Area 11.1472-051.1472-05RUNOF(1)AGRIDry Bulk Density of soil in Agricultural Area 11.5002+001.5002+00RHOB(1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01SLDEINSTP(1)AGRICropping-management factor of Agricultural Area 13.0002-033.0002-03CRPMANG(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01TPOF(1)AGRIAreal extent of Agricultural Area 2mot used4.0002-01CONVPRAC(1)AGRIAreal extent of Agricultural Area 2mot used4.0002-01FARZA_PLANT(2)AGRIAreal extent of Agricultural Area 20.0002+031.0002+03FARZA_PLANT(2)AGRIRunoff coefficient in Agricultural Area 22.0002-015.0002-01FARZA_PLANT(2)AGRIRunoff coefficient in Agricultural Area 21.5002-01FARZA_PLANT(2)AGRIRunoff coefficient in Agricultural Area 21.5002-01FARZA_PLANT(2)AGRIRunoff coefficient in Agricultural Area 21.5002-0	AGRI	Fraction of Agri. Area 1 directly over the c.z.	0.000E+00	0.000E+00		FAREA_PLANT(1)
AGRIMixing depth/plow layer of Agricultural Area 11.5002-011.5002-01DDTHMIXG(1)AGRIWater filled porosity of soil in Agri. Area 13.0002-013.0002-01TMOF(1)AGRIComputed erosion rate of soil in Agri. Area 11.1472-051.1472-05EROSN(1)AGRIDry Bulk Density of soil in Agricultural Area 11.5002+001.5002+00EROSN(1)AGRISoil erodibility factor of Agricultural Area 14.0002-014.0002-01ERODIBILITY(1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-033.0002-03CCPPANG(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CCNVPRAC(1)AGRIConservation practice factor of Agricultural Area 11.0002+031.0002+03CCNVPRAC(1)AGRIAreal extent of Agricultural Area 2(m**2)1.0002+03FARZA_PELANT(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+03FARZA_PELANT(2)AGRIRunoff coefficient in Agricultural Area 21.0002+01FARZA_PELANT(2)AGRIMater filled porosity of soil in Agricultural Area 21.0002+01FARZA_PELANT(2)AGRIComputed erosion rate of soil in Agri. Area 21.0002+01FARZA_PELANT(2)AGRIComputed erosion rate of soil in Agri. Area 21.0002+01FARZA_PELANT(2)AGRIComputed erosion rate of soil in Agri. A	AGRI	Evapotranspiration coefficient in Agri. Area l	5.000E-01	5.000E-01		EVAPTRN(1)
AGRIWater filled porosity of soil in Agri. Area 13.0002-013.0002-01TMOF(1)AGRIComputed erosion rate of soil in Agri. Area 11.1472-051.1472-05ZROSN(1)AGRIDry Bulk Density of soil in Agricultural Area 11.5002+001.5002+00RHOB(1)AGRISoil erodibility factor of Agricultural Area 14.0002-014.0002-01RHOB(1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01SLPLENSTP(1)AGRICorpping-management factor of Agricultural Area 13.0002-033.0002-03CCPMANG(1)AGRIConservation practice factor of Agricultural Area 11.0002+00TPOF(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01READ(2)AGRIFraction of AgricArea 2(m**2)1.0002+03READ(2)AGRIFraction of Agricultural Area 2(m**2)1.0002+03RUNOF(2)AGRIRunoff coefficient in Agricultural Area 22.0002-012.0002-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.0002+001.0002-01RUNOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05RUNOF(2)AGRIComputed erosion rate of soil in Agricultural Area 21.000	AGRI	Runoff coefficient in Agricultural Area 1	2.000E-01	2.000E-01		RUNOF(1)
AGRIComputed erosion rate of soil in Agri. Area 11.1472-051.1472-05ZROSN(1)AGRIDry Bulk Density of soil in Agricultural Area 11.5002+001.5002+00RHOB(1)AGRISoil erodibility factor of Agricultural Area 14.0002-014.0002-01RHOB(1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01SLPLENSTP(1)AGRICropping-management factor of Agricultural Area 13.0002-033.0002-03CRPMANG(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CONVPRAC(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01TPOF(1)AGRIAreal extent of Agricultural Area 2(m**2)1.0002+03ARZAO(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+000.0002+00FARZA PLANT(2)AGRIRunoff coefficient in Agricultural Area 22.0002-012.0002-01FARZA PLANT(2)AGRIMater filled porosity of soil in Agri. Area 23.0002-01DPTHMIXG(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05RUNOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.5002-01DPTHMIXG(2)AGRIComputed erosion rate of soil in Agri. Area 21.5002+00RUNOF(2)AGRISoil perodibility factor of Agricultural Area 2 </td <td>AGRI</td> <td>Mixing depth/plow layer of Agricultural Area 1</td> <td>1.500E-01</td> <td>1.500E-01</td> <td></td> <td>DPTHMIXG(1)</td>	AGRI	Mixing depth/plow layer of Agricultural Area 1	1.500E-01	1.500E-01		DPTHMIXG(1)
AGRIDry Bulk Density of soil in Agricultural Area 11.5002+001.5002+00RHOB(1)AGRISoil erodibility factor of Agricultural Area 14.0002-014.0002-01ERODIBILITY(1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01ERDDIBILITY(1)AGRICropping-management factor of Agricultural Area 13.0002-033.0002-03CCPPANG(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CCNVPRAC(1)AGRITotal porosity of soil in Agricultural Area 2I.0002+031.0002+03TPOF(1)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+03FAREA_PELANT(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+01FAREA_PELANT(2)AGRIRunoff coefficient in Agricultural Area 25.0002-012.0002-01FAREA_PELANT(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01FMONF(2)AGRIComputed erosion rate of soil in Agri. Area 21.4002-01FMONF(2)AGRI (2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002-011.5002-01FMONF(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002-01FMONF(2)AGRISoil erodibility factor of Agricultural Area 21.5002-014.0002-01FMONF(2)AGRISlope-le	AGRI	Water filled porosity of soil in Agri. Area l	3.000E-01	3.000E-01		TMOF(1)
AGRISoil erodibility factor of Agricultural Area 14.0002-014.0002-01FRODIBILITY(1)AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01SLDIENSTP(1)AGRICropping-management factor of Agricultural Area 13.0002-033.0002-03SLDIENSTP(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CRPMANG(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01TPOF(1)AGRIFraction of Agricultural Area 2(m**2)1.0002+03ARZA0(2)AGRIFraction of Agricultural Area 20.0002+000.0002+00ARZA0(2)AGRIFraction of Agricultural Area 25.0002-015.0002-01RUNOF(2)AGRIRunoff coefficient in Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.6002-011.5002-01RUNOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-05RNOS(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002-014.0002-01RNOS(2)AGRISlope-length-steepness factor, Agricultural Area 21.0002+00RNOS(2)AGRISoil per-length-steepness factor, Agricultural Area 21.0002+00RNOS(2)AGRISlope-length-steepness factor, Agricultural Area 21.0002-01	AGRI	Computed erosion rate of soil in Agri. Area l	1.147E-05	1.147E-05		EROSN(1)
AGRISlope-length-steepness factor, Agricultural Area 14.0002-014.0002-01SLPLENSTP(1)AGRICropping-management factor of Agricultural Area 13.0002-033.0002-03CRPMANG(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CRPMANG(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01TPOF(1)AGRIAreal extent of Agricultural Area 2(m**2)1.0002+031.0002+03ARZAO(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+000.0002+00FARZA PLANT(2)AGRIRunoff coefficient in Agricultural Area 22.0002-012.0002-01FARZA PLANT(2)AGRIRunoff coefficient in Agricultural Area 21.5002-012.0002-01RUNOF(2)AGRIMater filled porosity of soil in Agri. Area 23.0002-013.0002-01DPTHMIXG(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05RNOS(2)AGRISoil erodibility factor of Agricultural Area 21.5002-011.5002+00RNOB(2)AGRISoil per-length-steepness factor, Agricultural Area 24.0002-01RNDB(2)AGRISlope-length-steepness factor, Agricultural Area 23.0002-01RNDB(2)AGRISlope-length-steepness factor of Agricultural Area 23.0002-01RNDB(2)AGRISlope-length-steepness f	AGRI	Dry Bulk Density of soil in Agricultural Area 1	1.500E+00	1.500E+00		RHOB(1)
AGRICropping-management factor of Agricultural Area 13.0002-033.0002-03CRPMANG(1)AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CONVPRAC(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002+01TPOF(1)AGRIAreal extent of Agricultural Area 2(m**2)1.0002+031.0002+03FAREA_PELANT(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+000.0002+00FAREA_PELANT(2)AGRIEvapotranspiration coefficient in Agricultural Area 25.0002-015.0002-01FAREA_PELANT(2)AGRIRunoff coefficient in Agricultural Area 21.5002-011.5002-01FUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01DPTHMIXG(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05FROSN(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002+001.5002+00FRODENLLTY(2)AGRISlope-length-steepness factor, Agricultural Area 24.0002-014.0002-01SLDEINSTP(2)AGRICropping-management factor of Agricultural Area 21.0002+03CCPMANG(2)AGRIConproding-management factor of Agricultural Area 21.0002+00CCPMANG(2)AGRIConping-management factor of Agricultural Area 21.0002+00CONVPRAC(2)AGR	AGRI	Soil erodibility factor of Agricultural Area 1	4.000E-01	4.000E-01		ERODIBILITY(1)
AGRIConservation practice factor of Agricultural Area 11.0002+001.0002+00CONVPRAC(1)AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01TPOF(1)AGRIAreal extent of Agricultural Area 2not used4.0002+03AREAO(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+000.0002+00FAREA_PLANT(2)AGRIEvapotranspiration coefficient in Agri. Area 25.0002-015.0002-01RUNOF(2)AGRIRunoff coefficient in Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 23.0002-013.0002-01RUNOF(2)AGRIWater filled porosity of soil in Agri. Area 21.1472-051.1472-05EROSN(2)AGRIComputed erosion rate of soil in Agri. Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.0002-014.0002-01RHOB(2)AGRISlope-length-steepness factor, Agricultural Area 23.0002-033.0002-03CONVPRAC(2)AGRICoroping-management factor of Agricultural Area 21.0002+001.0002+00CONVPRAC(2)AGRICoroping-management factor of Agricultural Area 21.0002+00CONVPRAC(2)AGRICoroping-managem	AGRI	Slope-length-steepness factor, Agricultural Area 1	4.000E-01	4.000E-01		SLPLENSTP(1)
AGRITotal porosity of soil in Agricultural Area 1not used4.0002-01TPOF(1)AGRIAreal extent of Agricultural Area 2(m**2)1.0002+031.0002+03ARZAO(2)AGRIFraction of Agri. Area 2directly over the c.z.0.0002+000.0002+00FARZA_PLANT(2)AGRIEvapotranspiration coefficient in Agricultural Area 25.0002-015.0002-01FARZA_PLANT(2)AGRIRunoff coefficient in Agricultural Area 22.0002-012.0002-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIMater filled porosity of soil in Agri. Area 23.0002-013.0002-01TMOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05RNOB(2)AGRISoil erodibility factor of Agricultural Area 21.0002-014.0002-01RNOB(2)AGRISlope-length-steepness factor, Agricultural Area 23.0002-033.0002-01SLPLENSTP(2)AGRICropping-management factor of Agricultural Area 23.0002-033.0002-03CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.0002+001.0002+00CRPMANG(2)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00CRPMANG(2)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00CRPMANG(2)	AGRI	Cropping-management factor of Agricultural Area 1	3.000E-03	3.000E-03		CRPMANG(1)
AGRI Areal extent of Agricultural Area 2 (m**2) 1.0002+03 1.0002+03 AREAO(2) AGRI Fraction of Agri. Area 2 directly over the c.z. 0.0002+00 0.0002+00 FAREA_PLANT(2) AGRI Evapotranspiration coefficient in Agri. Area 2 5.0002-01 5.0002-01 FAREA_PLANT(2) AGRI Runoff coefficient in Agricultural Area 2 2.0002-01 5.0002-01 FAREA_PLANT(2) AGRI Mixing depth/plow layer of Agricultural Area 2 1.5002-01 2.0002-01 RUNOF(2) AGRI Mixing depth/plow layer of Agricultural Area 2 1.5002-01 1.5002-01 PDTHMIXG(2) AGRI Computed erosion rate of soil in Agri. Area 2 1.1472-05 1.1472-05 RHOB(2) AGRI Dry Bulk Density of soil in Agricultural Area 2 1.5002+00 1.5002+00 RHOB(2) AGRI Solpe-length-steepness factor, Agricultural Area 2 1.0002+01 4.0002-01 SLPLENSTP(2) AGRI Cropping-management factor of Agricultural Area 2 3.0002-03 3.0002-03 SLPLENSTP(2) AGRI Corpping-management	AGRI	Conservation practice factor of Agricultural Area 1	1.000E+00	1.000E+00		CONVPRAC(1)
AGRIFraction of Agri. Area 2directly over the c.z.0.0002+000.0002+00FAR2A_PLANT(2)AGRIEvapotranspiration coefficient in Agri. Area 25.0002-015.0002-01FVAPTRN(2)AGRIRunoff coefficient in Agricultural Area 22.0002-012.0002-01FVAPTRN(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIMater filled porosity of soil in Agri. Area 23.0002-013.0002-01DPTHMIXG(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05EROSN(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.0002-014.0002-01RHOB(2)AGRISlope-length-steepness factor, Agricultural Area 23.0002-033.0002-01SLPLENSTP(2)AGRICompping-management factor of Agricultural Area 23.0002-033.0002-03CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.0002+001.0002+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00CONVPRAC(2)	AGRI	Total porosity of soil in Agricultural Area 1	not used	4.000E-01		TPOF(1)
AGRIEvapotranspiration coefficient in Agri. Area 25.0002-015.0002-01EVAPTRN(2)AGRIRunoff coefficient in Agricultural Area 22.0002-012.0002-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.5002-011.5002-01RUNOF(2)AGRIMater filled porosity of soil in Agri. Area 23.0002-013.0002-01RUNOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05RHOB(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.0002-014.0002-01RHOB(2)AGRISlope-length-steepness factor, Agricultural Area 23.0002-033.0002-03CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.0002+001.0002+00CRPMANG(2)AGRITotal porosity of soil in Agricultural Area 21.0002+001.0002+00CRPMANG(2)	AGRI	Areal extent of Agricultural Area 2 (m**2)	1.000E+03	1.000E+03		AREAO(2)
AGRIRunoff coefficient in Agricultural Area 22.000Z-012.000Z-01RUNOF(2)AGRIMixing depth/plow layer of Agricultural Area 21.500Z-011.500Z-01DPTRMIXG(2)AGRIMixing depth/plow layer of Agricultural Area 23.000Z-011.500Z-01DPTRMIXG(2)AGRIComputed erosion rate of soil in Agri. Area 21.147Z-051.147Z-05TMOF(2)AGRIDry Bulk Density of soil in Agricultural Area 21.500Z+001.500Z+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.000Z-014.000Z-01RHOB(2)AGRISlope-length-steepness factor, Agricultural Area 23.000Z-033.000Z-03SLPLENSTP(2)AGRICropping-management factor of Agricultural Area 21.000Z+001.000Z+00CRPMANG(2)AGRITotal porosity of soil in Agricultural Area 21.000Z+001.000Z+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 21.000Z+00TPOF(2)	AGRI	Fraction of Agri. Area 2 directly over the c.z.	0.0002+00	0.0002+00		FAREA_PLANT(2)
AGRIMixing depth/plow layer of Agricultural Area 21.500Z-011.500Z-01DPTHMIXG(2)AGRIWater filled porosity of soil in Agri. Area 23.000Z-013.000Z-01TMOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.147Z-051.147Z-05EROSN(2)AGRIDry Bulk Density of soil in Agricultural Area 21.500Z+011.500Z+00EROSN(2)AGRISoil erodibility factor of Agricultural Area 24.000Z-014.000Z-01ERODIBILITY(2)AGRISlope-length-steepness factor, Agricultural Area 24.000Z-014.000Z-01SLPLENSTP(2)AGRICropping-management factor of Agricultural Area 23.000Z-033.000Z+00CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.000Z+001.000Z+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 2not used4.000Z-01TPOF(2)	AGRI	Evapotranspiration coefficient in Agri. Area 2	5.000E-01	5.000E-01		EVAPTRN(2)
AGRIWater filled porosity of soil in Agri. Area 23.0002-013.0002-01TMOF(2)AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05EROSN(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.0002-014.0002-01RHOB(2)AGRISlope-length-steepness factor, Agricultural Area 24.0002-014.0002-01SLPLENSTP(2)AGRICropping-management factor of Agricultural Area 23.0002-033.0002-03CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.0002+001.0002+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 2not used4.0002-01TPOF(2)	AGRI	Runoff coefficient in Agricultural Area 2	2.000E-01	2.000E-01		RUNOF(2)
AGRIComputed erosion rate of soil in Agri. Area 21.1472-051.1472-05EROSN(2)AGRIDry Bulk Density of soil in Agricultural Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.0002-014.0002-01RHOB(2)AGRISlope-length-steepness factor, Agricultural Area 24.0002-014.0002-01SLPLENSTP(2)AGRICropping-management factor of Agricultural Area 23.0002-033.0002-03CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.0002+001.0002+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 2not used4.0002-01TPOF(2)	AGRI	Mixing depth/plow layer of Agricultural Area 2	1.500E-01	1.500E-01		DPTHMIXG(2)
AGRIDry Bulk Density of soil in Agricultural Area 21.5002+001.5002+00RHOB(2)AGRISoil erodibility factor of Agricultural Area 24.0002-014.0002-01ERODIBILITY(2)AGRISlope-length-steepness factor, Agricultural Area 24.0002-014.0002-01SLPLENSTP(2)AGRICropping-management factor of Agricultural Area 23.0002-033.0002-03CRPMANG(2)AGRIConservation practice factor of Agricultural Area 21.0002+001.0002+00CONVPRAC(2)AGRITotal porosity of soil in Agricultural Area 2not used4.0002-01TPOF(2)	AGRI	Water filled porosity of soil in Agri. Area 2	3.000E-01	3.000E-01		TMOF(2)
AGRI Soil erodibility factor of Agricultural Area 2 4.0002-01 4.0002-01 FRODIBILITY(2) AGRI Slope-length-steepness factor, Agricultural Area 2 4.0002-01 4.0002-01 SLPIENSTP(2) AGRI Cropping-management factor of Agricultural Area 2 3.0002-03 3.0002-03 CRPMANG(2) AGRI Conservation practice factor of Agricultural Area 2 1.0002+00 1.0002+00 CONVPRAC(2) AGRI Total porosity of soil in Agricultural Area 2 not used 4.0002-01 TPOF(2)	AGRI	Computed erosion rate of soil in Agri. Area 2	1.147E-05	1.147E-05		EROSN(2)
AGRI Slope-length-steepness factor, Agricultural Area 2 4.0002-01 4.0002-01 SLPLENSTP(2) AGRI Cropping-management factor of Agricultural Area 2 3.0002-03 3.0002-03 CRPMANG(2) AGRI Conservation practice factor of Agricultural Area 2 1.0002+00 1.0002+00 CCPMANG(2) AGRI Total porosity of soil in Agricultural Area 2 not used 4.0002-01 TPOF(2)	AGRI	Dry Bulk Density of soil in Agricultural Area 2	1.500E+00	1.500E+00		RHOB(2)
AGRI Cropping-management factor of Agricultural Area 2 3.000Z-03 3.000Z-03 CRPMANG(2) AGRI Conservation practice factor of Agricultural Area 2 1.000Z+00 1.000Z+00 CONVPRAC(2) AGRI Total porosity of soil in Agricultural Area 2 not used 4.000Z-01 TPOF(2)	AGRI	Soil erodibility factor of Agricultural Area 2	4.000E-01	4.000E-01		ERODIBILITY(2)
AGRI Conservation practice factor of Agricultural Area 2 1.0002+00 1.0002+00 CONVPRAC(2) AGRI Total porosity of soil in Agricultural Area 2 not used 4.0002-01 TPOF(2)	AGRI	Slope-length-steepness factor, Agricultural Area 2	4.000E-01	4.000E-01		SLPLENSTP(2)
AGRI Total porosity of soil in Agricultural Area 2 not used 4.000Z-01 TPOF(2)	AGRI	Cropping-management factor of Agricultural Area 2	3.000E-03	3.000E-03		CRPMANG(2)
	AGRI	Conservation practice factor of Agricultural Area 2	1.0002+00	1.0002+00		CONVPRAC(2)
AGRI Areal extent of Agricultural Area 3 (m**2) not used 1.0003+04 AREAO(3)	AGRI	Total porosity of soil in Agricultural Area 2	not used	4.000E-01		TPOF(2)
	AGRI	Areal extent of Agricultural Area 3 (m**2)	not used	1.0002+04		AREAO(3)

Livestock Fields not used:

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Title : RESRAD-OFFSITE Default	Parameters				
File : Site3.ROF					

Site-Specific Parameter Summary (continued)

fenu	Parameter	User Input	Default	RESRAD computed	Parameter Name
AGRI	Fraction of Agri. Area 3 directly over the c.z.	not used	0.0002+00		FAREA PLANT(3)
AGRI	Evapotranspiration coefficient in Agri. Area 3	not used	5.000 <u>-01</u>		EVAPTRN(3)
AGRI	Runoff coefficient in Agricultural Area 3	not used	2.000E-01		RUNOF (3)
AGRI	Mixing depth/plow layer of Agricultural Area 3	not used	1.500E-01		DPTHMIXG(3)
AGRI	Water filled porosity of soil in Agri. Area 3	not used	3.000E-01		TMOF (3)
AGRI	Computed erosion rate of soil in Agri. Area 3	not used	1.1472-05		EROSN(3)
AGRI	Dry Bulk Density of soil in Agricultural Area 3	not used	1.500E+00		RHOB (3)
AGRI	Soil erodibility factor of Agricultural Area 3	not used	4.000E-01		ERODIBILITY(3)
AGRI	Slope-length-steepness factor, Agricultural Area 3	not used	4.000E-01		SLPLENSTP(3)
AGRI	Cropping-management factor of Agricultural Area 3	not used	3.000E-03		CRPMANG (3)
AGRI	Conservation practice factor of Agricultural Area 3	not used	1.000E+00		CONVPRAC(3)
AGRI	Total porosity of soil in Agricultural Area 3	not used	4.000E-01		TPOF(3)
AGRI	Areal extent of Agricultural Area 4 (m**2)	not used	1.000E+04		AREAO(4)
AGRI	Fraction of Agri. Area 4 directly over the c.z.	not used	0.0002+00		FAREA_PLANT(4)
AGRI	Evapotranspiration coefficient in Agri. Area 4	not used	5.000E-01		EVAPTRN(4)
AGRI	Runoff coefficient in Agricultural Area 4	not used	2.000E-01		RUNOF (4)
AGRI	Mixing depth/plow layer of Agricultural Area 4	not used	1.500E-01		DPTHMIXG(4)
AGRI	Water filled porosity of soil in Agri. Area 4	not used	3.000E-01		TMOF(4)
AGRI	Computed erosion rate of soil in Agri. Area 4	not used	1.1472-05		EROSN(4)
AGRI	Dry Bulk Density of soil in Agricultural Area 4	not used	1.500 2 +00		RHOB(4)
AGRI	Soil erodibility factor of Agricultural Area 4	not used	4.000E-01		ERODIBILITY(4)
AGRI	Slope-length-steepness factor, Agricultural Area 4	not used	4.000E-01		SLPLENSTP(4)
AGRI	Cropping-management factor of Agricultural Area 4	not used	3.000E-03		CRPMANG (4)
AGRI	Conservation practice factor of Agricultural Area 4	not used	1.0002+00		CONVPRAC(4)
AGRI	Total porosity of soil in Agricultural Area 4	not used	4.000E-01		TPOF(4)
DWEL	Areal extent of Offsite dwelling site (m**2)	not used	1.0002+03		AREAODWELL
DWEL	Evapotranspiration coefficient in dwelling (Off)site	not used	5.000E-01		EVAPTRNDWELL
DWEL	Runoff coefficient in Offsite dwelling site	not used	2.000E-01		RUNOFDWELL
DWEL	Mixing depth of Offsite dwelling site	not used	1.5002-01		DPTHMIXCDWELL
DWEL	Water filled porosity of soil in Offsite Dwelling	not used	3.000E-01		TMOFDWELL
DWEL	Computed erosion rate of soil in Offsite Dwelling	not used	0.0002+00		EROSNDWELL
DWEL	Dry Bulk Density of soil in Offsite dwelling site	not used	1.5002+00		RHOBDWELL
DWEL	Soil erodibility factor of soil in Dwelling site	not used	0.0002+00		ERODIBILITYDWELL
DWEL	Slope-length-steepness factor of Dwelling site	not used	4.000E-01		SLPLENSTPDWELL
DWEL	Cropping-management factor of Dwelling site	not used	3.0002-03		CRPMANGDWELL
DWEL	Conservation practice factor of Offsite Dwelling sit	not used	1.0002+00		CONVPRACDWELL

Plant info used, livestock info not used:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01		DVI(2)
INGE	Fraction of vegetable 2 from affected area	5.000E-01	5.000E-01		FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01		DMI(1)
INGE	Fraction of meat lfrom affected area	not used	1.0002+00		FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01		DMI(2)
INGE	Fraction of milk from affected area	not used	1.0002+00		FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01		SOIL
					i
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01		YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01		GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01		FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	2.0002+01	2.000E+01		RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	2.500E-01	2.500E-01		FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	2.500E-01	2.500E-01		FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	1.2002+00	1.2002+00		DROOT (1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	1.5002+00	1.5002+00		YIELD(2)
VEGE	Growing Season for Leafy (years)	2.500E-01	2.500E-01		GROWTIME(2)
VEGE	Translocation Factor for Leafy	1.0002+00	1.0002+00		FOLI F(2)
VEGE	Weathering Removal Constant for Leafy	2.0002+01	2.0002+01		RWEATHER (2)
VEGE	Foliar Interception Fraction for dust Leafy	2.500E-01	2.500E-01		FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	2.500E-01	2.500E-01		FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	9.000E-01	9.000E-01		DROOT (2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00		YIELD(3)
VEGE	Growing Season for Pasture (years)	not used	8.000E-02		GROWTIME (3)
VEGE	Translocation Factor for Pasture	not used	1.000E+00		FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01		RWEATHER (3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01		FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01		FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01		DROOT (3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01		YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.700E-01		GROWTIME (4)
VEGE	Translocation Factor for Grain	not used	1.000E-01		FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01		RWEATHER (4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.500E-01		FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.500E-01		FINTCEPT(4,2)
VEGE	Depth of roots for Grain (m)	not used	1.200E+00		DROOT (4)
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External pathway parameters not sued:

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I		User	I	RESRAD	Parameter	
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SEXT	Shape factor array from offsite dwelling:				1	
SEXT	Radii of shape factor array (used if non-circular):					
SEXT	Outer annular radius (m), ring 13:	not used	1.3252+01		RAD SHAPE(13)	
SEXT	Outer annular radius (m), ring 14:	not used	2.650E+01		RAD SHAPE (14)	
SEXT	Outer annular radius (m), ring 15:	not used	3.9752+01		RAD SHAPE(15)	
SEXT	Outer annular radius (m), ring 16:	•	5.300E+01		RAD SHAPE (16)	
SEXT	Outer annular radius (m), ring 17:		6.6252+01		RAD SHAPE (17)	
EXT	Outer annular radius (m), ring 18:	•	7.950E+01		RAD SHAPE (18)	
EXT	Outer annular radius (m), ring 19:	•	9.275E+01		RAD SHAPE (19)	
EXT	Outer annular radius (m), ring 20:	not used	1.0602+02		RAD SHAPE (20)	
EXT	Outer annular radius (m), ring 21:		1.1922+02		RAD SHAPE (21)	
EXT	Outer annular radius (m), ring 22:	•	1.3252+02		RAD SHAPE (22)	
EXT	Outer annular radius (m), ring 23:	not used	1.4582+02		RAD SHAPE (23)	
EXT	Outer annular radius (m), ring 24:	not used	1.5902+02		RAD SHAPE (24)	
SEXT	Fractions of annular areas within AREA:					
SEXT	Ring 13	not used	0.0002+00		FRACA(13)	
SEXT	Ring 14	not used	0.0002+00		FRACA(14)	
SEXT	Ring 15	•	0.0002+00		FRACA(15)	
SEXT	Ring 16	not used	2.400E-02		FRACA(16)	
SEXT	Ring 17	•	1.900E-01		FRACA(17)	
SEXT	Ring 18	not used	2.400E-01		FRACA(18)	
SEXT	Ring 19	not used	2.000E-01	i	FRACA(19)	
SEXT	Ring 20	not used	1.700E-01	i	FRACA (20)	
SEXT	Ring 21	not used	1.5002-01	i	FRACA(21)	
SEXT	Ring 22	not used	1.300E-01	i	FRACA (22)	
SEXT	Ring 23	not used	1.200E-01	i	FRACA (23)	
SEXT	Ring 24	not used	5.200E-02		FRACA (24)	
SEXT	Shape factor array from offsite area 1:	i	i	i	i	
SEXT	Radii of shape factor array (used if non-circular):		i i	i	i	
SEXT	Outer annular radius (m), ring 25:	not used	1.500E+02		RAD_SHAPE(25)	
SEXT	Outer annular radius (m), ring 26:	not used	1.5812+02	i	RAD_SHAPE(26)	
SEXT	Outer annular radius (m), ring 27:	not used	1.683E+02	i	RAD_SHAPE(27)	
SEXT	Outer annular radius (m), ring 28:	not used	1.785E+02	i	RAD_SHAPE(28)	
SEXT	Outer annular radius (m), ring 29:	not used	1.887E+02	i	RAD_SHAPE(29)	
SEXT	Outer annular radius (m), ring 30:	not used	1.990E+02	i	RAD_SHAPE(30)	
SEXT	Outer annular radius (m), ring 31:	not used	2.0922+02	i	RAD_SHAPE(31)	
SEXT	Outer annular radius (m), ring 32:	not used	2.194E+02	·	RAD SHAPE (32)	

c-14 and H-3 not used

Summary of athway selections is correct:

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Site-Specific Parameter Summary (continued)

ienu	Parameter	User Input	Default	RESR comput
:14	C-12 evasion flux rate from soil (1/sec)	not used	1.0002-10	
214	Fraction of vegetation carbon from air	not used	9.800E-01	
214	Fraction of vegetation carbon from soil	not used	2.000E-02	
1		Í		
212	C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01	
212	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	
212	C-12 concentration in water (g/cm**3)	not used	2.000E-05	
212	C-12 concentration in meat 1 (g/g)	not used	2.400E-01	
212	C-12 concentration in milk (g/g)	not used	7.000E-02	
212	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01	
212	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02	
212	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02	
212	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01	
I		1		
13	Humidity in air (g/cm**3)	not used	8.000E+00	
13	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01	
13	Mass fraction of water in milk (g/g)	not used	8.800E-01	
13	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01	
13	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01	
13	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01	
13	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01	

Summary of Pathway Selections

Pathway	User Selection
<pre>1 external gamma 2 inhalation (w/o radon) 3 plant ingestion 4 meat ingestion 5 milk ingestion 6 aquatic foods 7 drinking water 8 soil ingestion 9 radon</pre>	suppressed suppressed active suppressed suppressed suppressed suppressed suppressed suppressed

Now look at Meat Pathway only

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BBI BDadrade	Meat Ingestion	Initial Concentrations		
		Nuclide Specific Release		and a
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Change Title	Dinking Water	Reporting Times	Instal Concentrations Nuclide Concentration: Lit of Nuclides Present at the Site	
Set Pathways	Soil Ingestion	Storage Times	Nuclide Concentration: List of Nuclides Present at the Site Co=60 100	a
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		Physical and Hydrological		-
Run	Close	Primary Contamination Sediment Delivery Ratio	Radionuclide Co-60 🚔	2
View Output	These	Agricultural Areas	Distribution Location coefficient	
		Livestock Feed Areas	Location coefficient [cm ³ /g]	
Quit		Dwelling Site	Epotaminated medium: 1000	1000
		Atmospheric Transport	Contaminated zone: 1000	1000
		Water Use	Unselurated zone 1: 1000	
		Unsaturated Zones	Frug, grain, nonleady heids	1000
		Saturated Zone		1000
		Groundwater Transport		1000
		Surface Water Body	Livestock feed grain fields	1000
		Ingestion Rates	Dwelling site	1000
		Plant Factors	Saturated zone: 1000	1000
		Livestock Intakes	Number of unsaturated zones:	
		Livestock Feed Factors	sec in preniminary inputs tonis	
		Inhalation, Gamma	Save	
		Shape Factors		
		Occupancy	Cancel	
		Ration		

Plant areas not used:

Agricultural Areas		
Сгорз	Fruit, grain, non-leafy	Leafy vegetables
<u>Area (square meters):</u>	1000	1000
<u>Fraction of area directly over primary contamination:</u>	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
<u>R</u> unoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Ero <u>s</u> ion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>p</u> orosity	.4	.4
Sediment from primary contamination delivery ratio	<u> </u>	0
Save Cancel		

Both Livestock areas used:

Livestock Feed Growing Areas		
Сгорз	Pasture, silage	Grain
<u>Area (square meters):</u>	10000	10000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil <u>m</u> ixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Ero <u>si</u> on rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>p</u> orosity	.4	.4
Sediment from primary contamination delivery ratio	0	0

Only Beef cattle need water to drink:

			Fraction o	of water from	Number of individuals to
Description of water usage	Quantity		Surface body	v Well	compute well water needs
Consumption per person	510	Liters/year	0	1	neeus
Use indoors of dwelling per person	225	Liters/day	0	1	4
Beef cattle per animal	50	Liters/day	0	1	2
Dairy cows per animal	160	Liters/day	0	1	2
Irrigation applied to:		•			Area of Plot [square meters]
Fruit, grain, non-leafy vegetables	.2	m per year	0	1	1000
Leafy vegetables	.2	m per year	0	1	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.2	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000
Well pumping rate:		-	i 100 ci	ubic meters/ye	ar
Well pumping rate needed to support	t specified wa	ter use: 4	.001 CI	ubic meters/ye	ar
		Save	_		
-		Canaal			
		Cancel			

on 4.0	Show Sub		
Livestock Feed Factors	Horizon	tallu	
Crops		Pasture, silage	Grain
Wet weight crop yield (kg/m²)		1.1	.7
Duration of growing season (years)		.08	.17
Foliage to food transfer coefficient		1	.1
Weathering removal constant (1/year)		20	20
Foliar interception factor for irrigation		.25	.25
Foliar interception factor for <u>d</u> ust		.25	.25
<u>R</u> oot depth (meters)		.9	1.2
	Cancel		
	Cancel		
	Livestock re Dwelling		Dairy co w s
	Livestock re Dwelling	Site eef cattle	Dairy co w s 160
t Livestock Intakes <u>W</u> ater (liters/day) Past <u>u</u> re, and silage (kg/day)	Livestock re Dwelling B	site eef cattle	
Livestock Intakes <u>W</u> ater (liters/day) Past <u>u</u> re, and silage (kg/day) <u>G</u> rain (kg/day)	Livestock re Dwelling B	Site eef cattle	160
Livestock Intakes <u>W</u> ater (liters/day) Past <u>u</u> re, and silage (kg/day) <u>G</u> rain (kg/day) <u>S</u> oil from pasture and silage (kg/day)	Dwelling B 14 54 14	Site eef cattle	160 44
Livestock Intakes <u>W</u> ater (liters/day) Past <u>u</u> re, and silage (kg/day) <u>G</u> rain (kg/day)	Dwelling Dwelling 5(14 54	Site eef cattle	160 44 11
it Livestock Intakes <u>W</u> ater (liters/day) Past <u>u</u> re, and silage (kg/day) <u>G</u> rain (kg/day) <u>S</u> oil from pasture and silage (kg/day)	Dwelling Dwelling 14 54 .1 .4	Site eef cattle	160 44 11 .4
t Livestock Intakes <u>W</u> ater (liters/day) Past <u>u</u> re, and silage (kg/day) <u>G</u> rain (kg/day) <u>S</u> oil from pasture and silage (kg/day) Soi <u>l</u> from grain (kg/day) Sar	Dwelling Dwelling 14 54 .1 .4	Site	160 44 11 .4

Both fields used but only Beef cattle eat:

Inhalation and external gamma not used:

Inhalation and External Gamma						
Inhalation rate:	8400 m³/year					
<u>Mass loading of all particulates above primary contamination:</u>	<mark>.0001</mark> grams/m³					
Respirable particulates as a fraction of total particulates:	1					
Massloading and respirable fraction at offsite locations • Use same values as for primary contamination						
 O Input different values 						
Indoor to outdoor <u>d</u> ust concentration ratio:	.4					
E <u>x</u> ternal gamma penetration factor:	.7					
Shape of Primary Contamination						
Occupancy <u>Factors</u>						
Save Cancel						

Ran the case

Ag areas 1&2 not used but 3&4 for livestock are used:

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		User		RESRAD	Parameter
lenu	Parameter	Input	Default	computed	Name
STI	Exposure duration for risk	3.0002+01	3.0002+01		ZD
STI	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01		BRDL
ELT	lst release time (years)	0.0002+00			RelTime(1)
NC	Initial concentration of Co-60 (pCi/g)	1.0002+02	0.0002+00		S1(1)
DEP	Deposition velocity of Co-60 on total particulates	1.000E-03	1.0002-03		DEPVEL(1)
DEP	Dep. velocity of Co-60 on respirable particulates	1.0002-03	1.0002-03		DEPVELT(1)
CLR	Distribution coefficients for Co-60				
CLR	Contaminated zone (cm**3/g)	1.0002+03	1.0002+03		DCNUCC(1)
CLR	Unsaturated zone 1 (cm**3/g)	1.0002+03	1.000E+03		DCNUCU(1,1)
LR	Saturated zone (cm**3/g)	1.0002+03	1.0002+03		DCNUCS(1)
LR	Bottom sediment in surface water body (cm**3/g)	1.0002+03	1.000E+03		DCNUCSWB(1)
CLR	Suspended sediment in surface water body (cm ^{3/g})		1.0002+03		DCNUCSWS(1)
CLR	Agricultural area 1 (cm**3/g)	not used	1.000E+03		DCNUCOF(1,1
CLR	Agricultural area 2 (cm**3/g)	not used	1.0002+03		DCNUCOF(1,2
LR					
CLR	Agricultural area 3 (cm**3/g)	1.0002+03	1.0002+03		DCNUCOF(1,3
	Agricultural area 4 (cm**3/g)	1.0002+03	1.0002+03		DCNUCOF(1,4
CLR	Offsite Dwelling (cm**3/g)	not used	1.0002+03		DCNUCDWE(1)
LR	Leach rate constant of Co-60 (/yr)	0.0002+00	0.0002+00	1.6662-04	Rleach(1,1)
OT	Bearing of X axis (clockwise angle N>X in degrees)		9.0002+01		DNXBEARING
YOT	Length of Primary contamination in X Direction	1.0002+02	1.0002+02		SOURCEXY(1)
TOT	Length of Primary contamination in Y Direction	1.0002+02	1.0002+02		SOURCEXY(2)
YOT	Smaller X coordinate of Agricultural Area 1	not used	3.438E+01		AGRIXY(1,1)
TOT	Larger X coordinate of Agricultural Area 1	not used	6.5622+01		AGRIXY(2,1)
YOT	Smaller Y coordinate of Agricultural Area 1	not used	2.340E+02		AGRIXY(3,1)
YOT	Larger Y coordinate of Agricultural Area 1	not used	2.6602+02		AGRIXY(4,1)
YOT	Smaller X coordinate of Agricultural Area 2	not used	3.438E+01		AGRIXY(1,2)
TOT	Larger X coordinate of Agricultural Area 2	not used	6.5622+01		AGRIXY(2,2)
YOT	Smaller Y coordinate of Agricultural Area 2	not used	2.6802+02		AGRIXY(3,2)
TOT	Larger Y coordinate of Agricultural Area 2	not used	3.000E+02		AGRIXY(4,2)
TOT	Smaller X coordinate of Agricultural Area 3	0.0002+00	0.0002+00		AGRIXY(1,3)
TOT	Larger X coordinate of Agricultural Area 3	1.0002+02	1.000E+02		AGRIXY(2,3)
TOT	Smaller Y coordinate of Agricultural Area 3	4.5002+02	4.500E+02		AGRIXY(3,3)
YOT	Larger Y coordinate of Agricultural Area 3	5.500E+02	5.500E+02		AGRIXY(4.3)
YOT	Smaller X coordinate of Agricultural Area 4	0.0002+00	0.0002+00		AGRIXY(1.4)
YOT	Larger X coordinate of Agricultural Area 4	1.0002+02	1.0002+02		AGRIXY(2,4)
YOT	Smaller Y coordinate of Agricultural Area 4	3.0002+02	3.0002+02		AGRIXY(3,4)
YOT	Larger Y coordinate of Agricultural Area 4	4.000E+02	4.000E+02		AGRIXY(4,4)
YOT	Smaller X coordinate of Dwelling Area	not used	3.438E+01		DWELLXY(1)

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	-OFFSITE, Version 4.0 TH Limit = 30 days	02/13/20	20 11:01 Pa	age 27			
	Dose Report						
	: RESRAD-OFFSITE Default Parameters						
File	: Site3.ROF						
	Site-Specific Par	ameter Summa:	ry (continue)	i)			
Menu	P	User	Default	RESRAD	Parameter Name		
menu	Parameter	Input	Derault	computed	Name		
INGE	Leafy vegetable consumption (kg/vr)	not used	1.4002+01		DVI(2)	-	
INGE	Fraction of vegetable 2 from affected area	not used	5.0002-01		FVEG(2)		
INGE	Meat 1 consumption (kg/yr)	6.300E+01	6.3002+01		DMI(1)		
INGE	Fraction of meat lfrom affected area	1.0002+00	1.0002+00		FMEMI(1)		
INGE	Milk consumption (L/yr)	not used	9.200E+01		DMI(2)		
INGE	Fraction of milk from affected area	not used	1.0002+00		FMEMI(2)		
INGE	Soil ingestion rate (g/yr)	not used	3.6502+01		SOIL		
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.0002-01		YIELD(1)		
VEGE	Growing Season for Non-Leafy (years)	not used	1.7002-01		GROWTIME(1)		
VEGE	Translocation Factor for Non-Leafy	not used	1.0002-01		FOLI_F(1)		
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01		RWEATHER(1)		
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01		FINTCEPT(1,1)		
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01		FINTCEPT(1,2)		
VEGE	Depth of roots for Non-Leafy (m)	not used	1.2002+00		DROOT(1)		
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.5002+00		YIELD(2)		
VEGE	, (],	not used	2.500E-01		GROWTIME(2)		
VEGE	Translocation Factor for Leafy	not used	1.000E+00		FOLI_F(2)		
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01		RWEATHER(2)		
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.5002-01		FINTCEPT(2,1)		
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.5002-01		FINTCEPT(2,2)		
VEGE	Depth of roots for Leafy (m)	not used	9.0002-01		DROOT (2)		
VEGE	Wet weight crop yield for Pasture (kg/m**2)	1.1002+00	1.1002+00		YIELD(3)		
	Growing Season for Pasture (years)	8.000E-02	8.0002-02		GROWTIME(3)		
VEGE	Translocation Factor for Pasture Weathering Removal Constant for Pasture	2.0002+00	1.000E+00 2.000E+01		FOLI_F(3) RWEATHER(3)		
VEGE		2.5002+01	2.5002+01				
VEGE	Foliar Interception Fraction for dust Pasture Foliar Intercept-n Fract-n for irrigation Pasture	2.5002-01	2.5002-01		FINTCEPT(3,1) FINTCEPT(3,2)		
VEGE	Depth of roots for Pasture (m)		9.000E-01		DROOT (3)		
VEGE	Wet weight crop yield for Grain (kg/m**2)	7.000E-01	7.000E-01		YIELD(4)		
VEGE	Wet weight crop yield for Grain (rg/m ^{**} 2) Growing Season for Grain (vears)		1.700E-01		GROWTIME (4)		
VEGE	Translocation Factor for Grain		1.0002-01		FOLI F(4)		
VEGE	Weathering Removal Constant for Grain		2.0002+01		RWEATHER(4)		
VEGE	Foliar Interception Fraction for dust Grain	2.5002-01	2.5002-01		FINTCEPT(4,1)		
VEGE			2.5002-01		FINTCEPT(4,2)		
	Torrar inscreeps a flact a for firigation drain	2.0002 01	2.0002 01		(4,2)		

Inhalation not used:

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Site-Specific Parameter Summary (continued)

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		User		RESRAD	Parameter
Menu	Parameter	Input	Default	computed	Name
INHE	Inhalation rate (m**3/vr)	not used	8.4002+03		INHALR
	Mass loading of all particulates from Primary contam		1.0002-04		MLFD
INHE	Respirable particulates as a fraction of total	not used	1.0002+00		RESPERACEC
INHE		not used	1.0002400		SAMEMLRF
	Total mass loading at agricultural area 1 (g/m**3)	not used	1.0002-04		MLTOTOF (1)
INHE		not used	1.0002+00		RESPERACOF(1)
INHE		not used	1.0002-04		MLTOTOF (2)
INHE		not used	1.0002+00		RESPERACOF(2)
INHE		not used	1.0002-04		MLTOTOF (3)
INHE		not used	1.0002+00		RESPERACOF (3)
INHE	Total mass loading at agricultural area 4 (g/m**3)	not used	1.0002-04		MLTOTOF (4)
INHE	Respirable fraction at agricultural area 4	not used	1.0002-04		RESPERACOF (4)
INHE	Total mass loading at offsite dwelling(g/m**3)	not used	1.0002-04		MLTOTDWELL
INHE	Respirable fraction at offsite dwelling(g/m * 3)	not used	1.0002+00		RESPERACOWELL
INHE	Indoor dust filtration factor, inhalation	not used	4.0002-01		SHF3
INHE	Shielding factor, external gamma	not used	7.0002-01		SHF1
INHE	Shape factor flag, external gamma	not used		noncircular	
SEXT	Onsite shape factor array (used if non-circular):	nov uscu	1.0001.000	noncer curver	
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 1:	not used	6.0002+00		RAD SHAPE (1)
SEXT	Outer annular radius (m), ring 2:	not used	1.2002+01		RAD SHAPE (2)
SEXT	Outer annular radius (m), ring 3:	not used	1.8002+01		RAD SHAPE (3)
SEXT	Outer annular radius (m), ring 4:	not used	2.4002+01		RAD SHAPE(4)
SEXT	Outer annular radius (m), ring 5:	not used	3.0002+01		RAD SHAPE(5)
SEXT	Outer annular radius (m), ring 6:	not used	3.6002+01		RAD SHAPE(6)
SEXT		not used	4.200E+01		RAD SHAPE (7)
SEXT		not used	4.8002+01		RAD SHAPE (8)
SEXT		not used	5.400E+01		RAD SHAPE (9)
SEXT		not used	6.000E+01		RAD SHAPE(10)
SEXT	Outer annular radius (m), ring 10:	not used	6.600E+01		RAD_SHAPE(11)
SEXT	Outer annular radius (m), ring 11:	not used	7.2002+01		RAD_SHAPE(12)
SEXT	Fractions of annular areas within AREA:	uocu			
SEXT	Ring 1	not used	1.0002+00		FRACA(1)
SEXT	Ring 2	not used	1.0002+00		FRACA (2)
		and abed			

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Parent Title	D-OFFSITZ, Version 4.0 T+ Limit = 30 days t Dose Report : RISRAD-OFFSITZ Default Parameters : Site3.ROF Site-Specific Para		20 11:01 P	-			
	Site-specific Para	meter Summa.	ry (continue)	1)			
Menu	Parameter	User Input	Default	RESRAD	Parameter Name		
		-		-		-	
	Shape factor array from offsite dwelling:						
EXT							
EXT			1.3252+01 2.6502+01		RAD_SHAPE(13) RAD_SHAPE(14)		
EXT			2.650±+01 3.975±+01		RAD_SHAPE(14)		
EXT			5.300E+01				
EXT I			6.6252+01		RAD_SHAPE(16) RAD_SHAPE(17)		
EXT I							
EXT			7.9502+01 9.2752+01		RAD_SHAPE(18) RAD_SHAPE(19)		
EXT			1.0602+02	•	RAD_SHAPE(19)		
EXT			1.1922+02		RAD_SHAPE(20)		
EXT			1.3252+02		RAD_SHAPE(21)		
EXT			1.4582+02		RAD_SHAPE(22)		
EXT			1.5903+02		RAD_SHAPE(23)		
	Fractions of annular areas within AREA:	not used	1.0002102		KHD_SHAF2(24)		
EXT		not used	0.0002+00		FRACA(13)		
EXT			0.0002+00		FRACA(14)		
EXT	Ring 15		0.0002+00		FRACA (15)		
EXT			2.4002-02		FRACA (16)		
EXT			1.9002-01		FRACA(17)		
EXT			2.4002-01		FRACA(18)		
EXT			2.0002-01		FRACA(19)		
EXT			1.7002-01		FRACA (20)		
EXT			1.5002-01		FRACA (21)		
EXT			1.3002-01		FRACA (22)		
EXT		not used	1.2002-01		FRACA (23)		
EXT			5.200E-02		FRACA (24)		
EXT	Shape factor array from offsite area 1:		i	i	i a a		
EXT	Radii of shape factor array (used if non-circular):		i	i	i		
EXT	Outer annular radius (m), ring 25:	not used	1.5002+02		RAD_SHAPE(25)		
EXT	Outer annular radius (m), ring 26:	not used	1.5812+02		RAD_SHAPE(26)		
SEXT	Outer annular radius (m), ring 27:	not used	1.6832+02		RAD SHAPE (27)		
SEXT			1.7852+02		RAD SHAPE (28)		
	Outer annular radius (m), ring 29:	not used	1.8872+02		RAD SHAPE (29)		

C-14 and H-3 not used

Summary Pathway selection is correct:

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Site-Specific Parameter Summary (continued)

Parameter	User Input	Default	RESRAD computed	Parameter Name
C-12 evasion flux rate from soil (1/sec)	not used	1.0002-10		C12EVSN
Fraction of vegetation carbon from air	not used	9.800E-01		CAIR
Fraction of vegetation carbon from soil	not used	2.000E-02		CSOIL
C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01		C12AIR
C-12 concentration in contaminated soil (g/g)	not used	3.000E-02		C12CZ
C-12 concentration in water (g/cm**3)	not used	2.000E-05		C12WTR
C-12 concentration in meat 1 (g/g)	not used	2.400E-01		C12MEAT_MILK(1)
C-12 concentration in milk (g/g)	not used	7.000E-02		C12MEAT_MILK(2)
C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01		C12PLANT(1)
C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02		C12PLANT(2)
C-12 concentration in livestock feed 1 (q/q)	not used	9.000E-02		C12PLANT(3)
C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01		C12PLANT(4)
Humidity in air (g/cm**3)	not used	8.000E+00		HUMID
Mass fraction of water in meat 1 (g/g)	not used	6.000E-01		H2OMEAT_MILK(1)
Mass fraction of water in milk (g/g)	not used	8.800E-01		H2OMEAT_MILK(2)
Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01		H2OPLANT (1)
Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01		H2OPLANT (2)
Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01		H2OPLANT (3)
Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01		H2OPLANT (4)
	C-12 evasion flux rate from soil (1/sec) Fraction of vegetation carbon from air Fraction of vegetation carbon from soil C-12 concentration in the atmosphere (g/m**3) C-12 concentration in water (g/cm**3) C-12 concentration in meat 1 (g/g) C-12 concentration in milk (g/g) C-12 concentration in wigetable 1 (g/g) C-12 concentration in livestock feed 1 (g/g) C-12 concentration in livestock feed 2 (g/g) Humidity in air (g/cm**3) Mass fraction of water in meat 1 (g/g) Mass fraction of water in wegetable 2 (g/g) Mass fraction of water in vegetable 1 (g/g) Mass fraction of water in vegetable 2 (g/g) Mass fraction of water in vegetable 2 (g/g) Mass fraction of water in vegetable 1 (g/g) Mass fraction of water in vegetable 2 (g/g)	C-12evasionfunctionC-12evasion flux rate from soil (1/sec)not usedFraction of vegetation carbon from airnot usedFraction of vegetation carbon from soilnot usedC-12concentration in the atmosphere (g/m**3)not usedC-12concentration in water (g/cm**3)not usedC-12concentration in water (g/g)not usedC-12concentration in math (g/g)not usedC-12concentration in milk (g/g)not usedC-12concentration in wegetable 2 (g/g)not usedC-12concentration in livestock feed 1 (g/g)not usedC-12concentration in livestock feed 2 (g/g)not usedC-12concentration in milk (g/g)not usedC-12concentration in livestock feed 1 (g/g)not usedC-12concentration in milk (g/g)not usedMass fraction of water in math 1 (g/g)not usedMass fraction of water in vegetable 1 (g/g)not usedMass fraction of water in wegetable 2 (g/g)not usedMass fraction of water in vegetable 2 (g/g)not usedMass fraction of water in vegetable 2 (g/g)not usedMass fraction of water in livestock feed 1 (g/g)not used	C-12 evasion flux rate from soil (1/sec)not used1.0002-10Fraction of vegetation carbon from airnot used $9.8002-01$ Fraction of vegetation carbon from soilnot used $2.0002-02$ C-12 concentration in the atmosphere (g/m**3)not used $1.8002-01$ C-12 concentration in contaminated soil (g/g)not used $2.0002-02$ C-12 concentration in water (g/cm**3)not used $2.0002-05$ C-12 concentration in math (g/g)not used $2.0002-05$ C-12 concentration in milk (g/g)not used $2.0002-05$ C-12 concentration in water (g/cm**3)not used $7.0002-02$ C-12 concentration in wegetable 1 (g/g)not used $7.0002-02$ C-12 concentration in livestock feed 1 (g/g)not used $9.0002-02$ C-12 concentration in livestock feed 2 (g/g)not used $8.0002-01$ Humidity in air (g/cm**3)not used $8.0002-01$ Mass fraction of water in milk (g/g)not used $8.0002-01$ Mass fraction of water in vegetable 1 (g/g)not used $8.0002-01$ Mass fraction of water in vegetable 2 (g/g)not used $8.0002-01$ Mass fraction of water in milk (g/g)not used $8.0002-01$ Mass fraction of water in model 2 (g/g)not used $8.0002-01$ Mass fraction of water in livestock feed 1 (g/g)not used $8.0002-01$	C-12 evasion flux rate from soil (1/sec)not used1.000Z-10Fraction of vegetation carbon from airnot used $1.000Z-10$ Fraction of vegetation carbon from soilnot used $2.000Z-02$ C-12 concentration in the atmosphere (q/m**3)not used $1.800Z-01$ C-12 concentration in contaminated soil (g/g)not used $3.000Z-02$ C-12 concentration in water (g/cm**3)not used $2.000Z-05$ C-12 concentration in math (g/g)not used $2.000Z-05$ C-12 concentration in milk (g/g)not used $7.000Z-02$ C-12 concentration in vegetable 1 (g/g)not used $7.000Z-02$ C-12 concentration in livestock feed 1 (g/g)not used $9.000Z-02$ C-12 concentration in livestock feed 1 (g/g)not used $9.000Z-02$ C-12 concentration in math (g/g)not used $9.000Z-02$ C-12 concentration in livestock feed 2 (g/g)not used $9.000Z-02$ C-12 concentration in livestock feed 2 (g/g)not used $8.000Z-01$ Humidity in air (g/cm**3)not used $8.000Z-01$ Mass fraction of water in wegetable 1 (g/g)not used $8.000Z-01$ Mass fraction of water in vegetable 2 (g/g)not used $8.000Z-01$ Mass fraction of water in vegetable 2 (g/g)not used $8.000Z-01$ Mass fraction of water in livestock feed 1 (g/g)not used $8.000Z-01$

Summary of Pathway Selections

Pathway	User Selection
l external gamma	suppressed
2 inhalation (w/o radon)	suppressed
3 plant ingestion	suppressed
4 meat ingestion	active
5 milk ingestion	suppressed
6 aquatic foods	suppressed
7 drinking water	suppressed
8 soil ingestion	suppressed
9 radon	suppressed

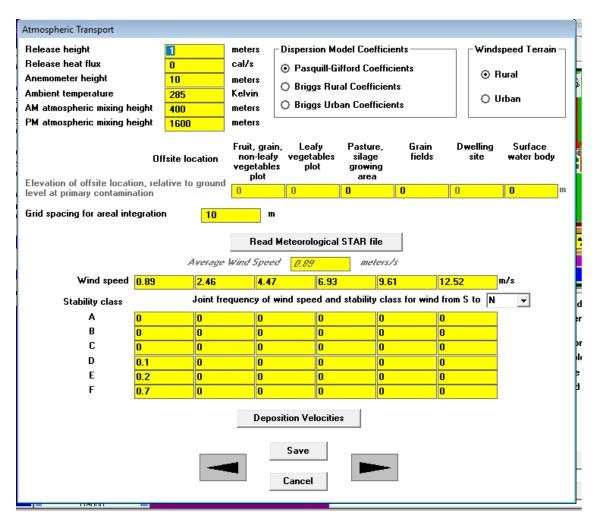
Now look at Milk Pathway only

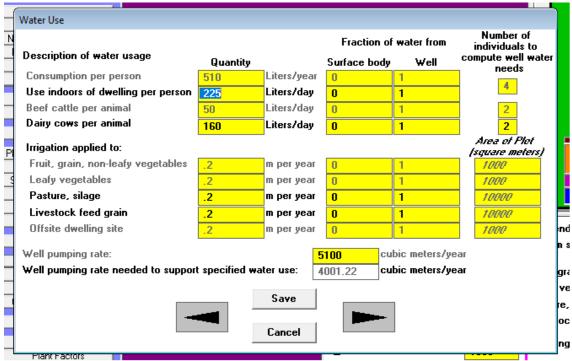
RESRAD - OFFSITE Site3.ROF (Modified)				– ø ×
File Pathways Site Data View Form Option				
RESRAD- Set Pathways	Modify Data		ľ	Iconic Navigator
OFFSITE	Hide Subforms			Problem Inputs Results Help
Version 40	Show Subforms Horizontally			a raumays
	Preliminary Inputs			C-14 H-3 (2) (2)
Plant Ingestion	Release Times			
Meat Ingestion	Initial Concentrations Nuclide Specific Release			
File Milk Ingestion	Distribution Coefficients	Occupancy	oncentrations	
Aquatic Foods	Deposition Velocities Transfer Factors	Fraction of time spent on primary contamination	le Concentration:	
Change Title Drinking Water	Reporting Times	Outdoors 0	Nuclides Present Site	
Set Pathways Soil Ingestion	Storage Times	Fraction of time spent in offsite dwelling site	50 100	
Modify Data	Site Layout	Indoors .5		
Bun	Physical and Hydrological Primary Contamination	Outdoors .1	o-60 ÷	
View Output	Sediment Delivery Ratio Agricultural Areas	Fraction of time spent in farmed lands	Distribution	
	Livestock Feed Areas	Fruit, grain, and nonleafy fields	coefficient (cm ³ /g)	
Quit	Dwelling Site	Pasture and silage fields		Suspended sediment in surface water body 1000
	Atmospheric Transport	Livestock grain fields .1	1000	Bottom sediment in surface water body 1000
	Water Use Unsaturated Zones	Save	1000	Fruit, grain, nonleafy fields 1000
	Saturated Zone Groundwater Transport	Bun		Leafy vegetable fields 1000
	Surface Water Body	Cancel		Pasture, silage growing areas 1000 Livestock feed grain fields 1000
	Ingestion Rates			Dwelling site
	Plant Factors	S <u>a</u> turated zone:	1000	
	Livestock Intakes Livestock Feed Factors	Number of unsatu set in preliminary		
	Inhalation, Gamma			Save
	Shape Factors Occupancy			Canad
	Badon	#1		Cancel

Only livestock feed fields are used:

Site Layout Bearing of X axis (clockwise angle from X dimension of primary contamination Y dimension of primary contamination		90 100 100	degrees meters meters		
	Smaller	Larger	Smaller	Larger	
Location	X Coo			ordinate	_
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters
Leafy vegetables plot	34.375	65.625	268	300	meters
Pasture, silage growing area	0	100	450	550	meters
Grain fields	0	100	300	400	meters
Dwelling site	34.375	65.625	134	166	meters
Surface water body	-100	200	550	850	meters
		y Map ive ncel			

Agricultural Areas	F 22 - 2	
Crops	Fruit, grain, non-leafy	Leafy vegetables
<u>Area (square meters):</u>	1000	1000
Fraction of area directly over primary contamination:	0	0
rrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil <u>m</u> ixing layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
Ero <u>si</u> on rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>p</u> orosity	.4	.4
Sediment from primary contamination delivery ratio		0
	unboy of uncot	urstad samaa
Livestock Feed Growing Areas		
Livestock Feed Growing Areas	Pasture, silage	Grain
Livestock Feed Growing Areas Crops	Pasture, silage 10000	
s Livestock Feed Growing Areas Crops <u>Area (square meters):</u> Eraction of area directly over primary contamination	Pasture, silage 10000	Grain
s Livestock Feed Growing Areas Crops <i>Area (square meters):</i> <u>F</u> raction of area directly over primary contamination Irrigation (m) applied per year:	Pasture, silage 10000 : 0 .2	Grain 10000 0 .2
Eraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient:	Pasture, silage 10000 : 0 .2 .5	Grain <u>10000</u> 0
s tivestock Feed Growing Areas tivestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient:	Pasture, silage 10000 .2 .5 .2 .2	Grain 10000 0 .2 .5 .2 .2
s Livestock Feed Growing Areas crops <i>Area (square meters):</i> Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters):	Pasture, silage 10000 .2 .2 .5 .2 .2 .15	Grain 10000 0 .2 .5 .2 .15
Livestock Feed Growing Areas Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Bunoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content:	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3	Grain 10000 0 .2 .5 .2 .15 .3
Livestock Feed Growing Areas Livestock Feed Growing Areas Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Bunoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: Erosion rate (meters/year):	Pasture, silage 10000 .2 .5 .5 .2 .15 .3 1.147E-5	Grain 10000 0 .2 .5 .2 .15 .3 1.147E-5
Livestock Feed Growing Areas Livestock Feed Growing Areas Livestock Feed Growing Areas Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Evapotranspiration coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: Erosion rate (meters/pear): Dry bulk density of soil (grams/cm³):	Pasture, silage 10000 .2 .5 .2 .15 .3 1.147E-5 1.5	Grain 10000 0 .2 .5 .2 .15 .3 1.147E-5 1.5
Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: <i>Eroxion rate (meters/pear)</i> : Dry bulk density of soil (grams/cm ³): Soil erodibility factor (tons/acre):	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3 1.147E-5 1.5 .4	Grain 10000 0 .2 .5 .2 .15 .3 1.147E-5 1.5 .4
Livestock Feed Growing Areas Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: <i>Erosion rate (meters/year)</i> : Dry bulk density of soil (grams/cm³): Soil erodibility factor (tons/acre): Slope-length-steepness factor:	Pasture, silage 10000 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4	Grain
Livestock Feed Growing Areas Livestock Feed Growing Areas <i>Area (square meters):</i> Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: <i>Erossion rate (meters/sear):</i> Dry bulk density of soil (grams/cm ³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor:	Pasture, silage 10000 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4 .4 .003	Grain 10000 0 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4 .4 .003
Livestock Feed Growing Areas Livestock Feed Growing Areas <i>Area (square meters):</i> Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: <i>Erosion rate (meters/year):</i> Dry bulk density of soil (grams/cm³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor:	Pasture, silage 10000 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4 .003 1	Grain 10000 0 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4 .003 1
Livestock Feed Growing Areas Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: <i>Erosion rate (meters/year):</i> Dry bulk density of soil (grams/cm³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3 1.15 .3 1.147E-5 1.5 .4 .4 .003 1 1.4 .4	Grain
Livestock Feed Growing Areas Livestock Feed Growing Areas <i>Area (square meters):</i> Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: <i>Erasjon rate (meters/year):</i> Dry bulk density of soil (grams/cm³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity Sediment from primary contamination delivery ratio	Pasture, silage 10000 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4 .003 1	Grain 10000 0 .2 .5 .2 .15 .3 1.147E-5 1.5 .4 .4 .003 1
s Livestock Feed Growing Areas crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Runoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: Frozion rate (meters/year): Diry bulk density of soil (grams/cm³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity Sediment from primary contamination delivery ratio	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3 1.15 .3 1.147E-5 1.5 .4 .4 .003 1 1.4 .4	Grain
Intersection Intersection	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3 1.15 .3 1.147E-5 1.5 .4 .4 .003 1 1.4 .4	Grain
Livestock Feed Growing Areas Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Bunoff coefficient: Depth of soil <u>mixing</u> layer or plow layer (meters): Volumetric <u>w</u> ater content: <i>Erosion rate (meters/pear)</i> : Dry bulk density of soil (grams/cm ³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity Sediment from primary contamination delivery ratio	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3 1.15 .3 1.147E-5 1.5 .4 .4 .003 1 1.4 .4	Grain
Livestock Feed Growing Areas Crops Area (square meters): Fraction of area directly over primary contamination Irrigation (m) applied per year: Evapotranspiration coefficient: Bunoff coefficient: Depth of soil mixing layer or plow layer (meters): Volumetric water content: Erossion rate (meters/year): Dry bulk density of soil (grams/cm³): Soil erodibility factor (tons/acre): Slope-length-steepness factor: Cover and management factor: Support practice factor: Total porosity Sediment from primary contamination delivery ratio	Pasture, silage 10000 .2 .5 .2 .5 .2 .15 .3 1.15 .3 1.147E-5 1.5 .4 .4 .003 1 1.4 .4	Grain



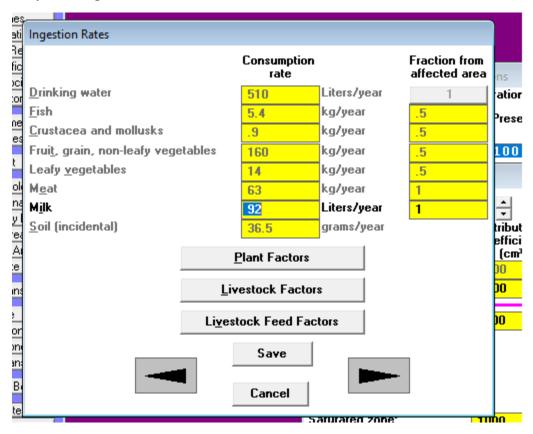


Surface Water Body still used:

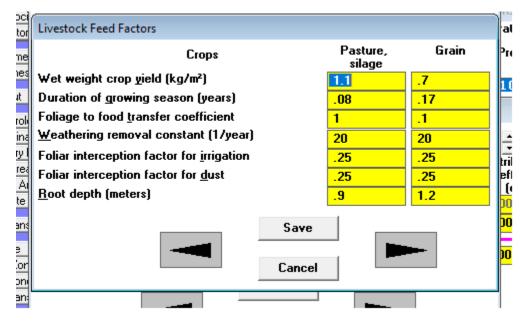
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Surface Water Body				
Surface area of water in surface water body:		90000	square meters	
Volume of surface water body:		150000	cubic meters	
Potential evaporation:		1	m/year	
Stream outflow (as a fraction of total outflow)		0.9983	🔽 use inflow ratio	
Settling velocity of sediments		.1	cm/s	
Density of bottom sediment		1.5	grams/cm³	
Thickness of bottom sediment layer in adsorpti equilibrium of radionuclids with water	on/desorption	.05	m	
Sediment from primary contamination delivery r	atio	1		
Number of catchment areas	1 ••			
Characteristics of catchment area	1			
Smaller X coordinate (meters)	-1450			
Larger X coordinate (meters)	1550			Dist
Smaller Y coordinate (meters)	-2450			-12
Larger Y coordinate (meters)	550			
Surface area (square meters)	9000000			
Runoff coefficient	.2			
Soil erodibility factor (tons/acre):	.4			Co
Slope-length-steepness factor:	.4			ζo
Cover and management factor:	.003			
Support practice factor	1			Jn
Sediment delivery ratio	0.2121	🔽 estimate u	sing catchment area	
Fraction of deposited radionuclides reaching Surface water body	.02			
 Model atmospheric deposition on catchment 	it			
O Approximate by atmospheric release				<u>a</u>
Convergence criterion for atmospheric deposit	ion	.001		Pa
				lu tet
	Save			ret
	Juit			
	Cancel			
	Cancel			

Only milk ingestion used:



Livestock Feed Factors used:



Inhalation and External not used:

Н		
Inhalation rate: B400 m³/year Mass loading of all particulates above primary contamination: 0001 grams/m³ Respirable particulates as a fraction of total particulates: 1 Massloading and respirable fraction at offsite locations 1 Imput different values 1 Indoor to outdoor dust concentration ratio: 4 External gamma penetration factor: .7		
Respirable particulates as a fraction of total particulates: Massloading and respirable fraction at offsite locations Image: State of the state of th		m³/year
al ary net grid sto Du Cancel	eli <u>M</u> ass loading of all particulates above primary contamination:	grams/m³
al ary net grid sto Du Cancel	Respirable particulates as a fraction of total particulates:	
al ary net grid sto Du Cancel	All Massloading and respirable fraction at offsite locations	_
al ary net grid sto Du Cancel	 Use same values as for primary contamination 	
al ary net grid sto Du Cancel	O Input different values	
al ary net grid sto Du Cancel	Tar Indoor to outdoor <u>d</u> ust concentration ratio: .4	
al ary net grid sto Du Cancel	eg External gamma penetration factor: .7	
al ary net grid sto Du Cancel	Ste	_
al ary net grid sto Du Cancel	S Shape of Primary Contamination	
	Occupancy <u>Factors</u>	
	net	
	Save	
450		

Ran the Case

Areas 1&2 not used; 3&4 used:

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.0002+01	3.0002+01		ΞD
FSTI	Basic radiation dose limit (mrem/yr)	2.5002+01	2.5002+01		BRDL
RELT	1st release time (years)	0.0003+00			RelTime(1)
	-		i		
CONC	Initial concentration of Co-60 (pCi/g)	1.0002+02	0.0002+00		S1(1)
					i i i i i i i i i i i i i i i i i i i
VDEP	Deposition velocity of Co-60 on total particulates	1.0002-03	1.000E-03		DEPVEL(1)
VDEP	Dep. velocity of Co-60 on respirable particulates	1.0002-03	1.000E-03		DEPVELT(1)
					l
DCLR					
DCLR	Contaminated zone (cm**3/g)		1.0002+03		DCNUCC(1)
DCLR		1.0002+03	1.0002+03		DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	1.000E+03			DCNUCS(1)
DCLR		1.0002+03	1.0002+03		DCNUCSWB(1)
DCLR		1.000E+03	1.0002+03		DCNUCSWS(1)
DCLR		not used	1.000E+03		DCNUCOF(1,1)
DCLR		not used	1.0002+03		DCNUCOF(1,2)
DCLR		1.000E+03	1.0002+03		DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	1.000E+03			DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	1.000E+03		DCNUCDWE(1)
DCLR	Leach rate constant of Co-60 (/yr)	0.0003+00	0.0002+00	1.6662-04	Rleach(1,1)
					1
LYOT	Bearing of X axis (clockwise angle N>X in degrees)		9.000E+01		DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.0002+02	1.0002+02		SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.0002+02	1.0002+02		SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	not used	3.438E+01		AGRIXY(1,1)
LYOT		not used	6.5622+01		AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	not used	2.3402+02		AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1		2.6602+02		AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	not used	3.438E+01		AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	not used	6.5622+01		AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	not used	2.6802+02		AGRIXY(3,2)
LYOT		not used	3.000E+02		AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3		0.0002+00		AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	1.000E+02	1.000E+02		AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	4.500E+02	4.500E+02		AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	5.5002+02	5.5002+02		AGRIXY(4,3)

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Farent Dose Report Title : SISAD-OFSTIT Default Parameters File : Site3.ROF Site-Specific Parameter Summary (continued) Menu Parameter Input Default computed Name Computed Name LYOT Smaller Y coordinate of Surface water body 5.5002402 SWXY(3) LYOT Larger Y coordinate of Surface water body 8.5002402 9.5002402 SWXY(4) STOR Storage times of contaminated foodstuffs (days): 1.0002400 STOR_T(1) STOR Well water 1.0002400 1.0002400 STOR_T(2) STOR Livestock feed - pasture or silage 1.0002400 1.0002400 STOR_T(4) STOR Livestock feed - grain 1.0002400 1.0002400 STOR_T(6) STOR Hink 1.0002400 1.0002400 STOR_T(6) STOR Livestock feed - pasture or silage 1.0002400	Eont:	MS LineDraw 💌 7.4 💌 🗿 📄 📭 Page: 📑 💌	¥≰			
Farent Dose Report Title : SISAD-OFSTIT Default Parameters File : Site3.ROF Site-Specific Parameter Summary (continued) Menu Parameter Input Default computed Name Computed Name LYOT Smaller Y coordinate of Surface water body 5.5002402 SWXY(3) LYOT Larger Y coordinate of Surface water body 8.5002402 9.5002402 SWXY(4) STOR Storage times of contaminated foodstuffs (days): 1.0002400 STOR_T(1) STOR Well water 1.0002400 1.0002400 STOR_T(2) STOR Livestock feed - pasture or silage 1.0002400 1.0002400 STOR_T(4) STOR Livestock feed - grain 1.0002400 1.0002400 STOR_T(6) STOR Hink 1.0002400 1.0002400 STOR_T(6) STOR Livestock feed - pasture or silage 1.0002400	RESRAI	D-OFFSITE, Version 4.0 T4 Limit = 30 days	02/13/20	20 11:15 Pa	age 5	
Site-Specific Parameter Summary (continued) Menu Parameter Input Default Computed Name LYOT Smaller Y coordinate of Surface water body 5.5002402 6.5002402					-	
Site-Specific Parameter Summary (continued) Menu Parameter User Refult Response Re	Title	: RESRAD-OFFSITE Default Parameters				
MenuParameterUserRESADParameterLYOTSmaller Y coordinate of Surface water body5.5002402computedNameLYOTLarger Y coordinate of Surface water body5.5002402s.5002402	File	: Site3.ROF				
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PRCZ Area of primary contamination (m**2) 1.0002+04 1.0002+04 ARZA PRCZ Length parallel to aquifer flow (m) 1.0002+02 1.0002+02 LCZPAQ PRCZ Depth of soil mixing layer (m) 1.0002+02 1.0002+02 LCZPAQ PRCZ Depth of soil mixing layer (m) 1.0002+01 1.0002-01 LCZPAQ PRCZ Depth of soil mixing layer (m) 1.0002-01 1.0002-04 MEFD PRCZ DepositionVelocityOfAllParticulates for release(m/s) 1.0002-03 1.0002-03 DEPV3L_DUSTT PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002-03 RETAURT PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002-03 RETURN	SITE	Precipitation (m/yr)	1.000E+00	1.0002+00		PRECIP
PRC2 Length parallel to aquifer flow (m) 1.0002+02 1.0002+02 LCZPAQ PRC2 Depth of soil mixing layer (m) 1.5002-01 DM PRC2 Mass loading of all particulates for release (g/m**3) 1.0002-04 1.0002-04 MLFD PRC2 DepositionVelocityOfAllParticulates for release (m/s) 1.0002-03 1.0002-04 MLFD PRC2 DepositionVelocityOfAllParticulates for release (m/s) 1.0002-03 1.0002+00 RSPFRACPC PRC2 DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002+03 RSPFRACPC PRC2 Trigation (m/yr) 2.0002-01 2.0002-03 RT	SITE	Rainfall Erosion Index	1.6002+02	1.6002+02		RAINEROS
PRC2 Length parallel to aquifer flow (m) 1.0002+02 1.0002+02 LCZPAQ PRC2 Depth of soil mixing layer (m) 1.5002-01 DM PRC2 Mass loading of all particulates for release (g/m**3) 1.0002-04 1.0002-04 MLFD PRC2 DepositionVelocityOfAllParticulates for release (m/s) 1.0002-03 1.0002-04 MLFD PRC2 DepositionVelocityOfAllParticulates for release (m/s) 1.0002-03 1.0002+00 RSPFRACPC PRC2 DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002+03 RSPFRACPC PRC2 Trigation (m/yr) 2.0002-01 2.0002-03 RT	PRCZ	Area of primary contamination (m**2)	1 0007+04	1 0003+04		ARTA
PRCZ Depth of soil mixing layer (m) 1.5002-01 1.5002-01 DM PRCZ Mass loading of all particulates for release(g/m**3) 1.0002-04 1.0002-04 MEFD PRCZ PossitionVelocityOfAllParticulates for release(g/m**3) 1.0002-03 1.0002-03 DEPVZL_DUSTT PRCZ Respirable particulates as a fraction of total not used 1.0002+00 RESPERACPC PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002-01 RESPERACPC PRCZ Trigation (m/yr) 2.0002-01 2.0002-01 RT_DUST						
PRCZ Mass Loading of all particulates for release(g/m**3) 1.0002-04 1.0002-04 MLFD PRCZ DepositionVelocityOfAllParticulates for release(m/s) 1.0002-03 1.0002-03 DEPVEL_DUSTF PRCZ Respirable particulates as a fraction of total not used 1.0002+00 RESPFRACEC PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002+03 RESPFRACEC PRCZ Trigation (m/yr) 2.0002-01 2.0002-01 RE						
PRCZ DepositionVelocityOfAllParticulates for release(m/s) 1.000Z-03 1.000Z-03 DZPVZL_DUSTT PRCZ Respirable particulates as a fraction of total not used 1.000Z+03 RZSPFRACPC PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.000Z+03 RZSPFRACPC PRCZ Irrigation (m/yr) 2.000Z-01 2.000Z-01 RI						
PRCZ Respirable particulates as a fraction of total not used 1.0002+00 RZSPFRACPC PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002-03 DEPVZL_DUST PRCZ Irrigation (m/yr)						•
PRCZ DepositionVelocityOfRespirableParticulatesForRe(m/s) not used 1.0002-03 DEFVEL_DUST PRCZ Irrigation (m/yr) 2.0002-01 2.0002-01 RI						
PRCZ Irrigation (m/yr) 2.0002-01 2.0002-01 RI						

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
AGRI	Fraction of Agri. Area 3 directly over the c.z.	0.0002+00	0.0002+00		FAREA_PLANT(3)
AGRI	Evapotranspiration coefficient in Agri. Area 3	5.000E-01	5.000E-01		EVAPTRN(3)
AGRI	Runoff coefficient in Agricultural Area 3	2.000E-01	2.000E-01		RUNOF (3)
AGRI	Mixing depth/plow layer of Agricultural Area 3	1.500E-01	1.500E-01		DPTHMIXG(3)
AGRI	Water filled porosity of soil in Agri. Area 3	3.000E-01	3.000E-01		TMOF(3)
AGRI	Computed erosion rate of soil in Agri. Area 3	1.147E-05	1.147E-05		EROSN(3)
AGRI	Dry Bulk Density of soil in Agricultural Area 3	1.500E+00	1.5002+00		RHOB(3)
AGRI	Soil erodibility factor of Agricultural Area 3	4.000E-01	4.000E-01		ERODIBILITY(3)
AGRI	Slope-length-steepness factor, Agricultural Area 3	4.000E-01	4.000E-01		SLPLENSTP(3)
AGRI	Cropping-management factor of Agricultural Area 3	3.0002-03	3.0002-03		CRPMANG (3)
AGRI	Conservation practice factor of Agricultural Area 3	1.0002+00	1.0002+00		CONVPRAC(3)
AGRI	Total porosity of soil in Agricultural Area 3	not used	4.000E-01		TPOF(3)
AGRI	Areal extent of Agricultural Area 4 (m**2)	1.000E+04	1.000E+04		AREAO(4)
AGRI	Fraction of Agri. Area 4 directly over the c.z.	0.000E+00	0.0002+00		FAREA_PLANT(4)
AGRI	Evapotranspiration coefficient in Agri. Area 4	5.000E-01	5.000E-01		EVAPTRN(4)
AGRI	Runoff coefficient in Agricultural Area 4	2.000E-01	2.000E-01		RUNOF (4)
AGRI	Mixing depth/plow layer of Agricultural Area 4	1.500E-01	1.500E-01		DPTHMIXG(4)
AGRI	Water filled porosity of soil in Agri. Area 4	3.000E-01	3.000E-01		TMOF(4)
AGRI	Computed erosion rate of soil in Agri. Area 4	1.1472-05	1.1472-05		EROSN(4)
AGRI	Dry Bulk Density of soil in Agricultural Area 4	1.5002+00	1.5002+00		RHOB(4)
AGRI	Soil erodibility factor of Agricultural Area 4	4.000E-01	4.000E-01		ERODIBILITY(4)
AGRI	Slope-length-steepness factor, Agricultural Area 4	4.000E-01	4.000E-01		SLPLENSTP(4)
AGRI	Cropping-management factor of Agricultural Area 4	3.000E-03	3.000E-03		CRPMANG (4)
AGRI	Conservation practice factor of Agricultural Area 4	1.000E+00	1.000E+00		CONVPRAC(4)
AGRI	Total porosity of soil in Agricultural Area 4	not used	4.000E-01		TPOF(4)
					1
DWEL	Areal extent of Offsite dwelling site (m**2)	not used	1.0002+03		AREAODWELL
DWEL	Evapotranspiration coefficient in dwelling (Off)site	not used	5.000Z-01		EVAPTRNDWELL
DWEL	Runoff coefficient in Offsite dwelling site	not used	2.000E-01		RUNOFDWELL
DWEL	Mixing depth of Offsite dwelling site	not used	1.500E-01		DPTHMIXGDWELL
DWEL	Water filled porosity of soil in Offsite Dwelling	not used	3.000E-01		TMOFDWELL
DWEL	Computed erosion rate of soil in Offsite Dwelling	not used	0.0002+00		EROSNDWELL
DWEL	Dry Bulk Density of soil in Offsite dwelling site	not used	1.500E+00		RHOBDWELL
DWEL	Soil erodibility factor of soil in Dwelling site	not used	0.0002+00		ERODIBILITYDWELL
DWEL	Slope-length-steepness factor of Dwelling site	not used	4.0002-01		SLPLENSTPDWELL
DWEL	Cropping-management factor of Dwelling site	not used	3.0002-03		CRPMANGDWELL
DWEL	Conservation practice factor of Offsite Dwelling sit	not used	1.0002+00	I	CONVPRACEWELL

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Site-Specific Parameter Summary (continued)

FTRUFraction of irrigation water 1 from surface waternot used0.0002+00FSW1R(1)FTRUFraction of irrigation water 1 from well waternot used1.0002+00FWW1R(1)FTRUIrrigation rate in Agricultural Area 2 (m/yr)not used1.0002+00FWW1R(1)FTRUFraction of irrigation water 2 from surface waternot used0.0002+00FWW1R(2)FTRUFraction of irrigation water 3 from surface waternot used1.0002+00FWW1R(2)FTRUFraction of irrigation water 3 from surface water1.0002+000.0002+00FSW1R(3)FTRUFraction of irrigation water 3 from surface water1.0002+001.0002+00FSW1R(3)FTRUFraction of irrigation water 4 from surface water0.0002+00FSW1R(4)FTRUFraction of irrigation water from surface water1.0002+001.0002+00FSW1R(4)FTRUFraction of irrigation water from surface waternot used1.0002+00FSW1R(4)FTRUFraction of irrigation water from surface waternot used1.0002+00FSW1RW2LLFTRUFraction of irri	ienu	Parameter	User Input	Default	RESRAD	Parameter Name
FTRU Irrigation rate in Agricultural Area 2 (m/yr) not used 2.0002-01 RIRRIG(2) FTRU Fraction of irrigation water 2 from well water not used 0.0002400 FWIR(2) FTRU Fraction of irrigation water 2 from well water not used 1.0002400 FWIR(2) FTRU Fraction of irrigation water 3 from surface water 0.0002400 0.0002400 FWRIR(3) FTRU Fraction of irrigation water 3 from surface water 1.0002400 1.0002400 FWWIR(3) FTRU Fraction of irrigation water 4 from surface water 1.0002400 1.0002400 FWWIR(4) FTRU Fraction of irrigation water 4 from surface water 1.0002400 1.0002400 FWWIR(4) FTRU Fraction of irrigation water from surface water 1.0002400 1.0002400 RIRRIGWELL FTRU Fraction of irrigation water from well water not used 1.0002400	TRU	Fraction of irrigation water 1 from surface water	not used	0.0002+00		FSWIR(1)
FTRCU Fraction of irrigation water 2 from surface water not used 0.0002+00 FSWIR(2) FTRU Fraction of irrigation water 2 from well water not used 1.0002+00 FSWIR(2) FTRU Fraction of irrigation water 3 from surface water 0.0002+00 0.0002+00 FRWIR(2) FTRU Fraction of irrigation water 3 from surface water 1.0002+00 0.0002+00 FSWIR(3) FTRU Irrigation rate in Agricultural Area 4 (m/yr) 1.0002+00 0.0002+00 FSWIR(3) FTRU Fraction of irrigation water 4 from surface water 1.0002+00 1.0002+00 FSWIR(4) FTRU Fraction of irrigation water from surface water 1.0002+00 1.0002+00 FSWIR(4) FTRU Fraction of irrigation water from surface water 1.0002+00 1.0002+00 FSWIR(4) FTRU Fraction of irrigation water from surface water not used 1.0002+00 FSWIR(4) FTRU Fraction of irrigation water from surface water not used 1.0002+00 FSWIRMWELL FTRU Fraction of irrigatio	TRU	Fraction of irrigation water 1 from well water	not used	1.0002+00		FWWIR(1)
WTRU Fraction of irrigation water 2 from well water not used 1.0002+00 FWWIR(2) WTRU Irrigation rate in Agricultural Area 3 (m/yr) 2.0002-01 2.0002-01 FWWIR(3) WTRU Fraction of irrigation water 3 from surface water 0.0002+00 1.0002+00 FWWIR(3) WTRU Irrigation rate in Agricultural Area 4 (m/yr) 2.0002-01 2.0002-01 FWWIR(3) WTRU Fraction of irrigation water 4 from surface water 0.0002+00 0.0002+00 FWWIR(4) WTRU Fraction of irrigation water 4 from surface water 1.0002+00 1.0002+00	ITRU	Irrigation rate in Agricultural Area 2 (m/yr)	not used	2.000E-01		RIRRIG(2)
FTRU Irrigation rate in Agricultural Area 3 (m/yr) 2.0002-01 RIRRIG(3) Fraction of irrigation water 3 from surface water 1.0002400 0.0002400 FSWIR(3) FTRU Fraction of irrigation water 3 from surface water 1.0002400 1.0002400 FSWIR(3) FTRU Fraction of irrigation water 4 from surface water 1.0002400 1.0002400 FSWIR(3) FTRU Fraction of irrigation water 4 from surface water 0.0002400 1.0002400 FSWIR(4) FTRU Fraction of irrigation water 4 from sulface water 1.0002400 1.0002400 FSWIR(4) FTRU Fraction of irrigation water from sulface water not used 1.0002400 FSWIR0WELL FTRU Fraction of irrigation water from sulface water not used 1.0002400 FSWIRDWELL FTRU Fraction of surface water from sulface water not used 1.0002400 FSWIRDWELL FTRU Sufface area of water in surface water body, m**2 5.0002404 5.0002404 VLAKE SWBY Sufface area of water in surface water body, m**3	TRU	Fraction of irrigation water 2 from surface water	not used	0.0002+00		FSWIR(2)
WTRU Fraction of irrigation water 3 from surface water 0.0002+00 0.0002+00	TRU	Fraction of irrigation water 2 from well water	not used	1.0002+00		FWWIR(2)
FTRU Fraction of irrigation water 3 from well water 1.0002+00 FWWIR(3) FTRU Irrigation rate in Agricultural Area 4 (m/yr) 2.0002-01 2.0002-01 RIREG(4) FTRU Fraction of irrigation water 4 from surface water 0.0002+00 1.0002+00 FSWIR(4) FTRU Fraction of irrigation water 4 from well water 1.0002+00 1.0002+00 FSWIR(4) FTRU Fraction of irrigation water 4 from well water 1.0002+00 RIREGDWELL FTRU Fraction of irrigation water from surface water not used 0.0002+00	VIRU	Irrigation rate in Agricultural Area 3 (m/yr)	2.0002-01	2.0002-01		RIRRIG(3)
FTRU Irrigation rate in Agricultural Area 4 (m/yr) 2.0002-01 RIRRIC(4) Fraction of irrigation water 4 from surface water 0.0002+00 0.0002+00 RIRRIC(4) FTRU Fraction of irrigation water 4 from well water 1.0002+00 1.0002+00 RIRRICWE(4) FTRU Irrigation rate in Offsite dwelling site (m/yr) not used 2.0002-01 RIRRICWELL FTRU Fraction of irrigation water from well water not used 2.0002+00 FSWIR(4) FTRU Fraction of irrigation water from well water not used 1.0002+00 FSWIRDWELL FTRU Fraction of irrigation water from well water not used 1.0002+00 FSWIRDWELL FTRU Well pumping rate (m**3/yr) 5.1002+03 5.1002+04 UWW SWBY Surface area of water in surface water body, m**3 1.5002+05 1.5002+04 UXAKZ SWBY Volume of surface water body, m**3 1.5002+05 1.0002+00 UVAKZ SWBY Volume of surface water body, m**3 1.5002+05 1.0002-01 U	VIRU	Fraction of irrigation water 3 from surface water	0.0002+00	0.0002+00		FSWIR(3)
Fraction of irrigation water 4 from surface water0.0002+000.0002+00FSW1R(4)FTRUFraction of irrigation water 4 from well water1.0002+001.0002+00FRW1R(4)FTRUFraction of irrigation water from surface waternot used2.0002-01FRW1R(4)FTRUFraction of irrigation water from surface waternot used0.0002+00FRW1R(4)FTRUFraction of irrigation water from surface waternot used0.0002+00FFW1RDWILLFTRUFraction of irrigation water from well waternot used1.0002+00FFW1RDWILLFTRUFraction of irrigation water from well waternot used1.0002+00FW1RDWILLFTRUWell pumping rate (m**3/yr)5.1002+035.1002+03UWWEYSurface area of water in surface water body, m**31.5002+045.0002+04ILAKZFWEYVolume of surface water body, m**31.0002+001.0002+00IZAFOTFWEYStream outflow as a fraction of seepage+stm outflows5.9832-015.9832-01FSTMFLOWINFWEYDry bulk density of suspended sediments, cm/s1.0002-011.0002+00FSTMFLOWINFWEYDry bulk density of bottom sediments, cm/s1.0002-011.0002-01RhobSedFWEYNumber of distinct catchments11ISt02+03ISt02+03FWEYNumber of distinct catchments11 </td <td>VIRU</td> <td>Fraction of irrigation water 3 from well water</td> <td>1.0002+00</td> <td>1.0002+00</td> <td></td> <td>FWWIR(3)</td>	VIRU	Fraction of irrigation water 3 from well water	1.0002+00	1.0002+00		FWWIR(3)
WERU Fraction of irrigation water 4 from well water 1.0002+00 FWWIR(4) WTRU Fraction of irrigation water from surface water not used 2.0002-01 FWWIR(4) WTRU Fraction of irrigation water from surface water not used 2.0002+00 FWWIRULL WTRU Fraction of irrigation water from surface water not used 1.0002+00 FWWIRUMWILL WTRU Fraction of irrigation water from surface water not used 1.0002+00 FWWIRUMWILL WTRU Fraction of irrigation water from surface water body, m**2 5.1002+03 5.1002+04 UWWIRUMWILL WENY Surface area of water in surface water body, m**3 1.5002+05 1.5002+04 VLAKZ WBY Volume of surface water body, m**3 1.5002+05 1.5002+00 VLAKZ WBY Stream outflow as a fraction of seepage+stm outflows 5.9832-01 5.9832-01	VIRU	Irrigation rate in Agricultural Area 4 (m/yr)	2.000E-01	2.000E-01		RIRRIG(4)
VTRUIrrigation rate in Offsite dwelling site (m/yr)not used2.0002-01RIRRIGDWELLVTRUFraction of irrigation water from surface waternot used0.0002400FSWIRDWELLVTRUFraction of irrigation water from well waternot used1.0002400FSWIRDWELLVTRUFraction of irrigation water from well waternot used1.0002400FSWIRDWELLVTRUWell pumping rate (m**3/yr)5.10024035.1002403UWSWEYSurface area of water in surface water body, m**29.00024049.0002404ALAKZSWEYVolume of surface water body, m**31.50024051.5002405ULAKZSWEYStream outflow as a fraction of seepagetsm outflows5.5832-01FSTMFLOWSWEYStream outflow as a fraction of suepagetsm outflows5.5832-01FSTMFLOWINSWEYSettling velocity of suepended sediments, cm/s1.0002-011.0002-01NebSedSWEYDry bulk density of bottom sediments, g/cm**31.50024031.5002403ThickSedSWEYNumber of distinct catchments111NCATCHSWEYCatchment 1, smaller X coordinate (m)1.55024031.5502403CATCHXY(1,1)SWEYCatchment 1, larger X coordinate (m)1.5502403CATCHXY(2,1)SWEYCatchment 1, larger X coordinate (m)1.5502403CATCHXY(4,1)SWEYCatchment 1	VIRU	Fraction of irrigation water 4 from surface water	0.0002+00	0.0002+00		FSWIR(4)
WTRU Fraction of irrigation water from wulface water not used 0.0002+00 FSWIRDWILL WTRU Fraction of irrigation water from well water not used 1.0002+00 FWWIRDWILL WTRU Well pumping rate (m**3/yr) 5.1002+03 5.1002+03 UW WHY Surface area of water in surface water body, m**2 9.0002+04 9.0002+04 UAKE WBY Surface area of water in surface water body, m**3 1.5002+05 1.5002+06 ULAKE WBY Potential evaporation, m/y 1.0002+00 1.0002+00 FSTMFLOW WBY Steram outflow as a fraction of seepagetstm outflows 5.9832-01 5.9832-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Dry bulk density of bottom sediments, cm/s 1.0002-01 1.0002-01 WabSed WBY Thickness of bottom sediment absorbing nuclides, m 5.0002-02 5.0002-02 ThickSed WBY Number of distinct catchments 1 1 NCA	TRU	Fraction of irrigation water 4 from well water	1.0002+00	1.0002+00		FWWIR(4)
FIRUFraction of irrigation water from well waternot used1.0002+00FWWIRDWZLLFIRUWell pumping rate (m**3/yr)5.1002+035.1002+03UWWHISufface area of water in surface water body, m**29.0002+049.0002+04ALAKZWBYVolume of surface water body, m**31.5002+051.5002+05VLAKZWBYPotential evaporation, m/y1.0002+001.0002+00ZVAPOTWBYStream outflow as a fraction of seepage+stm outflows9.9832-019.9832-01FSTMFIOWWBYSet inflow ratio for outflow ratio, 1 yes, 0 no11FSTMFIOWWBYSettling velocity of suspended sediments, cm/s1.0002-011.0002-01ThickSedWBYDry bulk density of bottom sediment absorbing nuclides, m5.0002-02ThickSedWBYNumber of distinct catchments111NCATCHWBYCatchment 1, smaller X coordinate (m)1.4502+031.4502+03CATCHXY(2,1)WBYCatchment 1, larger X coordinate (m)5.8002+02CATCHXY(2,1)NWEYWBYCatchment 1, larger X coordinate (m)5.8002+02CATCHXY(3,1)WBYCatchment 1, area, m**29.0002+069.0002+06AR2ACA(1)WBYCatchment 1, souff coefficient2.0002-012.0002-01CATCHXY(4,1)WBYCatchment 1, souff coefficient2.0002-012.0002-	TRU	Irrigation rate in Offsite dwelling site (m/yr)	not used	2.000E-01		RIRRIGDWELL
WTRU Well pumping rate (m**3/yr) 5.1002+03 5.1002+03 UW WBY Surface area of water in surface water body, m**2 5.0002+04 5.0002+04 ALAKZ WBY Volume of surface water body, m**3 1.5002+05 1.5002+05 VLAKZ WBY Potential evaporation, m/y 1.0002+05 1.5002+05 VLAKZ WBY Stream outflow as a fraction of seepage+stm outflows 5.9832-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOWIN WBY Disc timility of suspended sediments, cm/s 1.0002+01 1.0002+00 Welther WBY Dry bulk density of bottom sediments, cm/s 1.0002+01 1.0002+00 RhobSed WBY Inickness of bottom sediments, cm/s 1 1 NCATCH WBY Number of distinct catchments 1 1 NCATCH WBY Number of distinct catchments 1 1.5502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m)	TRU	Fraction of irrigation water from surface water	not used	0.0002+00		FSWIRDWELL
WBY Surface area of water in surface water body, m**2 9.0002+04 9.0002+04 ALAKE WBY Volume of surface water body, m**3 1.5002+05 1.5002+05 VLAKZ WBY Potential evaporation, m/y 1.0002+00 1.0002+00 VLAKZ WBY Stream outflow as fraction of seepagetstm outflows 5.9833-01 5.9833-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Dry bulk density of suspended sediments, cm/s 1.0002+00 1.5002+00 NcATCH WBY Dry bulk density of bottom sediments, cm/s 1.0002-01 1.5002+00 NcATCH WBY Dry bulk density of bottom sediments is 0.002-02 5.0002-02 NcATCH WBY Catchment 1, samaller X coordinate (m) 1.5502+03 1 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(4,1,1) WBY Catchment 1	TRU	Fraction of irrigation water from well water	not used	1.0002+00		FWWIRDWELL
WBY Volume of surface water body, m**3 1.5002+05 1.5002+05 VLAKE WBY Potential evaporation, m/y 1.0002+00 1.0002+00 ZVAPOT WBY Stream outflow as fraction of seepage+stm outflows 5.9833-01 S.9833-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Dse inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOWIN WBY Dry bulk density of suspended sediments, cm/s 1.0002-01 1.0002+00 RboSed WBY Thickness of bottom sediments, cm/s 1.0002-02 5.0002+02 ThickSed WBY Number of distinct catchments 1 1 NCATCH WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m)	TRU	Well pumping rate (m**3/yr)	5.100E+03	5.100E+03		UW
WBY Volume of surface water body, m**3 1.5002+05 1.5002+05 VLAKE WBY Potential evaporation, m/y 1.0002+00 1.0002+00 ZVAPOT WBY Stream outflow as fraction of seepage+stm outflows 5.9833-01 S.9833-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Dse inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOWIN WBY Dry bulk density of suspended sediments, cm/s 1.0002-01 1.0002+00 RboSed WBY Thickness of bottom sediments, cm/s 1.0002-02 5.0002+02 ThickSed WBY Number of distinct catchments 1 1 NCATCH WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m)						
WBY Potential evaporation, m/y 1.0002+00 ZVAPOT WBY Stream outflow as a fraction of seegagetsm outflows 5.9832-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Stream outflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOW WBY Settling velocity of suspended sediments, cm/s 1.0002-01 1.0002-01 Vsettle WBY Dry bulk density of bottom sediments, g/cm**3 1.5002+00 1.5002+00 RhobSed WBY Thickness of bottom sediment absorbing nuclides, m 5.0002-02 ThickSed WBY Catchment 1, smaller X coordinate (m) -1.4502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m) 5.002+02 CATCHXY(4,1) WBY Catchment 1, larger X coordinate (m) 5.002+02	SWBY	Surface area of water in surface water body, m**2	9.000E+04	9.000E+04		ALAKE
WBY Stream outflow as a fraction of seepagetstm outflows 9.5832-01 9.5832-01 FSTMFLOW WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOWIN WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 1 FSTMFLOWIN WBY Dsetling velocity of suspended sediments, cm/s 1.0007-01 1.0007-01 Væetle WBY Dry bulk density of bottom sediments, cm/s 1.5007+00 1.5002+00 RhobSed WBY Inickness of bottom sediment absorbing nuclides, m 5.0002-02 5.0002-02 ThicKsed WBY Number of distinct catchments 1 1 NCATCH WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Cat	SWBY	Volume of surface water body, m**3	1.5002+05	1.5002+05		VLAKE
WBY Use inflow ratio for outflow ratio, 1 yes, 0 no 1 1 FSTMFLOWIN WBY Settling velocity of suspended sediments, cm/s 1.0007-01 1.0007-01 Vsettle WBY Dry bulk density of bottom sediments, g/cm*3 1.5002+00 1.5002+00 RobSed WBY Thickness of bottom sediment absorbing nuclides, m 5.0002+02 5.0002-02 ThickSed WBY Number of distinct catchments 1 1 1 NCATCH WBY Catchment 1, smaller X coordinate (m) -1.4502+03 1.5502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, area, m**2 5.0002+06 5.0002+06 AREACA(1) WBY Catchmen	SWBY	Potential evaporation, m/y	1.0002+00	1.0002+00		EVAPOT
WBY Settling velocity of suspended sediments, cm/s 1.0002-01 Vsettle WBY Dry bulk density of bottom sediments, g/cm**3 1.5002+00 1.5002+00 RhobSed WBY Thickness of bottom sediment absorbing nuclides, m 1.5002+00 1.5002+00 RhobSed WBY Number of distinct catchments 1 1 1 NCATCH WBY Catchment 1, smaller X coordinate (m) -1.4502+03 CATCHXY(1,1) NEY WBY Catchment 1, larger X coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) 2.4502+03 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Catchment 1, area, m**2 9.0002+06 9.0002+06 AR2ACA(1) WBY Catchment 1, soil coefficient 2.0002-01 2.0002-01 AR2MOTEN(1) WBY Catchment 1, soil coefficient 4.000	SWBY	Stream outflow as a fraction of seepage+stm outflows	9.9832-01	9.9832-01		FSTMFLOW
WEY Dry bulk density of bottom sediments, g/cm**3 1.5002+00 1.5002+00 RhobSed WBY Thickness of bottom sediment absorbing nuclides, m 5.0002-02 5.0002-02 ThickSed WBY Number of distinct catchments 1 1 NCATCH WBY Catchment 1, smaller X coordinate (m) -1.4502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Catchment 1, area, m**2 9.0002+06 9.0002+06 AREACA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 RUNOFFCA(1)	SWBY	Use inflow ratio for outflow ratio, 1 yes, 0 no	1 1	1		FSTMFLOWIN
WBY Thickness of bottom sediment absorbing nuclides, m 5.0002-02 5.0002-02 ThickSed WBY Number of distinct catchments 1 1 NCATCH WBY Catchment 1, smaller X coordinate (m) -1.4502+03 -1.4502+03 CATCHXY(1,1) WBY Catchment 1, larger X coordinate (m) 1.5502+03 CATCHXY(2,1) WBY Catchment 1, larger Y coordinate (m) -2.4502+03 CATCHXY(3,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(3,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Catchment 1, area, m**2 5.0002+06 5.0002+06 AREACA(1) WBY Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNOFFCA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 RUNOFFCA(1)	SWBY	Settling velocity of suspended sediments, cm/s	1.000E-01	1.0002-01		Vsettle
SWEY Number of distinct catchments 1 1 NCATCH SWEY Catchment 1, smaller X coordinate (m) -1.4502+03 CATCHXY(1,1) SWEY Catchment 1, larger X coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) SWEY Catchment 1, smaller X coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) SWEY Catchment 1, smaller Y coordinate (m) 5.5002+02 .5002+02 CATCHXY(3,1) SWEY Catchment 1, larger Y coordinate (m) 5.002+02 CATCHXY(4,1) SWEY Catchment 1, area, m**2 5.0002+06 5.0002+06 AREACA(1) SWEY Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNOFGCA(1) SWEY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 RUNDERLIFICA(1)	SWBY	Dry bulk density of bottom sediments, g/cm**3	1.500E+00	1.500E+00		RhobSed
WBY [Catchment 1, smaller X coordinate (m) -1.4502+03 CATCHXY(1,1) WBY [Catchment 1, larger X coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) WBY [Catchment 1, smaller Y coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) WBY [Catchment 1, smaller Y coordinate (m) -2.4502+03 2.4502+03 CATCHXY(3,1) WBY [Catchment 1, larger Y coordinate (m) 5.5002+02 5.5002+02 CATCHXY(4,1) WBY [Catchment 1, area, m**2 9.0002+06 5.0002+06 AREACA(1) WBY [Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNOFFCA(1) WBY [Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 TRUNDERCA(1)	SWBY	Thickness of bottom sediment absorbing nuclides, m	5.000E-02	5.000E-02		ThickSed
WBY Catchment 1, larger X coordinate (m) 1.5502+03 1.5502+03 CATCHXY(2,1) WBY Catchment 1, smaller Y coordinate (m) -2.4502+03 CATCHXY(2,1) WBY Catchment 1, larger X coordinate (m) -2.4502+03 CATCHXY(3,1) WBY Catchment 1, larger X coordinate (m) 5.5002+02 5.5002+02 CATCHXY(4,1) WBY Catchment 1, area, m**2 9.0002+06 9.0002+06 NARACA(1) WBY Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNOFFCA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0007-01 4.0007-01 RUNOFFCA(1)	SWBY	Number of distinct catchments	1	1		NCATCH
WBY Catchment 1, smaller Y coordinate (m) -2.4502+03 CATCHXY(3,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Catchment 1, larger Y coordinate (m) 5.5002+02 CATCHXY(4,1) WBY Catchment 1, area, m**2 9.0002+06 9.0002+06 AREACA(1) WBY Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNDFGA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 ZRODIBILITYCA(1)	WBY	Catchment 1, smaller X coordinate (m)	-1.450E+03	-1.450E+03		CATCHXY(1,1)
WBY Catchment 1, larger Y coordinate (m) 5.5002+02 5.5002+02 CATCHXY(4,1) WBY Catchment 1, area, m**2 5.0002+06 5.0002+06 AREACA(1) WBY Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNOFFCA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 RODIBILITYCA(1)	WBY	Catchment 1, larger X coordinate (m)	1.5502+03	1.5502+03		CATCHXY(2,1)
WBY Catchment 1, area, m**2 9.0002+06 9.0002+06 AREACA(1) WBY Catchment 1, runoff coefficient 2.0002-01 RUNOFFCA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 RUNOFFCA(1)	SWBY	Catchment 1, smaller Y coordinate (m)	-2.450E+03	-2.450E+03		CATCHXY(3,1)
WBY Catchment 1, runoff coefficient 2.0002-01 2.0002-01 RUNOFFCA(1) WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 ERODIBILITYCA(1)	WBY	Catchment 1, larger Y coordinate (m)	5.500Z+02	5.500Z+02		CATCHXY(4,1)
WBY Catchment 1, soil erodibility factor, tons/acre 4.0002-01 4.0002-01 ERODIBILITYCA(1)	WBY	Catchment 1, area, m**2	9.0002+06	9.0002+06		AREACA(1)
	SWBY	Catchment 1, runoff coefficient	2.000Z-01	2.0002-01		RUNOFFCA(1)
WEY Catabrant Slang-langth-steernass factor 4 0007-01 4 0007-01 SUBTROTICA(1)	SWBY	Catchment 1, soil erodibility factor, tons/acre	4.000E-01	4.000E-01		ERODIBILITYCA(1)
SWEI Catchment I, Stope-rength-steephess factor 4.0002-01 4.0002-01 SLPLENSIPCA(I)	SWBY	Catchment 1, Slope-length-steepness factor	4.000E-01	4.000E-01		SLPLENSTPCA(1)
WBY Catchment 1, Cover and management factor 3.0002-03 3.0002-03 CRPMANGCA(1)	SWBY	Catchment 1, Cover and management factor	3.000E-03	3.000E-03		CRPMANGCA(1)
WBY Catchment 1, support practice factor 1.0002+00 CONVPRACCA(1)	SWBY	Catchment 1, support practice factor	1.0002+00	1.0002+00		CONVPRACCA(1)
WBY Catchment 1, sediment delivery ratio 2.1212-01 2.1212-01 SDRCA(1)	WBY	Catchment 1, sediment delivery ratio	2.1212-01	2.1212-01		SDRCA(1)

Inhalation and external not used: View - SUMMARY.REP

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ESRAD-OFFSITE, Version 4.0	TH Limit = 30 days	02/13/2020 11:15 Pag	e 28

HISRAD-OFFSITE, Version 4.0 To Lin Varent Dose Report Litle : RISRAD-OFFSITE Default Parameters Litle : Site3.ROF

Site-Specific Parameter Summary (continued)

		User	1	RESRAD	Parameter
lenu	Parameter	Input	Default	computed	Name
INHE	Inhalation rate (m**3/yr)	not used	8.400E+03		INHALR
INHE	Mass loading of all particulates from Primary contam	1.0002-04	1.0002-04	I I	MLFD
INHE	Respirable particulates as a fraction of total	not used	1.000E+00		RESPFRACPC
INHE	Offsite mass loading same as onsite mass loading?	not used			SAMEMLRF
INHE	Total mass loading at agricultural area l (g/m**3)	not used	1.0002-04		MLTOTOF(1)
INHE	Respirable fraction at agricultural area 1	not used	1.000E+00		RESPFRACOF(1)
INHE	Total mass loading at agricultural area 2 (g/m**3)	not used	1.000E-04		MLTOTOF (2)
INHE	Respirable fraction at agricultural area 2	not used	1.000E+00		RESPFRACOF(2)
INHE	Total mass loading at agricultural area 3 (g/m**3)	not used	1.000E-04		MLTOTOF (3)
INHE	Respirable fraction at agricultural area 3	not used	1.0002+00		RESPFRACOF(3)
INHE	Total mass loading at agricultural area 4 (g/m**3)	not used	1.0002-04	I I	MLTOTOF (4)
INHE	Respirable fraction at agricultural area 4	not used	1.0002-04	i i	RESPFRACOF(4)
INHE	Total mass loading at offsite dwelling(g/m**3)	not used	1.0002-04	i i	MLTOTDWELL
INHE	Respirable fraction at offsite dwelling(g/m**3)	not used	1.0002+00	i i	RESPFRACDWELL
INHE	Indoor dust filtration factor, inhalation	not used	4.000E-01	i i	SHF3
INHE	Shielding factor, external gamma	not used	7.000E-01	i i	SHF1
INHE	Shape factor flag, external gamma	not used	1.0002+00	noncircular	FS
EXT	Onsite shape factor array (used if non-circular):		i	i i	
EXT	Radii of shape factor array (used if non-circular):		i	i i	
EXT	Outer annular radius (m), ring 1:	not used	6.000Z+00	i i	RAD SHAPE(1)
EXT	Outer annular radius (m), ring 2:	not used	1.2002+01	i i	RAD SHAPE (2)
EXT	Outer annular radius (m), ring 3:	not used	1.8002+01	i i	RAD SHAPE (3)
EXT	Outer annular radius (m), ring 4:	not used	2.400E+01	i i	RAD SHAPE (4)
EXT	Outer annular radius (m), ring 5:	not used	3.0002+01	i i	RAD SHAPE (5)
EXT	Outer annular radius (m), ring 6:	not used	3.6002+01	i i	RAD SHAPE (6)
EXT	Outer annular radius (m), ring 7:	not used	4.2002+01	i i	RAD SHAPE (7)
EXT	Outer annular radius (m), ring 8:	not used	4.8002+01	i i	RAD SHAPE (8)
EXT	Outer annular radius (m), ring 9;	not used	5.4002+01	i i	RAD SHAPE (9)
EXT	Outer annular radius (m), ring 10;	not used	6.000 <u>2</u> +01	i i	RAD SHAPE (10)
EXT	Outer annular radius (m), ring 11:	not used	6.6002+01	i i	RAD SHAPE (11)
EXT	Outer annular radius (m), ring 12:	not used	7.200E+01	i i	RAD SHAPE (12)
EXT	Fractions of annular areas within AREA:		i	i i	_
EXT	Ring 1	not used	1.0002+00		FRACA(1)
EXT	Ring 2	not used	1.0002+00	i	FRACA (2)
EXT	Ring 3	not used	1.0002+00	1	FRACA (3)
EXT	Ring 4	not used	1.0002+00		FRACA (4)
EXT	Ring 5	not used	1.0002+00		FRACA (5)

C-14 and H-3 not used

Summary of Pathway selection is correct

I View - SUMMARY.REP File Edit Help

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File	: Site3.ROF									
	Site-Specific Parameter Summary (continued)									
Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name					
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.0002-10		C12EVSN					
C14	Fraction of vegetation carbon from air	not used	9.800Z-01		CAIR					
C14	Fraction of vegetation carbon from soil	not used	2.0002-02		CSOIL					
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.8002-01		C12AIR					
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02		C12CZ					
C12	C-12 concentration in water (g/cm**3)	not used	2.0002-05		C12WTR					
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01		C12MEAT_MILK(1)					
C12	C-12 concentration in milk (g/g)	not used	7.000E-02		C12MEAT MILK(2)					
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01		C12PLANT(1)					
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02		C12PLANT(2)					
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02		C12PLANT(3)					
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01		C12PLANT(4)					
		1			1					
НЗ	Humidity in air (g/cm**3)	not used	8.000 E +00		HUMID					
НЗ	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01		H2OMEAT_MILK(1)					
НЗ	Mass fraction of water in milk (g/g)	not used	8.800E-01		H2OMEAT_MILK(2)					
НЗ	Mass fraction of water in vegetable 1 (g/g)	not used	8.0002-01		H2OPLANT(1)					
НЗ	Mass fraction of water in vegetable 2 (g/g)	not used	8.0002-01		H2OPLANT (2)					
НЗ	Mass fraction of water in livestock feed 1 (g/g)	not used	8.0002-01		H2OPLANT (3)					
нз	Mass fraction of water in livestock feed 2 (g/g)	not used	8.0002-01		H2OPLANT (4)					

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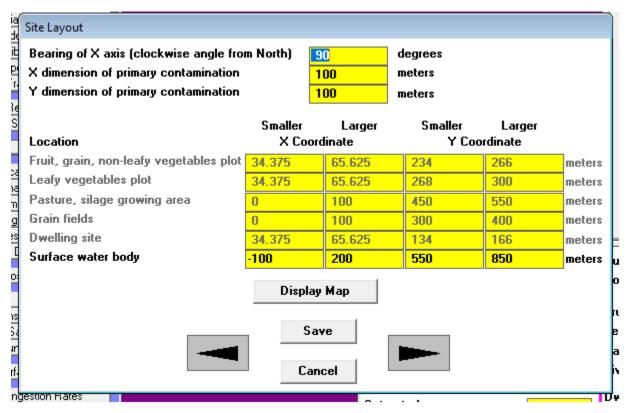
Summary of Pathway Selections

Pathway	User Selection
<pre>1 external gamma 2 inhalation (w/o radon) 3 plant ingestion 4 meat ingestion 5 milk ingestion 6 aquatic foods 7 drinking water 8 soil ingestion 9 radon</pre>	suppressed suppressed suppressed active suppressed suppressed suppressed suppressed

Now Switch to Aquatic Pathway only:

RESRAD - OFFSITE Site3.ROF (Modified)		- 0	×
File Pathways Site Data View Form Option	ns Data Transfer Help		
	21 🗠		
RESRAD- Set Pathways	Modify Data	Iconic Navigator	
OFFSITE	Hide Subforms	Problem Inputs Results Help	
Version 4.0	Show Subforms Horizontally		
Inhalation	Preliminary Inputs		
Meat Ingestion	Release Times Initial Concentrations		
Mik Ingestion	Nuclide Specific Release		
File English	Distribution Coefficients Deposition Velocities		
Change Title	Transfer Factors	Nuclide Concentration:	
Set Pathways	Reporting Times Storage Times	List of Nuclides Present at the Site Co=60 100	
Sollingestion	Site Layout		
	Physical and Hydrological	Distribution Coefficients	
Run	Primary Contamination Sediment Delivery Ratio	Radionuclide Co-60	
View Dutput	Agricultural Areas Livestock Feed Areas	Distribution Location coefficient	
Quit 🖊 📂	Dwelling Site	(cm²/g) (cm²/g) Contaminated medium: 1000 Suspended sediment in surface water body 1000	
	Atmospheric Transport	Contaminated zone: 1000 Bottom sediment in surface water body 1000	
	Water Use Unsaturated Zones	Unsaturated zone <u>1</u> : 1000 Fruit, grain, nonleafy fields 1000	2
	Saturated Zone	Leafy vegetable fields 1000	
	Groundwater Transport	Pasture, silage growing areas	
	Surface Water Body	Livestock feed grain fields 1000	
	Ingestion Rates Plant Factors	Saturated zone: 1000 Dwelling site 1000	
	Livestock Intakes Livestock Feed Factors	Number of unsaturated zones:	
	Inhalation, Gamma	Save	
	Shape Factors Occupancy		
	Badon	Cancel	

Only Pond location matters beside contamination:



Only need to know how much erosion goes to pond:

Precipitation:	1	motore/upar	Incentration:
Fate of Material Eroded from the Primary Contamir	nation by Runoff		
Fraction of eroded radionuclides deposited at	dwelling site		0
Fraction of eroded radionuclides deposited in t	the nonleafy vegetable	plot	0
Fraction of eroded radionuclides deposited in t	the leafy vegetable plot		0
Fraction of eroded radionuclides deposited in t		0	
Fraction of eroded radionuclides deposited in t	the feed grain plot		0
Fraction of eroded radionuclides deposited in t	the surface water body		1
	Save		
	Cancel		
Saturated Zone			Leaf
Jaturateu Zone			

No Ag areas used:

Agricultural Areas		
Crops	Fruit, grain, non-leafy	Leafy vegetables
<u>Area (square meters):</u>	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
<u>R</u> unoff coefficient:	.2	.2
Depth of soil <u>mixing</u> layer or plow layer (meters):	.15	.15
Volumetric <u>w</u> ater content:	.3	.3
<i>Ero<u>s</u>ion rate (meters/year):</i>	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>p</u> orosity	.4	.4
Sediment from primary contamination delivery ratio	(U	0
Save Cancel		

Crops	Pasture, silage	Grain
Area (square meters):	10000	10000
raction of area directly over primary contamination:	0	0
rrigation (m) applied per year:	.2	.2
vapotranspiration coefficient:	.5	.5
Aunoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
olumetric <u>w</u> ater content:	.3	.3
Ero <u>si</u> on rate (meters/year):	1.147E-5	1.147E-5
<u>)</u> ry bulk density of soil (grams/cm ³):	1.5	1.5
oil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
fotal <u>p</u> orosity	.4	.4
ediment from primary contamination delivery ratio	(U)	0
Save Cancel		

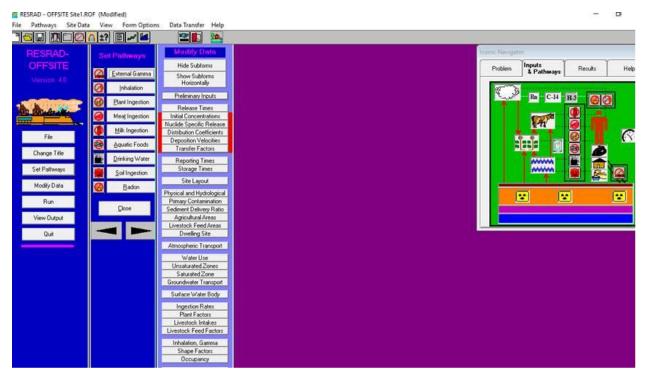
Sediment from primary contamination delivery ratio is on??

Offsite Dwelling Area		
	Building location	Offsite d w elling
<u>Area (square meters):</u>		1000
rrigation (m) applied per year:		.2
vapotranspiration coefficient:		.5
aunoff coefficient:		.2
Depth of soil <u>m</u> ixing layer or plow lay	yer (meters):	.15
/olumetric <u>w</u> ater content:		.3
Ero <u>si</u> on rate (meters/year):		0
<u>)</u> ry bulk density of soil (grams/cm ³):		1.5
Soil erodibility factor (tons/acre):		0
olope-length-steepness factor:		.4
Cover and management factor:		.003
Support practice factor:		1
fotal <u>p</u> orosity		.4
Sediment from primary contaminatior	n delivery rati	o ()
	Save	
	Cancel	
		Number of unsaturated zones

Try to set it give and Run-time Error 5

RESRAD - OFFSITE Site3.						-	o ×
File Pathways Site Dat		And and an other designs of the local data and the					
	∩±? ■						
RESRAD-	Set Pathways	Modify Data			Iconic Nav	gator	
OFFSITE		Hide Subforms			Problem	n Inputs Results	Help
	External Gamma	Show Subforms Horizontally				R & Pathways Hesuits	nop
	Inhalation	Conception of the local division of the loca			dan.		10.000
-50	Plant Ingestion	Preliminary Inputs	welling Area			P Rn C-14 H.3 🔞	0
	Meat Ingestion	Release Time Offsite D	wempy wee				
the second se	Mik Ingestion	Nuclide Specific Re Distribution Coeffic				1 M	
File	Aquatic Foods	Deposition Veloc		1000	15		8
Change Title		Fate of Material Eroded	from the Primary Contaminatio	n by Runoff	htion		5
Set Pathways	Drinking Water	-					
Concession of the local division of the loca	Soil Ingestion		RESWIN	×	0		
Modify Data	Badon	Ph			0	ing ing	
Run	Close	F	A Run-time	error '5':	0		
View Output	Tiose	S	invalid p	ocedure call or argument	0		
Quit			100.04 (100.000	0.05 1999 1922 1929 1929 1929 1920 1920 1930 1930 1930 1930 1930 1930 1930 193			
Que				OK	- 002/02	l sediment in surface water body	La de carrier de la carriera de la c
				and a second	im sed	liment in surface water body	1000
				Cancel		, nonleafy fields	1000
		Saturated Zor Groundwater Tran				table fields lage growing areas	1000
		Surface Water B		Save		ieed grain fields	1000
		Ingestion Rate		Cancel	Dwelling si	te	1000
		Plant Factors		assession .	<u> </u>		1000
		Livestock Intakes Livestock Feed Factors		Number of unsaturate set in preliminary inp	ed zones: 1		
		Inhalation, Gamma			Sav		
		Shape Factors Occupancy					
		Badon			Canc	el	
OVariables		THE REAL PROPERTY AND ADDRESS OF ADDRES ADDRESS OF ADDRESS OF ADDR					

Now Switch to Drinking Water Pathway only:



Only pond area location matters

Site Layout							
		90 100 100	degrees meters meters				
	Smaller	Larger	Smaller	Larger			
Location	X Co	ordinate	Y Co	ordinate			
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters		
Leafy vegetables plot	34.375	65.625	268	300	meters		
Pasture, silage growing area	0	100	450	550	meters		
Grain fields	0	100	300	400	meters		
Dwelling site	34.375	65.625	134	166	meters		
Surface water body	-100	200	550	850	meters		
Display Map Save Cancel							

Agricultural Areas		
Crops	Fruit, grain, non-leafy	Leafy vegetables
<u>Area (square meters):</u>	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric water content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total <u>p</u> orosity	.4	.4
Sediment from primary contamination delivery ratio	<u> </u>	0
Save Cancel		

Water Use					
			Fraction	of water from	Number of individuals to
Description of water usage	Quantity		Surface bo	dy Well	compute well water needs
Consumption per person	510	Liters/year	0	1	
Use indoors of dwelling per person	225	Liters/day	0	1	- 4
Beef cattle per animal	50	Liters/day	0	1	2
Dairy cows per animal	160	Liters/day	0	1	2
Irrigation applied to:					Area of Plot [square meters]
Fruit, grain, non-leafy vegetables	.2	m per year	0	1	1000
Leafy vegetables	.2	m per year	0	1	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.2	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000
Well pumping rate:			5100	cubic meters/ye	ar
Well pumping rate needed to suppor	t specified wa	iter use: 🔤	330.765	cubic meters/ye	ar
1		-			
	_	Save			
] –		Consel		-	
		Cancel			
1 Plant Factors					

Occupancy	
Fraction of time spent on primary contami Indoors Out <u>d</u> oors	ination 0 0
Fraction of time spent in offsite dwelling	site
<u>I</u> ndoors Out <u>d</u> oors	.5 .1
Fraction of time spent in farmed lands	
Fruit, grain, and nonleafy fields	.1
<u>L</u> eafy vegetable fields Past <u>u</u> re and silage fields	.1 .1
Livestock grain fields	.1
Save Cancel	Run

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enu	Parameter	User Input	Default	RESRAD computed	Parameter Name
STI	Exposure duration for risk	3.0002+01	3.0002+01		ZD
STI	Basic radiation dose limit (mSv/yr)	2.500E-01	2.500E-01		BRDL
ELT	lst release time (years)	0.0002+00			RelTime(1)
ONC	Initial concentration of Ac-227 (Bq/g)	1.0002+02	0.0002+00		S1(1)
DEP	Deposition velocity of Ac-227 on total particulates	1.0002-03	1.0002-03		DEPVEL(1)
DEP	Dep. velocity of Ac-227 on respirable particulates	1.000E-03	1.0002-03		DEPVELT(1)
CLR	Distribution coefficients for Ac-227				
DCLR	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01		DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	2.0002+01	2.0002+01		DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	2.000E+01	2.000E+01		DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	2.0002+01	2.0002+01		DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	2.000E+01	2.0002+01		DCNUCSWS(1)
DCLR	Agricultural area l (cm**3/g)	not used	2.000E+01		DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	not used	2.0002+01		DCNUCOF(1,2)
OCLR	Agricultural area 3 (cm**3/g)	not used	2.0002+01		DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	not used	2.0002+01		DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	2.0002+01		DCNUCDWE(1)
OCLR	Leach rate constant of Ac-227 (/yr)	0.0002+00	0.0002+00	8.2452-03	Rleach(1,1)
LYOT	Bearing of X axis (clockwise angle N>X in degrees)	9.0002+01	9.0002+01		DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.0002+02	1.0002+02		SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.0002+02		SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	not used	3.4382+01		AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	not used	6.5623+01		AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	not used	2.3402+02		AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	not used	2.6602+02		AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	not used	3.438E+01		AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	not used	6.5622+01		AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	not used	2.6802+02		AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	not used	3.0002+02		AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	not used	0.0002+00		AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	not used	1.0002+02		AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	not used	4.500E+02		AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	not used	5.500E+02		AGRIXY(4,3)
LYOT	Smaller X coordinate of Agricultural Area 4	not used	0.0002+00		AGRIXY(1,4)
TOY	Larger X coordinate of Agricultural Area 4	not used	1.0002+02		AGRIXY(2,4)
TOY	Smaller Y coordinate of Agricultural Area 4	not used	3.0002+02		AGRIXY(3,4)
LYOT	Larger Y coordinate of Agricultural Area 4	not used	4.000E+02		AGRIXY(4,4)
YOT	Smaller X coordinate of Dwelling Area	not used	3 4387+01		DWELLXY (1)

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Site-Specific Parameter Summary (continued)

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Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
AGRI	Fraction of Agri. Area 3 directly over the c.z.	not used	0.0002+00		FAREA_PLANT(3)
AGRI	Evapotranspiration coefficient in Agri. Area 3	not used	5.000E-01		EVAPTRN(3)
AGRI	Runoff coefficient in Agricultural Area 3	not used	2.000E-01		RUNOF (3)
AGRI	Mixing depth/plow layer of Agricultural Area 3	not used	1.500Z-01		DPTHMIXG(3)
AGRI	Water filled porosity of soil in Agri. Area 3	not used	3.000E-01		TMOF(3)
AGRI	Computed erosion rate of soil in Agri. Area 3	not used	1.1472-05		EROSN(3)
AGRI	Dry Bulk Density of soil in Agricultural Area 3	not used	1.500E+00		RHOB(3)
AGRI	Soil erodibility factor of Agricultural Area 3	not used	4.000E-01		ERODIBILITY(3)
AGRI	Slope-length-steepness factor, Agricultural Area 3	not used	4.000E-01		SLPLENSTP(3)
AGRI	Cropping-management factor of Agricultural Area 3	not used	3.000E-03		CRPMANG (3)
AGRI	Conservation practice factor of Agricultural Area 3	not used	1.0002+00		CONVPRAC(3)
AGRI	Total porosity of soil in Agricultural Area 3	not used	4.000E-01		TPOF(3)
AGRI	Areal extent of Agricultural Area 4 (m**2)	not used	1.000E+04		AREAO(4)
AGRI	Fraction of Agri. Area 4 directly over the c.z.	not used	0.0002+00		FAREA_PLANT(4)
AGRI	Evapotranspiration coefficient in Agri. Area 4	not used	5.000E-01		EVAPTRN(4)
AGRI	Runoff coefficient in Agricultural Area 4	not used	2.000E-01		RUNOF (4)
AGRI	Mixing depth/plow layer of Agricultural Area 4	not used	1.500E-01		DPTHMIXG(4)
AGRI	Water filled porosity of soil in Agri. Area 4	not used	3.000E-01		TMOF(4)
AGRI	Computed erosion rate of soil in Agri. Area 4	not used	1.1472-05		EROSN(4)
AGRI	Dry Bulk Density of soil in Agricultural Area 4	not used	1.5002+00		RHOB(4)
AGRI	Soil erodibility factor of Agricultural Area 4	not used	4.000E-01		ERODIBILITY(4)
AGRI	Slope-length-steepness factor, Agricultural Area 4	not used	4.000E-01		SLPLENSTP(4)
AGRI	Cropping-management factor of Agricultural Area 4	not used	3.000E-03		CRPMANG(4)
AGRI	Conservation practice factor of Agricultural Area 4	not used	1.0002+00		CONVPRAC(4)
AGRI	Total porosity of soil in Agricultural Area 4	not used	4.000E-01		TPOF(4)
					Í
DWEL	Areal extent of Offsite dwelling site (m**2)	not used	1.0002+03		AREAODWELL
DWEL	Evapotranspiration coefficient in dwelling (Off)site	not used	5.000E-01		EVAPTRNDWELL
DWEL	Runoff coefficient in Offsite dwelling site	not used	2.000E-01		RUNOFDWELL
DWEL	Mixing depth of Offsite dwelling site	not used	1.5002-01		DPTHMIXGDWELL
DWEL	Water filled porosity of soil in Offsite Dwelling	not used	3.000E-01		TMOFDWELL
DWEL	Computed erosion rate of soil in Offsite Dwelling	not used	0.0002+00		EROSNDWELL
DWEL	Dry Bulk Density of soil in Offsite dwelling site	not used	1.5002+00		RHOBDWELL
DWEL	Soil erodibility factor of soil in Dwelling site	not used	0.0002+00	i	ERODIBILITYDWELL

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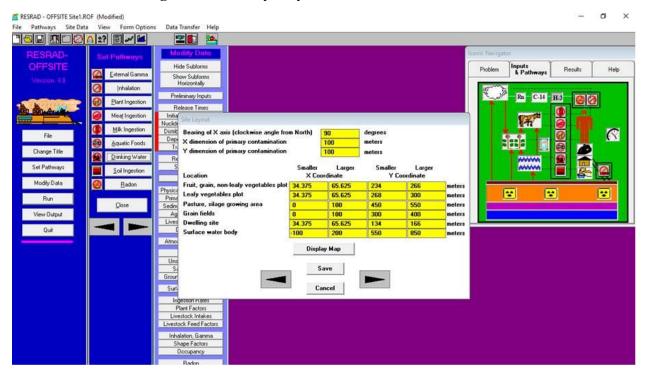
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Title : R2SRAD-OFFSITZ Default Parameters File : Sitel.ROF

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
USZN	Number of unsaturated zone strata	1	1		NS
USZN	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00		H(1)
USZN	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00		DENSUZ(1)
USZN	Unsat. zone 1, total porosity	4.0002-01	4.000E-01		TPUZ(1)
USZN	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01		EPUZ(1)
USZN	Unsat. zone 1, field capacity	3.000E-01	3.000E-01		FCUZ(1)
USZN	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01		HCUZ(1)
USZN	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00		BUZ(1)
USZN	Unsat. zone 1, longitudinal dispersivity (m)	1.000E-01	1.000E-01		ALPHALU(1)
i					i
SZNE	Well pump intake depth (m below water table)	1.0002+01	1.0002+01		DWIBWT
SZNE	Depth of aquifer contributing to surface water body	5.000E+00	5.000E+00		DPTHAQSW
SZNE	Thickness of saturated zone (m)	1.000E+02	1.000E+02		DPTHAQ
SZNE	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00		DENSAQ
SZNE	Saturated zone total porosity	4.000E-01	4.000E-01		TPSZ
SZNE	Saturated zone effective porosity	2.0002-01	2.0002-01		EPSZ
SZNE	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02		HCSZ
SZNE	Saturated zone hydraulic gradient to well	2.000E-02	2.000E-02		HGW
SZNE	Satur. zone hydraulic gradient to surface water body	2.0002-02	2.000E-02		HGSW
SZNE	longitudinal dispersivity to well (m)	3.0002+00	3.0002+00		ALPHALOW
SZNE	longitudinal dispersivity to SWB (m)	1.000E+01	1.000E+01		ALPHALOSW
SZNE	lateral (horizontal) dispersivity to well (m)	4.000E-01	4.000E-01		ALPHATW
SZNE	lateral (horizontal) dispersivity to SWB (m)	1.0002+00	1.000E+00		ALPHATSW
SZNE	lateral (vertical) dispersivity to well (m)	2.0002-02	2.000E-02		ALPHAVW
SZNE	lateral (vertical) dispersivity to SWB (m)	6.000E-02	6.000E-02		ALPHAVSW
SZNE	Irrigation rate over aquifer to well (m/yr)	not used	0.000E+00		RIAOW
SZNE	Irrigation rate over aguifer to SWB (m/yr)	not used	0.0002+00		RIAOSW
SZNE	Evapotranspiration coefficient over aquifer to well	not used	1.000E+00		EVAPTRAOW
SZNE	Evapotranspiration coefficient over aquifer to SWB	not used	1.0002+00		EVAPTRAOSW
SZNE	Runoff coefficient over aquifer to well	not used	1.000E+00		RUNOFFAQW
SZNE	Runoff coefficient over aquifer to SWB	not used	1.0002+00		RUNOFFAQSW
SZNE	Concentration of mobile colloids in the aguifer	0.0002+00	0.0002+00		CCOL
SZNE	Water - Soil Distribution coefficient of colloids	0.0002+00	0.0002+00		K1Col
SZNE	Water - Mobile Colloids Distribution coefficient	0.0002+00	0.000E+00		K3Col

Now Switch to Soil Ingestion Pathway only:



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Bearing of X axis (clockwise angle from X dimension of primary contamination Y dimension of primary contamination	n North)	90 100 100	degrees meters meters			
Location	Smaller X Coo	Larger ordinate	Smaller Y Coo	Larger ordinate		
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters	
Leafy vegetables plot	34.375	65.625	268	300	meters	
Pasture, silage growing area	0	100	450	550	meters	
Grain fields	0	100	300	400	meters	
Dwelling site	34.375	65.625	134	166	meters	
Surface water body	-100	200	550	850	meters	
Display Map Save Cancel						

Only soil ingestion is considered:

ş						
Ingestion Rates						
Ingestion Rates <u>D</u> rinking water Fish	Consumptio rate	n	Fraction from affected area			
<u>D</u> rinking water	510	Liters/year	1			
	5.4	kg/year	.5			
<u>C</u> rustacea and mollusks	.9	kg/year	.5			
Frui <u>t,</u> grain, non-leafy veget	ables 160	kg/year	.5			
Leafy <u>v</u> egetables	14	kg/year	.5			
M <u>e</u> at Milk	63	kg/year	1			
M <u>i</u> lk	92	Liters/year	1			
<u>S</u> oil (incidental)	36.5	grams/year				
<u>Soil (incidental)</u> <u>Blant Factors</u> <u>Livestock Factors</u>						
_	Enotook ruok					
Livestock Feed Factors						
	Cancel					

External and inhalation parameters not used:

Inhalation and External Gamma						
Inhalation rate: 8400 m³/year Mass loading of all particulates above primary contamination: 0001 grams/m³ Respirable particulates as a fraction of total particulates: 1 1 Massloading and respirable fraction at offsite locations 1 1 Image: State of the same values as for primary contamination 1 1						
O Input different values Indoor to outdoor dust concentration ratio: External gamma penetration factor: Shape of Primary Contamination						
Cancel						

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.000E+01	3.000E+01	i	ED
FSTI	Basic radiation dose limit (mSv/yr)	2.500E-01	2.500E-01		BRDL
RELT	lst release time (years)	0.0002+00			RelTime(1)
CONC	Initial concentration of $Ac-227$ (Bg/g)	1.0002+02	0.0003+00		S1(1)
VDEP	Deposition velocity of Ac-227 on total particulates	1.000E-03	1.000E-03		DEPVEL(1)
VDEP	Dep. velocity of Ac-227 on respirable particulates	1.000E-03	1.000E-03	i	DEPVELT(1)
DCLR	Distribution coefficients for Ac-227				
DCLR	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01		DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.0002+01		DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	2.000E+01	2.000E+01		DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	2.000E+01	2.000E+01		DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	2.000E+01	2.000E+01		DCNUCSWS(1)
DCLR	Agricultural area l (cm**3/g)	2.000E+01	2.000E+01		DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	2.000E+01	2.000E+01		DCNUCOF(1,2)
DCLR	Agricultural area 3 (cm**3/g)	2.000E+01	2.000E+01		DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	2.000E+01	2.000E+01		DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	2.000E+01	2.000 E+01		DCNUCDWE(1)
DCLR	Leach rate constant of Ac-227 (/yr)	0.0002+00	0.0002+00	8.2452-03	Rleach(1,1)
				1	1
LYOT	Bearing of X axis (clockwise angle N>X in degrees)		9.000E+01		DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.0002+02		SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction		1.0002+02		SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	3.438E+01	3.438E+01		AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	6.5622+01	6.5622+01		AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	2.340E+02	2.340E+02		AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1		2.660E+02	•	AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2		3.438E+01		AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2		6.5622+01		AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	2.680E+02	2.6802+02		AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	•	3.000E+02		AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3		0.0002+00		AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	1.0002+02	1.0002+02	!	AGRIXY(2,3)

Irrigation not used:

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not used not used not used

not used not used not used

not used not used

not used

2.000E+00 2.500E-01 2.500E-01

9.000E-01 7.000E-01 1.700E-01

1.0002-01 2.0002+01 2.5002-01 2.5002-01

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RWEATHER(3) FINTCEPT(3,1)

FINTCEPT(3,2)

DROOT (3) YIELD (4) GROWTIME (4)

FOLI_F(4) RWEATHER(4) FINTCEPT(4,1) FINTCEPT(4,2)

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ile	: Sitel.ROF				
	Site-Specific Para	ameter Summa:	ry (continue)	i)	
		User		RESRAD	Parameter
fenu	Parameter	Input	Default	computed	Name
i		-		-	
ISZN	Number of unsaturated zone strata	1	1		ทร
ISZN	Unsat. zone 1, thickness (m)	4.0002+00	4.0002+00		H(1)
SZN	Unsat. zone 1, soil density (g/cm**3)	1.5002+00	1.500E+00		DENSUZ (1)
JSZN	Unsat. zone 1, total porosity	4.000E-01	4.0002-01		TPUZ(1)
ISZN		2.0002-01	2.0002-01		EPUZ(1)
SZN	Unsat. zone 1, field capacity	3.000E-01	3.000E-01		FCUZ(1)
SZN	Unsat. zone 1, hydraulic conductivity (m/yr)	1.0002+01	1.0002+01		HCUZ(1)
SZN		5.300E+00	5.3002+00		BUZ(1)
SZN		1.0002-01	1.0002-01		ALPHALU(1)
i			i	i i i i i i i i i i i i i i i i i i i	i i i
ZNE	Well pump intake depth (m below water table)	1.0002+01	1.0002+01		DWIBWT
ZNE		5.000E+00	5.000E+00		DPTHAQSW
ZNE			1.000E+02		DPTHAQ
ZNE			1.5002+00		DENSAQ
ZNE			4.000E-01		TPSZ
ZNE			2.000E-01	•	IPSZ
		1.0002+02			HCSZ
ZNE			2.000E-02		HGW
ZNE	Satur, zone hydraulic gradient to surface water body				HGSW
			3.0002+00		ALPHALOW
ZNE			1.0002+01		ALPHALOSW
			4.000E-01		ALPHATW
	lateral (horizontal) dispersivity to SWB (m)		1.0002+00		ALPHATSW
		2.0002-02	•	•	ALPHAVW
ZNE			6.000E-02		ALPHAVSW
ZNE			0.0002+00		RIAOW
ZNE			0.0002+00		RIAOSW
ZNE			1.0002+00		EVAPTRACW
	Evapotranspiration coefficient over aquifer to SWB		1.0002+00	•	EVAPTRAOSW
	Runoff coefficient over aguifer to well		1.0002+00		RUNOFFAQW
	Runoff coefficient over aquifer to SWB		1.0002+00		RUNOFFAOSW
	Concentration of mobile colloids in the aguifer		0.0002+00	•	CCOL
		0.0002+00			K1Co1

No Vegetables considered

	Jit Help					
Eont:	MS LineDraw 💌 7.4 💌 🖉 📳 📴 Page: 🗾 🗸	¥ ★				
	D-OFFSITZ, Version 4.0 TH Limit = 30 days		20 16:52 Pa	age 27		,
	t Dose Report	01/11/20		-y/		
	: RESRAD-OFFSITE Default Parameters					
File	: Sitel.ROF					
	Site-Specific Para	ameter Summan	ry (continued	i)		
		User		RESRAD	Parameter	
Menu	Parameter	Input	Default	computed	Name	
INGE	Leafy vegetable consumption (kg/yr)	not used	1.4002+01		DVI(2)	
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01		FVEG(2)	
INGE		not used	6.300E+01		DMI(1)	
INGE	Fraction of meat lfrom affected area	not used	1.0002+00		FMEMI(1)	
	Milk consumption (L/yr)	not used	9.200E+01		DMI(2)	
INGE		not used	1.0002+00		FMEMI(2)	
INGE	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01		SOIL	
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.0002-01		YIELD(1)	
VEGE		not used	1.7002-01		GROWTIME(1)	
VEGE	Translocation Factor for Non-Leafy	not used	1.0002-01		FOLI_F(1)	
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.0002+01		RWEATHER(1)	
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01		FINTCEPT(1,1)	
VEGE		not used	2.5002-01		FINTCEPT(1,2)	
VEGE	Depth of roots for Non-Leafy (m)	not used	1.2002+00		DROOT (1)	
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.5002+00		YIELD(2)	
VEGE	Growing Season for Leafy (years)	not used	2.500E-01		GROWTIME (2)	
VEGE		not used	1.0002+00		FOLI_F(2)	
VEGE	······································	not used	2.0002+01		RWEATHER(2)	
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01		FINTCEPT(2,1)	
	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01		FINTCEPT(2,2)	
VEGE		not used	9.000E-01		DROOT (2)	
	Wet weight crop yield for Pasture (kg/m**2)	•	1.1002+00		YIELD(3)	
VEGE		not used	8.000E-02		GROWTIME (3)	
VEGE	Translocation Factor for Pasture	not used	1.0002+00		FOLI_F(3)	
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01		RWEATHER(3)	

View - SUMMARY.REP

VZGZ | Translocation Factor for Pasture VZGZ | Weathering Removal Constant for Pasture VZGZ | Foliar Interception Fraction for dust Pasture VZGZ | Foliar Intercept-n Fract-n for irrigation Pasture VZGZ | Depth of roots for Pasture (m) VZGZ | Wet weight crop yield for Grain (kg/m**2) VZGZ | Growing Season for Grain (years) VZGZ | Translocation Factor for Grain VZGZ | Weathering Removal Constant for Grain VZGZ | Foliar Intercept-n Fract-n for irrigation Grain VZGZ | Foliar Intercent-n Fract-n for irrigation Grain

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Now Switch to Radon only:

All locations matter

Bearing of X axis (clockwise angle from X dimension of primary contamination Y dimension of primary contamination		90 100 100	degrees meters meters			
	Smaller	Larger	Smaller	Larger		
Location	X Coor	dinate	Y Coo	ordinate		
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters	
Leafy vegetables plot	34.375	65.625	268	300	meters	
Pasture, silage growing area	0	100	450	550	meters	
Grain fields	0	100	300	400	meters	
Dwelling site	34.375	65.625	134	166	meters	
Surface water body	-100	200	550	850	meters	
Display Map						
Save						

			Fraction of	water from	Number of individuals to	
Description of water usage	Quantity		Surface body	Well	compute well water needs	
Consumption per person	510	Liters/year	0	1	neeus	
Use indoors of dwelling per person	225	Liters/day	0	1	4	
Beef cattle per animal	50	Liters/day	0	1	2	
Dairy cows per animal	160	Liters/day	0	1	2	
Irrigation applied to:					Area of Plot (square meters)	
Fruit, grain, non-leafy vegetables	.2	m per year	0	1		
Leafy vegetables	.2	m per year	0	1	1000	
Pasture, silage	.2	m per year	0	1	10000	
Livestock feed grain	.2	m per year	0	1	10000	
Offsite dwelling site	.2	m per year	0	1	1000	
Well pumping rate:		- 5	100 cu	bic meters/ye	ar	
Well pumping rate needed to suppor	t specified wa			bic meters/ye		
······ F -····F ···· 3 · · · · · · · · · · · · · ·						
Save						
Cancel						

Particulate inhalation and ingestion are not used

Inhalation and External Gamma						
Inhalation rate:	8400 m³/year					
<u>Mass loading of all particulates above primary contamination:</u>	.0001 grams/m³					
Respirable particulates as a fraction of total particulates:	1					
Massloading and respirable fraction at offsite locations						
 Use same values as for primary contamination 						
O Input different values						
Indoor to outdoor <u>d</u> ust concentration ratio:	.4					
External gamma penetration factor:						
Shape of Primary Contamination						
Occupancy <u>F</u> actors						
Save						
Cancel						

Radon parameters are now accessible and editable

In Radon		
Effective radon diffusion coefficient of cover:	.000002	m²/s
Effective radon diffusion coefficient of co <u>n</u> taminated zone:	.000002	m²/s
Effective radon diffusion coefficient of floor:	.0000003	m²/s
el <u>Thickness</u> of floor and foundation:	.15	meters
Introduction Effective radon diffusion coefficient of cover: Introduction Effective radon diffusion coefficient of contaminated zone: Image: Control of the state of the stateo	2.4	g/cm³
Ti Total porosity of floor and foundation:	.1	
Total <u>porosity</u> of floor and foundation: Wolumetric <u>w</u> ater content of floor and foundation:	.03	
Depth of Foundation <u>b</u> elow ground level:	-1	meters
	2	meters
Building room height:	2.5	meters
Building air <u>e</u> xchange rate:	.5	1/hr
A Building indoor area factor:	0	
Image: Second	.25	
	.15	
Effective radon diffusion coefficient of nonleafy veg field:	.000002	m²/s
	.000002	m²/s
Effective radon diffusion coefficient of pasture:	.000002	m²/s
Effective radon diffusion coefficient of leafy vegetable field: Effective radon diffusion coefficient of pasture: Effective radon diffusion coefficient of livestock grain field: Effective radon diffusion coefficient of offsite dwelling site:	.000002	m²/s
Effective radon diffusion coefficient of offsite dwelling site:	.000002	m²/s
er Save		·
3	1	
Run Cancel		
<u> </u>		
d Factors		

Vegetable ingestion is off

File Ed	lit Help				
Eont:	4S LineDraw 🗸 7.4 🖌 🖉 📳 Page: 🛐	₹			
Parent Title	D-OFFSITE, Version 4.0 T4 Limit = 30 days Dose Report : RZSRAD-OFFSITE Default Parameters : Sitel.ROF		20 17:01 P		
	Site-Specific P	arameter Summa	ry (continue	d)	
1		User	1	RESRAD	Parameter
Menu	Parameter	Input	Default	computed	Name
INGE	Leafy vegetable consumption (kg/yr)	not used	1.4002+01		DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01	i	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	i	DMI(1)
INGE	Fraction of meat lfrom affected area	not used	1.000E+00	1	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01		DMI (2)
INGE	Fraction of milk from affected area	not used	1.000E+00	i	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.6502+01		SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.0002-01		YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.7002-01	i	GROWTIME (1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	i	FOLI F(1)

		1	1 1	1	
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.0002-01	 YIELD(1)	
VEGE	Growing Season for Non-Leafy (years)	not used	1.7002-01	 GROWTIME (1)	
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	 FOLI_F(1)	
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.0002+01	 RWEATHER(1)	
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	 FINTCEPT(1,1)	
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	 FINTCEPT(1,2)	
VEGE	Depth of roots for Non-Leafy (m)	not used	1.200E+00	 DROOT (1)	
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	 YIELD(2)	
VEGE	Growing Season for Leafy (years)	not used	2.500E-01	 GROWTIME (2)	
VEGE	Translocation Factor for Leafy	not used	1.000E+00	 FOLI_F(2)	
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01	 RWEATHER(2)	
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01	 FINTCEPT(2,1)	
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01	 FINTCEPT(2,2)	
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01	 DROOT (2)	
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.1002+00	 YIELD(3)	
VEGE	Growing Season for Pasture (years)	not used	8.0002-02	 GROWTIME (3)	
VEGE	Translocation Factor for Pasture	not used	1.0002+00	 FOLI_F(3)	
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01	 RWEATHER (3)	
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01	 FINTCEPT(3,1)	
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.5002-01	 FINTCEPT(3,2)	
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01	 DROOT (3)	
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01	 YIELD(4)	
VEGE	Growing Season for Grain (years)	not used	1.7002-01	 GROWTIME (4)	
VEGE	Translocation Factor for Grain	not used	1.000Z-01	 FOLI_F(4)	
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01	 RWEATHER(4)	
VEGE	Foliar Interception Fraction for dust Grain	not used	2.5002-01	 FINTCEPT(4,1)	
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.5002-01	 FINTCEPT(4,2)	

Applicable Radon parameters used.

	able Radon parameters used.			
SEXT			4.633E-02	 FRACA(71)
SEXT	Ring 72	not used	2.2702-02	 FRACA (72)
				1
OCCD	Fraction of time spent indoors on contaminated site			 FIND
OCCD	Fraction of time spent outdoors on contaminated site			 FOTD
OCCU			5.000 <u>-</u> 01	 FINDDWELL
OCCD	Fraction of time spent outdoors in Offsite Dwelling			FOTDDWELL
OCCD			1.0002-01	OCCUPANCY (1)
OCCD		1.0002-01	1.0002-01	 OCCUPANCY (2)
OCCD		1.0002-01	1.0002-01	 OCCUPANCY (3)
OCCD	Fraction of time spent outdoors in agri. area 4	1.000E-01	1.000E-01	 OCCUPANCY (4)
RADN	Diffusion coefficient for radon gas (m/sec):			1
RADN	in cover material	not used	2.0002-06	 DIFCV
RADN	in contaminated zone soil	2.0002-06	2.0002-06	 DIFCZ
RADN	in fruit, grain and non-leafy vegetable field	2.0002-06	2.0002-06	 DIFOS(1)
RADN	in leafy vegetable field	2.0002-06	2.0002-06	 DIFOS(2)
RADN	in pature	2.0002-06	2.0002-06	 DIFOS(3)
RADN	in livestock grain field	2.0002-06	2.0002-06	 DIFOS(4)
RADN	in offsite dwelling site	2.0002-06	2.0002-06	 DIFOS(5)
RADN	in foundation material	not used	3.0002-07	 DIFFL
RADN	Thickness of building foundation (m)	not used	1.500E-01	 FLOOR1
RADN	Bulk density of building foundation (g/cm**3)	not used	2.4002+00	 DENSFL
RADN	Total porosity of the building foundation	not used	1.0002-01	 TPFL
RADN	Volumetric water content of the foundation	not used	3.000E-02	 PH2OFL
RADN	Building depth below ground surface (m)	not used	-1.000E+00	 DMFL
RADN	Radon vertical dimension of mixing (m)	2.0002+00	2.0002+00	 HMIX
RADN	Height of the building (room) (m)	not used	2.500E+00	 HRM
RADN	Average building air exchange rate (1/hr)	not used	5.000E-01	 REXG
RADN	Building interior area factor	not used	0.0002+00	 FAI
RADN	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	 EMANA(1)
RADN	Emanating power of Rn-220 gas	not used	1.5002-01	 EMANA(2)
C14	C-14 evasion layer thickness in soil (m)	not used	3.0002-01	 DMC
C14 I	Vertical dimension of mixing for vegetation (m)	not used	1.0002+00	 HMIXV
I	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	 C14EVSN

- \times Bug: Test 049

Documented in Bug_ Test 049.msg of 2/14/2020 3:09 PM

LePoire, David J.

Thu 2/13/2020 9:32 AM

If the aquatic pathway is the only one on, the "Sediment from Primary Contamination delivery ratio" on the Offsite Dwelling Area is still enabled.

It is set to zero, but if I click on the button, I get a run-time error 5 and the code crashes.

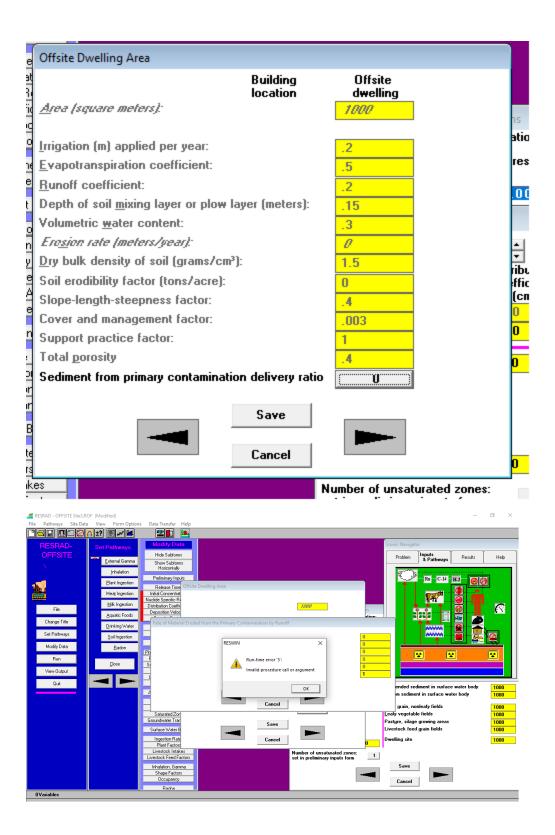
I repeated this and also made sure the button works when all pathways are enabled.

I do not think this is a show-stopper since it is rare since the user would not think to go here, it has the correct default, and stops the program (i.e., does not give wrong results).

Please let us know your decision on this issue.

Thanks,

Dave



12.82 TEST CASE 050 TESTER'S REPORT

Documented in Results Test Case 050.msg of 2/14/2020 3:08 PM

Results Test Case 050

LePoire, David J.

Thu 2/13/2020 1:14 PM

Summary: Passed by maintaining a set of nuclide-specfic properties under a change from one radionculdie transformaton database (ICRP-38) to another (ICRP-107)

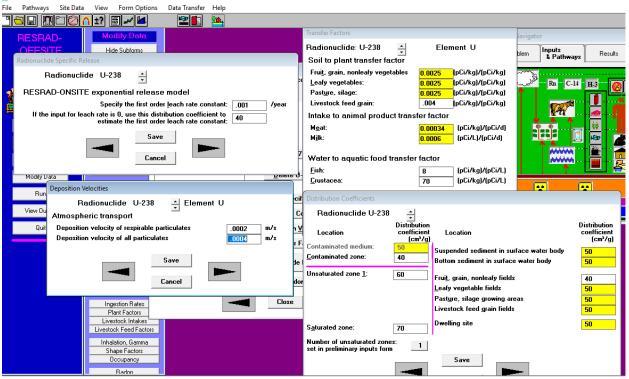
Add U-238 at 100 pCi/g and Po-210 at 60 pCi/g

Change some nuclide and element specific parameters for U-238

Start with ICRP-38 and then change to ICRP-107 to see if the radionculide specific properties are maintained.

RESRAD - OFFSITE Site4.ROF (Modified)	– 0° ×
File Pathways Site Data View Form Options Data Transfer Help	
RESRA Title & Radiological Data	Iconic Navigator
OFFSI Litle: RESRAD-OFFSITE Default Parameters	Problem Inputs Results Help
Version	Initial Concentrations
Location of dose, slope and transfer factor database: C:\RESRAD_FAMILY\DCF\3.1	Nuclide Concentration: 60 pCi/g contaminated List of ICRP38
Radionuclide transformations based on C ICRP 107 © ICRP 38	List of Nuclides Present zone Nuclides with half life greater than 30 days
ICRP 60 based external, inhalation, and ingestion dose conversion factors	at the Site
External exposure dose library ICRP 60	Pb-210 50 Ac-227 A Po-210 60 Ag-105
File Internal exposure dose library ICRP 72 (Adult)	Ra-226 70 Ag-108m Th-230 80 Ag-110m
Change T Slope factor (risk) library FGR 13 Morbidity 🗸	U-234 90 Ali26 U-238 100 Am-241
Set Pathw	Add Ac-227 21.77y Am-242m Am-243
	Ar-37 No DCFs
Modify D. Cut-off half life: 30 days 💌	Delete Po-210 Ar-33 No DLFs As-73 Au-195
Run Number of nuclides in the database with half life greater than the cut-off 209	Ba-133
View Outs	Be-7
	Distribution Coefficients Bi-207 Bi-210m
Quit Calculation Time points	Deposition Velocities Bk-247 Bk-249
Number of points: 2048 Ulinear spacing Ulinear spacing Ulinear spacing	Iransfer Factors C-14 Ca-41
Minimum time increment between points (year):	All Nuclide Factors Ca-45 Cd-109
Update progress of computation message every:	Cd-113 Cd-113m
Save input file when a form is saved	Turn on Radon Pathway Cd-115m V
Use line draw character	Close
Close	Liuse
Livestock Feed Factors Inhalation, Gamma Shape Factors Occupancy Radron	

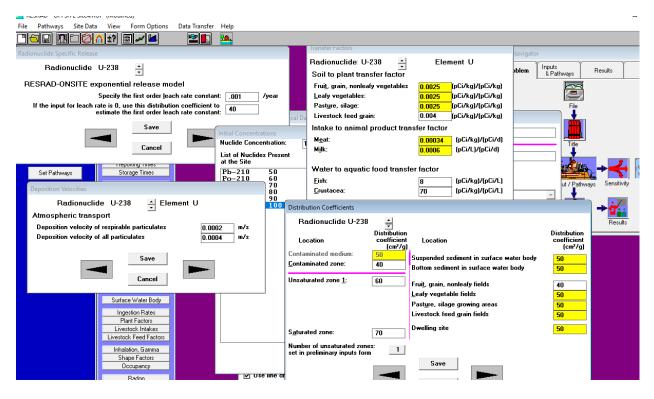
RESRAD - OFFSITE Site4.ROF (Modified)



Then Change to ICRP-107

a RESRAD - OFFSITE Site4.ROF (Modified)	– ō ×
File Pathways Site Data View Form Options Data Transfer Help	
RESRAD- Title & Radiological Data	Iconic Navigator
OFFSITE Litle: RESRAD-OFFSITE Default Parameters	Problem Inputs Results Help
Version 4.0	Initial Concentrations
Location of dose, slope and transfer factor database: C:\RESRAD_FAMILY\DCF\3.1	Nuclide Concentration: 50 pCi/g contaminated List of ICRP107
Radionuclide transformations based on © ICRP 107 C ICRP 38	List of Nuclides Present greater than 30 days
ICRP 60 based external, inhalation, and ingestion dose conversion factors	at the Site Pb-210 50 Ac-227
External exposure dose library DCFPAK3.02	Po-210 60 Ra-226 70 Ag-105
File Internal exposure dose library DOE STD-1196-2011 (Reference Person)	Th-230 80 Ag-110m U-234 90 Al-26
Change Title Slope factor (risk) library DCFPAK3.02 Morbidity	U-238 100 Am-241
Set Pathways Transfer factor library RESRAD Default Transfer factors	<u>Add Ac-227 21.772y</u> Am-242m Am-243
Modify Data Cut-off half life: 30 days	Ar-37 No DCFs Delete Pb-210 Ar-39 No DCFs
Modily Data	Ar-42 No DCFs
Run Number of nuclides in the database with half life greater than the cut-off 225	Nuclide Specific Release Ba-133
Number of nuclides lacking dose conversion factors or risk factors: 6	Be-10 Distribution Coefficients Be-7
	Bi-207
Quit Calculation Time points	Deposition <u>V</u> elocities Bi-208 Bi-210m
Number of points: 2048 ▼ ⊙ Linear spacing CLinear spacing	Bk-249
Minimum time increment between points (year):	All Nuclide Factors C-14 Ca-41
Update progress of computation message every:	Ca-45 Cd-109
Save input file when a form is saved	Turn on Radon Pathway Cd-113 V
✓ Use line draw character	Close
Livestock Feed Factors	
Inhalation, Gamma	
Shape Factors	

Values were maintained:



12.83 TEST CASE 051 TESTER'S REPORT

Documented in Results_ Test Case 051.msg of 2/14/2020 3:08 PM

Results: Test Case 051

LePoire, David J.

Thu 2/13/2020	0 2:01 PM
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Libraries available for ICRP-107

Title: RESRAD-OFFSITE Defaul	t Parameters			
Location of dose, slope and transfe	er factor database:	C:\RESRAD_FAM	ILY\DCF\3.1	
Radionuclide transformations base	d on	ICRP 107	C ICRP 38	
ICRP 60 based external, inhalation	, and ingestion dose	conversion factors		
External exposure dose library	DCFPAK3.02			
Internal exposure dose library	DOE STD-1196-2	011 (Reference Per	ion)	
Slope factor (risk) library	DCFPAK3.02 (Ad			
Transfer factor library	DCFPAK3.02 (Ag DCFPAK3.02 (Ag			
Transfer factor library	DCFPAK3.02 (Ag			
	DCFPAK3.02 (Ag			
	DUFFAKS.UZ Mg	6.01		

Litle: RESRAD-OFFSITE Defau	ult Parameters					
Location of dose, slope and transf	fer factor database:	C:\RESRAD_FAMILY\DCF\3.1				
Radionuclide transformations base ICRP 60 based external, inhalation	100 - 1000 - 1000 - 100	ICRP 107 C ICRP 38 e conversion factors				
External exposure dose library	DCFPAK3.02		*			
Internal exposure dose library	DOE STD-1196-2011 (Reference Person)					
Slope factor (risk) library	DCFPAK3.02 Mor	rbidity				
anaba ingerer (use) upidity	DCFPAK3.02 Morbidity					
Transfer factor library	DCFPAK3.02 Mor DCFPAK3.02 Mor					

With ICRP-38 after creating NoBa137

<u>Title:</u> RESRAD-OFFSITE Defau	It Parameters		
ocation of dose, slope and transf	er factor database:	C:\RESRAD_FAM	ILY\DCF\3.1
Radionuclide transformations base	d on	C ICRP 107	ICRP 38
ICRP 60 based external, inhalatior	n, and ingestion dose	e conversion factors	
External exposure dose library	ICRP 60		
Internal exposure dose library	ICRP 72 (Adult)		
Slope factor (risk) library	FGR 11		
Slope factor (risk) library Transfer factor library	ICRP 72 (Adult) ICRP 72 (Age 1) ICRP 72 (Age 10)		
Transfer factor library	ICRP 72 (Adult) ICRP 72 (Age 1)		

Litle: RESRAD-OFFSITE Defau	It Parameters		
Location of dose, slope and transf	er factor database:	C:\RESRAD_FAMILY\DCF\3.1	
Radionuclide transformations base	d on	C ICRP 107 @ ICRP 38	
ICRP 60 based external, inhalation	, and ingestion dose	conversion factors	
the experimental second second second second second second			
External exposure dose library	ICRP 60		
External exposure dose library Internal exposure dose library	ICRP 60		

ICRP-107 after adding library "Test-Release 4.0

Litle: RESRAD-OFFSITE Defau	It Parameters		
Location of dose, slope and transf	er factor database:	C:\RESRAD_FAMILY\DCF\3.1	
Radionuclide transformations base	d on	● ICRP 107 C ICRP 38	
ICRP 60 based external, inhalation	n, and ingestion dose	conversion factors	
External exposure dose library	DCFPAK3.02		1
Internal exposure dose library	DOE STD-1196-2	011 (Reference Person)	
Slope factor (risk) library	DCFPAK3.02 (Ag		-
Transfer factor library	DCFPAK3.02 (Ag DCFPAK3.02 (Ag		1
(DCFPAK3.02 (Ag	e 5)	
Cut-off half life:	DCFPAK3.02 (Inf. 0 DOE STD-1196-2	antj 011 (Reference Person)	
Gat off fight fire: [3	FRMAC-ICRP107		
Number of nucli	Test Release4.0	Murnan me greater than the curon 1223	

Title & Radiological Data <u>Litle:</u> RESRAD-OFFSITE Defau	lt Parameters		
Location of dose, slope and transf	er factor database:	C:\RESRAD_FAMILY\DCF\3.1	
Radionuclide transformations base	d on	€ ICRP 107 C ICRP 38	
ICRP 60 based external, inhalation	n, and ingestion dose	conversion factors	
External exposure dose library	DCFPAK3.02		
Internal exposure dose library	DOE STD-1196-2	011 (Reference Person)	
Slope factor (risk) library	DCFPAK3.02 Mor		
Transfer factor library	DCFPAK3.02 Mor DCFPAK3.02 Mor FBMAC-ICBP107	bidity	
Cut-off half life: 3	0 Test Release4.0		
		with half life greater than the cut-off 225 e conversion factors or risk factors: 6	_

12.84 TEST CASE 052 TESTER'S REPORT

Documented in Results_Test Case 052.msg of 2/14/2020 3:46 PM

Results: Test Case 052

LePoire, David J.

Fri 2/14/2020 2:38 PM

Summary: Pass, the numbers are the same in the manual and in the files after running the application

Follow instructions in E.4 of the manual (volume 1)

E.4.1 Pb-210 under ICRP-38

Summary: the numbers are the same in the manual and in the files after running the application

→ * ↑ → This PC → OSD	isk (C:) → RES	SRAD_Family > OFFSITE > 4.0	~	ට Search 4.0		
anize 🝷 New folder					== -	
OFFSITE	^	Name	Date modified	Туре	Size	
2.6		CorRegRO.exe	3/5/2009 1:27 PM	Application	568 KB	
2.7		GRPHCNV5.exe	4/23/2019 9:28 AM	Application	504 KB	
2_5		GRPHCNVP.exe	4/22/2019 6:59 PM	Application	565 KB	
3.1		LHSRO.exe	5/12/2006 4:59 PM	Application	782 KB	
3.1_final		ResOCalc.exe	12/2/2019 5:11 PM	Application	2,093 KB	
		🚅 ResOwin.exe	12/3/2019 11:54 PM	Application	5,744 KB	
3.2		🧭 Wresplot.exe	6/14/2019 6:12 PM	Application	110 KB	
3.3.3_beta		Graphics_Input_Data.dll	6/14/2019 6:12 PM	Application extens	50 KB	
3.100		GRAPHICS.ASC	2/14/2020 10:46 AM	ASC File	3,604 KB	
3_1		Area_factor_test1.CHN	12/16/2019 10:11	CHN File	1 KB	
4.0		Site4.CHN	2/14/2020 10:54 AM	CHN File	2 KB	
Metfiles		😫 ResOHelp.chm	4/15/2019 12:40 AM	Compiled HTML	308 KB	
 	~	GRAPHICS.INI	12/20/2019 12:21	Configuration sett	1 KB	
File name:				✓ All types (*.*)		
				Open	Cance	1

Compare information in the .CHN file to steps 1-4 on page E-5

E.4.1 ²¹⁰Pb under the ICRP-38 Transformation Database

The ²¹⁰Pb(22.3y) transforms to ²¹⁰Bi(0.01372y) which transforms to ²¹⁰Po(0.3789y) which transforms to the stable isotope ²⁰⁶Pb. When using a 30 day (0.082136y) cut-off half-life with the ICRP 72 (adult) internal exposure library and the FGR13 morbidity risk library, the five steps above yield:-

- thread 1, fraction = 1.0000, thread ²¹⁰Pb, ²¹⁰Bi, ²¹⁰Po;
- thread 1, fraction = 1.0000, thread ²¹⁰Pb, ²¹⁰Po;
- condensed thread 1, fraction = 1.0000, condensed thread ²¹⁰Pb+D, ²¹⁰Po;
- ²¹⁰Pb+D = ²¹⁰Pb + 1.0000 ²¹⁰Bi;

```
C:\RESRAD Family\OFFSITE\4.0\Site4.CHN - Notepad++
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File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
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🔚 VROFF_CASE2.CHN 🗷 🔚 Lepoire 1.nfo 🗵 🔚 Site4.CHN 🗵
                                                                                                                4 🕨
     All data in Nukes(), order matches NUCNAM list in .ROF file:
    # Nuclide Half-Life
001 Pb-210+D 2.23000E+01
                                                  Kd Def Fraction nNuc
1.000E+02 1.00000E+00 02
                                        AtWt
                                                                              nNuc Decay Chain
  3
                                        209.9842
                                                                                     Pb-210+D Po-210
  4 002 Po-210
                        3.78864E-01 209.9829 1.000E+01 1.000000E+00 01 Po-210
                        DPlusAll() data:
     -----
  5
  6 Pb-210+D : Bi-210
  8 Decay Chain: Pb-210
                             First Branch
  9
                                                       Second Branch
                                                                                  Third Branch
                                                                                                         Fourth Br
 10
                            _____
     # Nuclide Half-Life # Nuclide Fraction. # Nuclide Fraction # Nuclide Fraction # Nuclide
 12 001 Pb-210 2.230E+01 002 Bi-210 1.0000E+00 000 0.0000E+00 000 0.0000E+00 000

        13
        002
        Bi-210
        1.372E-02
        003
        Po-210
        1.0000E+00
        000

        14
        003
        Po-210
        3.789E-01
        000
        1.0000E+00
        000

                                                          0.0000E+00 000
0.0000E+00 000
                                                                                         0.0000E+00 000
                                                                                                                  C
                                                                                        0.0000E+00 000
                                                                                                                  (
 15
 16 All Threads In Decay Chain: Pb-210
 17 # Fraction Nuclides:
 18 001 1.0000E+00 Pb-210 Bi-210 Po-210
 19 Total Thread Fractions: 1.0000E+00
 20 1 - Total Thread Fractions: 0.0000E+00
 21
 22 Condensed Threads In Decay Chain: Pb-210 Fix Level = 0
 23
     # Fraction Nuclides:
 24 001 1.0000E+00 Pb-210+D Po-210
<
```

Compare DCF results to step 5 on page E-6: They are the same

5. Dose Coefficient, in mSv/Bq, for ingestion 210Pb +D = $6.9 \, 10^{-4} + 1.0 \times 1.3 \, 10^{-6} = 6.913 \, 10^{-4}$ inhalation 210Pb +D = 5.6 10^{-3} + 1.0 × 9.3 10^{-5} = 5.693 10^{-3} . Slope Factor, in risk/Bq, for ingestion of food 210Pb +D = $3.189 \ 10^{-8} + 1.0 \times 3.514 \ 10^{-10} = \frac{3.22 \ 10^{-8}}{3.22 \ 10^{-8}}$. ingestion of water 210Pb +D = $2.381 \ 10^{-8} + 1.0 \times 2.411 \ 10^{-10} =$ $2.41 \, 10^{-8}$ ingestion of soil 210Pb +D = $3.189 \ 10^{-8} + 1.0 \times 3.514 \ 10^{-10} = \frac{3.22 \ 10^{-8}}{3.22 \ 10^{-8}}$ inhalation ²¹⁰Pb +D = $4.27 \ 10^{-7} + 1.0 \times 1.23 \ 10^{-8} = 4.393 \ 10^{-7}$ 1.11 0.4 cc. 1 1 c . 1.4 11.1 1.0 -View - SUMMARY.REP File Edit Help Eont: MS LineDraw - 7.4 *e* e B Page: 🔁 - ₹★ RESRAD-OFFSITE, Version 4.0 Page T4 Limit = 30 days 02/14/2020 10:46 2 Parent Dose Report Title : RISRAD-OFFSITE Default Parameters File : Site4.ROF Dose Conversion Factor (and Related) Parameter Summary Current Library: ICRP 60 Default Library: ICRP 60 Current Parameter Menu Parameter Value Default Name DCSF DCF's for external ground radiation, (mSv/yr)/(Bq/g) DOSE Bi-210 (Source: ICRP 60) 1.4802-03 | 1.4802-03 DCFEXT (11 5.3542-04 5.3542-04 DCSF Pb-210 (Source: ICRP 60) DCFEXT (2) Po-210 (Source: ICRP 60) 1.3342-05 1.3342-05 DCFEXT (3) DCSF Current Library: ICRP 72 (Adult) Default Library: ICRP 72 (Adult) Current Parameter Menu Parameter Value Default Name DOSE Dose conversion factors for inhalation, mSv/Bq: 5 6937-03 Pb-210+D 5.693E-03 DCF2(1) DCSF DCSF Po-210 4.3002-03 4.3002-03 DCF2(2) Dose conversion factors for ingestion, mSv/Bg: DCSF 6.9132-04 | 6.9132-04 | 1.2002-03 | 1.2002-03 | DCSF Pb-210+D DCF3(1) DCSF | Po-210 DCF3(2)

Compare Slope Factor results to step 5 on page E-5: They are the same

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		4/2020 10:4	6 Page 2	
Risk R	eport : RISRAD-OFFSITE Default Parameters			
	: Site4 ROF			
	Cancer Risk Slope Factors Summary			
	Current library: FGR 13 Morbidi Default library: FGR 13 Morbidi	-		
	belauit libiary. For 13 holbidi	C Y		
	1	Current	I	Parameter
Menu	Parameter	Value	Default	Name
DCSF	Ground external radiation slope factors, 1/yr per (Bq/q):			
DCSF	Pb-210+D	1.132-07	1.132-07	SLPF(1,1)
DCSF	Po-210	1.072-09	1.072-09	SLPF(2,1)
DCSF	<mark>Inhalation</mark> , slope factors, <mark>1/(Bq)</mark> : Pb-210+D	4 267-07	4.392-07	SLPF(1,2)
DCSF	PD-210			SLPF(1,2)
	Food ingestion, slope factors, 1/(Bq):	i 🔜 🚽	Í	Í
DCSF	Pb-210+D		•	SLPF(1,3)
DCSF	Po-210	6.08 <u>2</u> -08	6.08 <u>2</u> -08	SLPF(2,3)
DCSF	Water ingestion, slope factors, 1/(Bg):			
DCSF	Pb-210+D	2.412-08	2.412-08	SLPF(1,4)
DCSF	Po-210	4.78E-08	4.78E-08	SLPF(2,4)
DCSF				
DCSF	<mark>Soil ingestion, slope factors, 1/(Bq);</mark> Pb-210+D	3.222-08	3.222-08	SLPF(1,5)
	12 21012	0.222 00	0.222 00	SLPF(2,5)

E.4.2 Pb-210 under ICRP-107

Summary: the numbers are the same in the manual and in the files after running the application

From E.4.2 page E-6

(Note: There was a minor typo identified in the manual. The ²¹⁰Hg should have been ²⁰⁶Hg

- thread 1, fraction = 1.0000, ²¹⁰Pb, ²¹⁰Pb, ²¹⁰Po, thread 2, fraction = 1.32 10⁻⁶, ²¹⁰Pb, ²¹⁰Bi, ²⁰⁶Tl, thread 3, fraction = 1.9 10⁻⁸, ²¹⁰Pb, ²¹⁰Hg, ²⁰⁶Tl;
- thread 1, fraction = 1.0000, ²¹⁰Pb, ²¹⁰Po, thread 2, fraction = 1.32 10⁻⁶, ²¹⁰Pb, thread 3, fraction = 1.9 10⁻⁸, ²¹⁰Pb;
- condensed thread 1, fraction = 1.0000, ²¹⁰Pb+D, ²¹⁰Po, condensed thread 2, fraction = 1.339 10⁻⁶, ²¹⁰Pb+D1;
- 4. ${}^{210}Pb+D = {}^{210}Pb + 1.0000 {}^{210}Bi$, ${}^{210}Pb+D1 = {}^{210}Pb + 1.32/1.339 {}^{210}Bi + 0.019/1.339 {}^{210}Hg + 1.0000 {}^{206}Tl$;

```
All data in Nukes(), order matches NUCNAM list in .ROF file:
       Nuclide
                                                      Kd Def
                          Half-Life
                                             AtWt
                                                                           Fraction
                                                                                           nNuc Decay Chain
      Pb-210+D
                        2.22000E+01
                                           210.9887
                                                         1.000E+02
                                                                         9.999987E-01 02 Pb-210+D Po-210
001
                       2.22000E+01 210.9887 1.000E+02 1.339000E-06 01 Pb-210
3.78853E-01 210.9866 1.000E+01 1.000000E+00 01 Po-210
002
       Pb-210+D1
                                                                                                  Pb-210+D1
003 Po-210
                     DPlusAll() data:
Pb-210+D : Bi-210
Pb-210+D1 : (Bi-210 9.8581E-01) T1-206 (Hg-206 1.4190E-02)
Decay Chain: Pb-210
                              First Branch
                                                               Second Branch
                                                                                              Third Branch
                                                                                                                           Fourth Branch
                            # Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction
001 Pb-210 2.220E+01 002 Bi-210 1.0000E+00 004 Hg-206 1.9000E-08 000 0.0000E+00 000
002 Bi-210 1.372E-02 003 Po-210 1.0000E+00 005 Tl-206 1.3200E-06 000 0.0000E+00 000
                                                                                                                                     0.0000E+00
                                                                                                                                      0.0000E+00

        1.0000E+00
        000
        0.0000E+00
        000

        1.0000E+00
        000
        0.0000E+00
        000

        1.0000E+00
        000
        0.0000E+00
        000

                                                                                                     0.0000E+00 000
0.0000E+00 000
0.0000E+00 000

        003
        Po-210
        3.789E-01
        000
        1.0000E+00
        000

        004
        Hg-206
        1.550E-05
        005
        TI-206
        1.0000E+00
        000

                                                                                                                                      0.0000E+00
                                                                                                                                     0.0000E+00
005 T1-206 7.985E-06 000
                                                                                                                                     0.0000E+00
All Threads In Decay Chain: Pb-210
     Fraction Nuclides:
 #
001 1.0000E+00 Pb-210 Bi-210 Po-210
002 1.3200E-06 Pb-210 Bi-210 T1-206
003 1.9000E-08 Pb-210 Hg-206 T1-206
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 2.2204E-16
Condensed Threads In Decay Chain: Pb-210
                                                         Fix Level = 0
# Fraction Nuclides:
001 1.0000E+00 Pb-210+D Po-210
002 1.3390E-06 Pb-210+D1
```

Compare DCF's:

5. Dose Coefficient, in mSv/Bq, for ingestion ²¹⁰Pb +D = 6.96 10⁻⁴ + 1.0 × 1.31 10⁻⁶ = 6.973 10⁻⁴, ingestion ²¹⁰Pb +D1 = 6.96 10⁻⁴ + 0.98581 × 1.31 10⁻⁶ + 0.01419 × 0 + 1.0 × 0 = 6.972 10⁻⁴, inhalation ²¹⁰Pb +D = 5.61 10⁻³ + 1.0 × 1.33 10⁻⁴ = 5.746 10⁻³,

Eont:	MS LineDraw ▼ 7.4 ▼ 🗿 🗐 📴 Page: 2 ▼ 🗲				
	D-OFFSITE, Version 4.0 T4 Limit = 30 days 02	/14/2020 11:0	3 Page 2		
	t Dose Report : RISRAD-OFFSITE Default Parameters				
	: Site4.ROF				
	Dose Conversion Factor (and Related) Pa Current Library: DCFPAK3.0		Y		
	Default Library: DCFPAK3.0				
	I	Current	1	Parameter	
Menu	Parameter	Value	Default	Name	
DCSF	DCF's for external ground radiation, (mSv/yr)/(Bg/g)				-
DCSF	Bi-210 (Source: DCFPAK3.02)			DCFEXT(1)	
	Hg-206 (Source: DCFPAK3.02)			DCFEXT(2)	
	Pb-210 (Source: DCFPAK3.02) Po-210 (Source: DCFPAK3.02)			DCFEXT(3) DCFEXT(4)	
	T1-206 (Source: DCFPAK3.02)			DCFEXT(5)	
	I	1	I	I	
	Current Library: DCFPAK3.02 (A	dult)			
	Default Library: DCFPAK3.02 (A	dult)			
	I	Current	I	Parameter	
Menu	Parameter	Value	Default	Name	
DCSF	Dose conversion factors for inhalation, mSv/Bg:				-
	Pb-210+D		5.746E-03		
	Pb-210+D1 Po-210		5.745E-03		
2002		4.2702-03	1.2,02.03	2012(0)	
	Dose conversion factors for ingestion, mSv/Bq:	i	i i	ĺ	
	Pb-210+D Pb-210+D1		6.973E-04		
DCDE	$P_{D}=210+D1$		6.972E-04 1.210E-03		
DCSF					

Compare Slope Factors

1.0 × 0 = 5./45 10 °, Slope Factor, in risk/Bq, for ingestion of food ²¹⁰Pb +D = 3.178 10⁻⁸ + 1.0 × 3.519 10⁻¹⁰ = 3|21 10⁻⁸, ingestion of food ²¹⁰Pb +D1 = 3.178 10⁻⁸ + 0.98581 × 3.519 10⁻¹⁰ + 0.01419 × 0 + 1.0 × 1.3 10⁻⁶ = 3.21 10⁻⁸, ingestion of water ²¹⁰Pb +D = 2.39 10⁻⁸ + 1.0 × 2.41 10⁻¹⁰ = 2.41 10⁻⁸, ingestion of water ²¹⁰Pb +D1 = 2.39 10⁻⁸ + +0.98581 × 2.41 10⁻¹⁰ + 0.01419 × 0 + 1.0 × 1.3 10⁻⁶ = 2.41 10⁻⁸, ingestion of soil ²¹⁰Pb +D = 3.178 10⁻⁸ + 1.0 × 3.519 10⁻¹⁰ = 3.21 10⁻⁸, ingestion of soil ²¹⁰Pb +D = 3.178 10⁻⁸ + 0.98581 × 3.519 10⁻¹⁰ + 0.01419 × 0 + 1.0 × 1.3 10⁻⁶ = 3.21 10⁻⁸, ingestion of soil ²¹⁰Pb +D = 4.289 10⁻⁷ + 1.0 × 1.23 10⁻⁸ = 4.41 10⁻⁷, inhalation ²¹⁰Pb +D = 4.289 10⁻⁷ + 0.98581 × 1.23 10⁻⁸ + 0.01419 × 0 + 1.0 × 1.3 10⁻⁶ = 4.41 10⁻⁷,

С

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RESRAD-		4/2020 11:0	3 Page 2		_
Risk Re					
	RESRAD-OFFSITE Default Parameters				
File :	Site4.ROF				
	Cancer Risk Slope Factors Summary	Table			
	Current library: DCFPAK3.02 Morbi				
	Default library: DCFPAK3.02 Morbid				
	•	-			
I		Current	I	Parameter	
Menu	Parameter	Value	Default	Name	
DCSF	Ground external radiation slope factors, 1/yr per (Bq/q):				-
	Pb-210+D	1.152-07	1.152-07	SLPF(1,1)	
DCSF	Pb-210+D1	•	•	SLPF(2,1)	
DCSF	Po-210	1.222-09	1.222-09	SLPF(3,1)	
- I		I	I	1	
DCSF	Inhalation, slope factors, 1/(Bq):				
	Pb-210+D	•	4.412-07		
DCSF	Pb-210+D1 Po-210		4.41E-07 3.92E-07	SLPF(2,2) SLPF(3,2)	
DCSF	P0-210	3.921-07	3.921-07	SLFF (3,2)	
DCSF	Food ingestion, slope factors, 1/(Bg):			1	
	Pb-210+D	3.212-08	3.212-08	SLPF(1,3)	
DCSF	Pb-210+D1	3.212-08	3.21E-08	SLPF(2,3)	
DCSF	Po-210	6.09E-08	6.09E-08	SLPF(3,3)	
				!	
	Water ingestion, slope factors, <mark>1/(Bq):</mark> Pb-210+D	2.412-08	2.412-08	CIDE (1 A)	
	Pb-210+D	2.412-08		SLPF(1,4)	
	Po-210	•	•	SLPF(3,4)	
DCSF	Soil ingestion, slope factors, 1/(Bg):	i	i	i	
	Pb-210+D	3.21 <u>2-</u> 08			
DCSF	Pb-210+D1		•	SLPF(2,5)	
DCSF	Po-210	6.09E-08	6.09E-08	SLPF(3,5)	

E.4.3 Ac-227 under ICRP-107

Summary: the numbers are the same in the manual and in the files after running the application

- 2. T# 1, $f = 9.8348 \ 10^{-1} \ ^{227}Ac$, T# 2, $f = 2.7219 \ 10^{-3} \ ^{227}Ac$, T# 3, $f = 1.3761 \ 10^{-2} \ ^{227}Ac$, T# 4, $f = 3.8086 \ 10^{-5} \ ^{227}Ac$, T# 5, $f = 8.2571 \ 10^{-7} \ ^{227}Ac$, T# 6, $f = 2.2853 \ 10^{-9} \ ^{227}Ac$;
- 3. condensed thread 1, fraction = 1.0000, ²²⁷Ac+D;
- 4. ${}^{227}\text{Ac}+\text{D} = {}^{227}\text{Ac} + 9.8620 \ 10^{-1} {}^{227}\text{Th} + {}^{223}\text{Ra} + {}^{219}\text{Rn} + {}^{215}\text{Po} + {}^{211}\text{Pb} + {}^{211}\text{Bi} + 9.9724 \ 10^{-1} {}^{207}\text{Tl} + 2.7600 \ 10^{-3} {}^{211}\text{Po} + \frac{1.3800 \ 10^{-2} {}^{22} {}^{23}\text{Fr} + 8.2800 \ 10^{-7} {}^{219}\text{At} + 8.2800 \ 10^{-7} {}^{215}\text{Bi};$

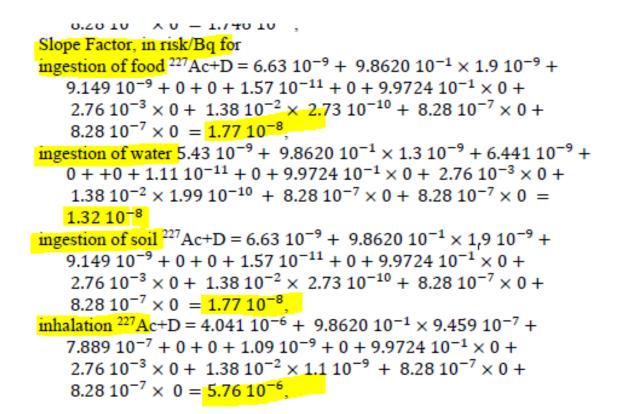
	Nuclio	ie H 7+D 2.	alf-L		AtWi		Kd Def		Fractio				y Chain							
		DP1				2/6 2	.000E+0	1 1	.0000001	+00	01	AC-2	27+0							
						3 1.000	0E+00)	(Rn-2	19 1.000	00E+00) Po-	-215 P	b-211 Bi-2	11 C	F1-207 9	9724E-01)	(Po-211 2.)	7600E-03)	(Fr-223]	.3800E-0
		,		/ (,	(/								(
Deca	y Chain:	Ac-227																		
													ranch							
4	Nuclide	Walf-Tife											Fraction			Exaction				
		2.177E+01											0.0000E+00			0.0000E+00				
		5.114E-02											0.0000E+00			0.0000E+00				
		4.183E-05									õ		0.0000E+00	000		0.0000E+00				
		3.129E-02							0.0000E-				0.0000E+00			0.0000E+00				
005	Rn-219	1.255E-07	008	Po-215	1.000	00E+00	000		0.0000E+	+00 00	0		0.0000E+00	000		0.0000E+00				
006	At-219	1.775E-06	007 1	Bi-215	1.000	00E+00			0.0000E+	00 00	0		0.0000E+00			0.0000E+00				
007	Bi-215	1.445E-05	008	Po-215	1.000	00E+00	000		0.0000E+	00 00	0		0.0000E+00	000		0.0000E+00				
800	Po-215	5.644E-11	009	Pb-211	1.000	00E+00			0.0000E+				0.0000E+00			0.0000E+00				
009	Pb-211	6.864E-05	010 1	Bi-211	1.000	00E+00	000		0.0000E+	00 00	0		0.0000E+00	000		0.0000E+00				
010	Bi-211	4.069E-06	011	F1-207	9.972	24E-01	012 Po-	211	2.7600E-	-03 00	0		0.0000E+00	000		0.0000E+00				
11	T1-207	9.069E-06	000		1.000	00E+00	000		0.0000E+	00 00	0		0.0000E+00	000		0.0000E+00				
12	Po-211	1.635E-08	000		1.000	00E+00	000		0.0000E+	00 00	0		0.0000E+00	000		0.0000E+00				
		In Decay		: Ac-22	7															
		on Nuclid																		
		-01 AC-227																		
		-03 AC-227																		
		-02 AC-227																		
		-07 Ac-227																		
		-09 Ac-227																		
		1 Fraction																		
		read Frac																		
Cond	ensed Th	reads In	Decav	Chain:	Ac-22	27 F	ix Leve	1 = 0												
		on Nuclid				-		-												

RESRAD-OFFSITE, Version 4.0 T4 Limit = 30 days 02/14/2020 16:25 Page 2 Parent Dose Report Title : RESRAD-OFFSITE Default Parameters File : Sitel.ROF Dose Conversion Factor (and Related) Parameter Summary Current Library: DCFPAK3.02 Default Library: DCFPAK3.02

Menu	Parameter	Value Default	Name
DCSF	DCF's for external ground radiation, (mSv/yr)/(Bg/g)		
DCSF	Ac-227 (Source: DCFPAK3.02)	7.0682-05 7.0682-05	DCFEXT(1)
DCSF	At-219 (Source: DCFPAK3.02)	0.0002+00 0.0002+00	DCFEXT (2)
DCSF	Bi-211 (Source: DCFPAK3.02)	6.514Z-02 6.514Z-02	DCFEXT (3)
DCSF	Bi-215 (Source: DCFPAK3.02)	3.700E-01 3.700E-01	DCFEXT (4)
DCSF	Fr-223 (Source: DCFPAK3.02)	4.751E-02 4.751E-02	DCFEXT(5)
DCSF	Pb-211 (Source: DCFPAK3.02)	9.946E-02 9.946E-02	DCFEXT (6)
DCSF	Po-211 (Source: DCFPAK3.02)	1.2722-02 1.2722-02	DCFEXT(7)
DCSF	Po-215 (Source: DCFPAK3.02)	2.555E-04 2.555E-04	DCFEXT (8)
DCSF	Ra-223 (Source: DCFPAK3.02)	1.5652-01 1.5652-01	DCFEXT(9)
DCSF	Rn-219 (Source: DCFPAK3.02)	8.027E-02 8.027E-02	DCFEXT(10)
DCSF	Th-227 (Source: DCFPAK3.02)	1.5252-01 1.5252-01	DCFEXT(11)
DCSF	T1-207 (Source: DCFPAK3.02)	6.462E-03 6.462E-03	DCFEXT(12)
	ĺ	i i i	ĺ

Current Library: DCFPAK3.02 (Adult) Default Library: DCFPAK3.02 (Adult)

Menu	Parameter	Current Value	Default	Parameter Name
	D <mark>ose conv</mark> ersion factors for <mark>inhalation, mSv/Bq</mark> : Ac-227+D	1.746E-01	1.7462-01	DCF2(1)
	D <mark>ose conversi</mark> on factors for ingestion, mSv/Bg: Ac-227+D	4.3412-04	4.3412-04	DCF3(1)



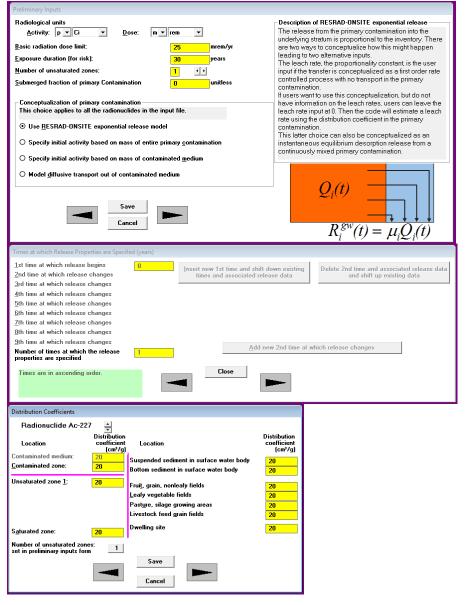
Eont: MS LineDraw - 7.4 - B B B Page: 2 - VA							
RESRAD-OFFSITZ, Version 4.0 T4 Limit = 30 days 02/14/2020 16:25 Page 2							
Risk R		4/2020 10:2	J Fage 1				
	: RESRAD-OFFSITE Default Parameters						
File	: Sitel.ROF						
	Cancer Risk Slope Factors Summary						
	Current library: D <mark>CFPAK3.02 Morbi</mark> Default library: DCFPAK3.02 Morbi						
	belaard ribrary. borrinko.or horbi	1.01					
Menu	Parameter	Current Value	 Default	Parameter Name			
menu		Value	Derault	Maibe			
DCSF DCSF	Ground external radiation slope factors, l/yr per (Bq/g):						
DCSF	AC-22/TD	4.40Ξ-05	4.40 <u>≍</u> −05	SLPF(1,1)			
DCSF	Inhalation, slope factors, 1/(Bq):			i			
DCSF	Ac-227+D	<mark>5.762-</mark> 06	5.762-06	SLPF(1,2)			
DCSF	Food ingestion, slope factors, 1/(Bq):	i and the second se	i	i			
DCSF	Ac-227+D	1.77 <u>2</u> -08	1.772-08	SLPF(1,3)			
	Water ingestion, slope factors, 1/(Bq):		i				
DCSF	Ac-227+D	1.322-08	1.322-08	SLPF(1,4)			
DCSF DCSF							
	Soil ingestion, slope factors, 1/(Bq):						

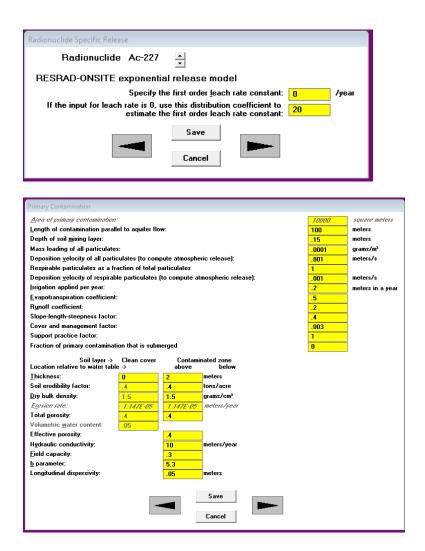
12.85 TEST CASE 053 TESTER'S REPORT

Documented in Test Case 53-JJCheng.docx of 2/19/2020 4:34 PM

Test Case – 53 – Tests OFFSITE's source conceptualization options tool

• Launched RESRAD-OFFSITE. Specified Ac-227 as the radionuclide of concern, and then selected "Use RESRAD-ONSITE exponential release model" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified, Distribution Coefficients, Radionuclide Specific Release, and the Primary Contamination input forms all displayed expectedly with input parameters associated with this conceptualization option.

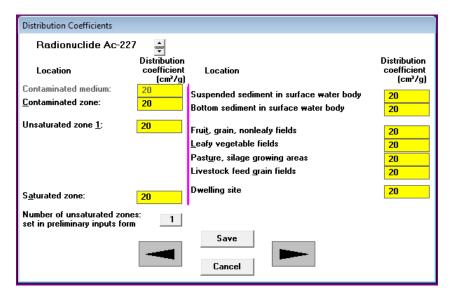




• Selected "Specify initial activity based on mass of entire primary contamination" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients, Radionuclide Specific Release, and the Primary Contamination input forms all displayed expectedly with input parameters associated with this conceptualization option.

Preliminary Inputs	
Radiological units Activity: p <u>v Ci v D</u> ose: m <u>v</u> rem <u>v</u>	Description of current conceptualization The properties of the primary contamination are used to compute the transfer of the radionuclides from the solid to
Basic radiation dose limit: 25 mrcm/yr Exposure duration (for risk): 30 years	the aqueous phase of the primary contamination, and the transport of the radionuclides through the primary contamination.
Mumber of unsaturated zones: 1 1 Submerged fraction of primary Contamination 0 unitless	The three options listed below are available to model the transfer of radionuclides from the contaminated medium to the soil moisture:
Conceptualization of primary contamination This choice applies to all the radionuclides in the input file.	Equilibrium desorption characterized by a linear distribution coefficient. Equilibrium solubility characterized by a soluble
Use <u>B</u> ESRAD-ONSITE exponential release model O Specify initial activity based on mass of entire primary <u>c</u> ontamination F Model multiple forms of contaminated media	concentration, Far from equilibrium desorption or dissolution characterized by a first order leach rate coefficient.
 Specify initial activity based on mass of contaminated medium Model diffusive transport out of contaminated medium 	
Save Cancel	All solids are contaminated

Times at which Release Properties are Specif	ed (years)		
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 7th time at which release changes 7th time at which release changes 8th time at which release changes	0 100 200 300	Insert new 4th time and shift down existing times and associated release data	Delete 4th time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	4	Add new 5th time at w	hich release changes
No time on the list can be less than the previous time.	-	Close	



Radionuclide Specific Release						
Radionuclide Ac-227	Element Ac					
O	nsfer mechanism First Order Rate Controlled Transfer Equilibrium Desorption Transfer Equilibrium Solubility Transfer					
Time a	t which release begins or changes (years)	0	100	200	300	Add Next Time
Cumulative fraction of ra	dionuclide bearing material that is releasable	1	1	1	1	
Incremental fraction of r	linearly over time adionuclide bearing becomes releasable stepwise at time	•	0	•	© 0	
Distribution	coefficient in primary contamination (cm³/g)	20				
	Radionuclide becomes available for release ⊙ In the same manner as for release to grou) Beginning at time zero	ndwater				
	Save Cancel		-			

Area of primary contamination: square meters Length of contamination parallel to aquifer flow: 100 Deph of soil mixing layer: 15 Mass loading of all particulates: 0001 Deposition velocity of all particulates (to compute atmospheric release): 0001 Respirable particulates as a fraction of total particulates 1 Deposition velocity of respirable particulates (to compute atmospheric release): 001 Inigation applied per year: 2 Evapot transpiration coefficient: 5 Bynoff coefficient: 2 Support practice factor: 003 Fraction of primary contamination that is submerged 003 Soil layer > Clean cover below Location relative to water table > 2 Soil layer > Clean cover below Linkerses: 0 Soil layer > 1.5 Soil layer > 1.5 Soil apter content: 05 Lipckness: 0 A 1.0 Materia and tables 1.0 Experimentation 1.15 grammation 1.14 Location relative to wat	Primary Contamination							
Depth of soil mixing layer: 15 neters Mass loading of all particulates: 0001 grams/m ³ Deposition yelocity of respirable particulates (to compute atmospheric release): 0011 meters/s Respirable particulates as a fraction of total particulates 0001 meters/s Deposition yelocity of respirable particulates (to compute atmospheric release): 0011 meters/s Inigation applied per year: .2 meters in a year Evapotranspiration coefficient: .2 .2 meters in a year Slope-length-steepness factor: .2 .2 .2 .2 Cover and management factor: .3 .3 .3 .3 .3 Support practice factor: .3 .3 .2 .3 .3 Fraction of primary contamination that is submerged 0 .2 .3 <t< td=""><td colspan="8">Area of primary contamination: 10000 square meters</td></t<>	Area of primary contamination: 10000 square meters							
Mass loading of all paticulates: 0001 grams/m ² Deposition velocity of all paticulates (to compute atmospheric release): 001 meters/s Respirable particulates as a fraction of total paticulates 001 meters/s Deposition velocity of respirable particulates (to compute atmospheric release): 001 meters/s Irrigation applied per year: 2 meters/s 2 Evapotranspiration coefficient: 2 3 3 Runoff coefficient: 003 003 003 Support practice factor: 003 003 003 Fraction of primary contamination that is submerged 0 0 0 Soil layer -> Clean cover above below 0 0 0 Inickness: 0 2 meters 0 0 Soil erodibility factor: 4 1.5 0 0 0 0 Ind gonosity: 4 0 meters/year 0 0 0 0 Volumetric water content: 05 05 meters/year 0 0 0 0 0 0 0 0 0 </td <td>Length of contamination parallel to aquifer flo</td> <td>100</td> <td>meters</td>	Length of contamination parallel to aquifer flo	100	meters					
Deposition yelocity of all particulates (to compute atmospheric release): .001 meters/s Respirable particulates as a fraction of total particulates .001 meters/s Deposition yelocity of respirable particulates (to compute atmospheric release): .001 meters/s Lyrigation applied per year: .2 .2 meters/s Evapotranspiration coefficient: .2 .2 meters/s Slope-length-steepness factor: .4 .2 .2 Cover and management factor: .003 1 .003 Support practice factor: .4 .003 .2 Fraction of primary contamination that is submerged .00 .2 .2 Soil layer -> Clean cover Contaminated zone above below .4 .2 Jhickness: .0 .4 tons/acre .2 Soil erodibility factor: .4 .4 tons/acre .2 Lyratic water content: .05 .4 .4 .2 Volumetric water content: .05 .4 .4 .2 Lorgitudinal dispersivity: .05 .3 .5 .3 .5	Depth of soil mixing layer:	.15	meters					
Respirable particulates as a fraction of total particulates 1 Deposition velocity of respirable particulates (to compute atmospheric release): .001 Inrigation applied per year: .2 Evapotranspiration coefficient: .5 Rynoff coefficient: .5 Stope-length-steepness factor: .4 Cover and management factor: .003 Support practice factor: 1 Fraction of primary contamination that is submerged 0 Soil layer -> Contaminated zone above below Ihickness: 0 2 Soil erodibility factor: .4 Jub dk density: 1.5 Erosion rate: .1.147E-05 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .05 Eifective porosity: .4 Hydraulic conductivity: .05 B parameter: .3 Longitudinal dispersivity: .05 .05 meters	Mass loading of all particulates:		.0001	grams/m³				
Deposition yelocity of respirable particulates (to compute atmospheric release): 001 meters/s Irrigation applied per year: .2 meters in a year Evapotranspiration coefficient: .2 .2 Slope-length-steepness factor: .2 .2 Cover and management factor: .4 .003 Suppot practice factor: .1 .003 Fraction of primary contamination that is submerged 0 0 Soil layer -> Clean cover admentated zone above below 0 Location relative to water table -> 2 meters Soil layer -> Clean cover below 0 Linkness: 0 2 meters Soil erodibility factor: .4 tons/acre Dry bulk density: 1.5 .5 Total gorosity: .4 .4 Volumetric water content: .05 Effective porosity: .4 .4 Hydraulic conductivity: .3 .05 jeid capacity: .3 .05 b parameter: .05 .05 Longitudinal dispersivity: .5 .3 <tr< td=""><td>Deposition <u>v</u>elocity of all particulates (to com</td><td>oute atmospheric release):</td><td>.001</td><td>meters/s</td></tr<>	Deposition <u>v</u> elocity of all particulates (to com	oute atmospheric release):	.001	meters/s				
Irrigation applied per year: .2 meters in a year Evapotranspiration coefficient: .5 .2 Rynoff coefficient: .2 .2 Slope-length-steepness factor: .4 .003 Cover and management factor: .003 .003 Support practice factor: .1 .003 Fraction of primary contamination that is submerged 0 0 Soil layer -> Contaminated zone above below 0 Thickness: 0 2 meters Soil endibility factor: .4 .4 tons/acre Dry bulk density: 1.5 grams/cm ³ meters/year Total goosity: .4 .4 .4 Volumetric water content: .05 .4 .4 Effective porosity: .4 .4 .4 Volumetric water content: .05 .4 .4 De parameter: .05 .3 .5 .3 Longitudinal dispersivity: .05 meters .4 Soil eacres/year .3 .05 .4 Longitudinal dispersivity: .5	Respirable particulates as a fraction of total p	articulates	1					
Evapotranspiration coefficient: Rynoff coefficient: Slope-length-steepness factor: Support practice factor: Fraction of primary contamination that is submerged Soil layer -> Clean cover Location relative to water table -> Soil layer -> Clean cover Location relative to water table -> Soil erodibility factor: Jickness: D Jy bulk density: Total goossity: Harden of the submeter is Effective porosity: Harden of the submeter is be parameter: Longitudinal dispersivity: Save Save	Deposition velocity of respirable particulates	to compute atmospheric release):	.001	meters/s				
Runoff coefficient: .2 Slope-length-steepness factor: .4 Cover and management factor: .003 Support practice factor: 1 Fraction of primary contamination that is submerged 0 Soil layer -> Clean cover above Contaminated zone below Location relative to water table -> 2 meters Soil erodibility factor: 4 .4 tons/acre Dry bulk density: 1.5 1.5 grams/cm ² Total goosity: 4 .4 volumetric water content: .05 Effective porosity: .4 .4	Irrigation applied per year:		.2	meters in a year				
Slope-length-steepness factor: Cover and management factor: Support practice factor: Fraction of primary contamination that is submerged Soil layer -> Clean cover Location relative to water table -> Soil erodibility factor: Hickness: 0 2 meters Soil erodibility factor: 4 Location relative: 5 1.5 1.5 1.5 1.7 1.7 2 meters 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7	Evapotranspiration coefficient:		.5	_				
Cover and management factor: .003 Support practice factor: 1 Fraction of primary contamination that is submerged 0 Soil layer -> Clean cover above Contaminated zone above Location relative to water table -> 0 2 Linkness: 0 2 Dy bulk density: 1.5 grams/cm ³ Egosion rate: 1.147E-405 .147E-405 Total gorosity: .4 .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .05 Eifed capacity: .3 b parameter: .05 Longitudinal dispersivity: .05	Runoff coefficient:		.2					
Support practice factor: 1 Fraction of primary contamination that is submerged 0 Soil layer -> Clean cover above below Location relative to water table -> above below Jhickness: 0 Soil erodibility factor: .4 Jy bulk density: 1.5 Total gorosity: .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .10 Field capacity: .3 b parameter: .05 Longitudinal dispersivity: .05 Save Save	Slope-length-steepness factor:		.4					
Fraction of primary contamination that is submerged 0 Soil layer -> Clean cover above below Thickness: 0 2 meters Soil erodibility factor: .4 4 tons/acre Dry bulk density: 1.5 1.5 grams/cm ³ Total goosity: .4 4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .10 Effective porosity: .4 Hydraulic conductivity: .3 b parameter: .5.3 Longitudinal dispersivity: .05 meters Save	Cover and management factor:		.003					
Soil layer -> Contaminated zone above below Location relative to water table -> above below Jhickness: 0 Soil erodibility factor: .4 Dry bulk density: 1.5 Erpsion rate: 1.147E-05 Total gorosity: .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: 10 Eield capacity: .3 b parameter: .05 Save	Support practice factor:		1					
Location relative to water table -> above below Thickness: 0 2 meters Soil erodibility factor: .4 tons/acre Dry bulk density: 1.5 grams/cm ³ Erosion rate: 1.147E-05 meters/year Total porosity: .4 .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .10 Field capacity: .3 b parameter: .05 Longitudinal dispersivity: .05 Save .05	Fraction of primary contamination that is subm	erged	0					
Location relative to water table -> above below Thickness: 0 2 meters Soil erodibility factor: .4 tons/acre Dry bulk density: 1.5 grams/cm ³ Erosion rate: 1.147E-05 meters/year Total porosity: .4 .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .10 Field capacity: .3 b parameter: .05 Longitudinal dispersivity: .05 Save .05	Soil laver -> Clean cover	Contaminated zone						
Soil erodibility factor: A A tons/acre Dry bulk density: 1.5 grams/cm³ Erosion rate: 1.147E-05 1.147E-05 Total porosity: 4 Volumetric water content: .05 Effective porosity: 4 Hydraulic conductivity: 10 Bield capacity: 3 b parameter: 5.3 Longitudinal dispersivity: Save		above below						
Dry bulk density: 1.5 grams/cm² Erosion rate: 1.147E-05 meters/year Total porosity: .4 .4 Volumetric water content: .05 .4 Hydraulic conductivity: .05 meters/year Eifed capacity: .3 .5 b parameter: .5.3 .05 Longitudinal dispersivity: .05 meters	<u>T</u> hickness: 0	2 meters						
Egosion rate: 1.147E-495 Total gorosity: .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: .10 Field capacity: .3 b parameter: .5.3 Longitudinal dispersivity: .05 Save	Soil erodibility factor: .4	.4 tons/acre						
Total gorosity: .4 Volumetric water content: .05 Effective porosity: .4 Hydraulic conductivity: 10 Field capacity: .3 b parameter: .5.3 Longitudinal dispersivity: .05 Meters	Dry bulk density: 1.5	1.5 grams/cm³						
Volumetric water content: 05 Effective porosity: .4 Hydraulic conductivity: 10 Field capacity: .3 b parameter: 5.3 Longitudinal dispersivity: .05 Save	E <u>r</u> osion rate: 1.147E-05	1.147E-05 meters/year						
Effective porosity: .4 Hydraulic conductivity: 10 Field capacity: .3 b parameter: 5.3 Longitudinal dispersivity: .05 Save	2 7	.4						
Hgdraulic conductivity: 10 meters/year Field capacity: .3 b parameter: 5.3 Longitudinal dispersivity: .05	Volumetric <u>w</u> ater content: .05							
Field capacity: .3 b parameter: 5.3 Longitudinal dispersivity: .05 Save	Effective porosity:	.4						
b parameter: Longitudinal dispersivity: Save	Hydraulic conductivity:	10 meters/year						
Longitudinal dispersivity: 05 meters	Field capacity:	.3						
Save	<u>b</u> parameter:	<u>b</u> parameter: 5.3						
	Longitudinal dispersivity:							

Selected "Specify initial activity based on mass of entire primary contamination" as the conceptualization of primary contamination and checked "Model multiple forms of contaminated media" in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients, Radionuclide Specific Release (fixed the change pattern of releasable fraction and leach rate as stepwise between release time periods), and the Primary Contamination input forms all displayed expectedly with input parameters associated with this conceptualization option.

Preliminary Inputs	
Badiological units	Description of current conceptualization The transfer of radionuclides from the solid phase to the moisture within the primary contamination is controlled by first order leach rates. Different leach rates can be specified for the same radionuclide in different fractions of the primary contamination to model different forms of contaminated material.
Conceptualization of primary contamination This choice applies to all the radionuclides in the input file. Use <u>B</u> ESRAD-ONSITE exponential release model Specify initial activity based on mass of entire primary <u>contamination</u> $\overline{\lor}$ Model multiple forms of contaminated media Specify initial activity based on mass of contaminated <u>medium</u>	The properties of the primary contamination are used to compute the transport of the radionuclides through the primary contamination.
Model diffusive transport out of contaminated medium Save Cancel	All solids are contaminated

<u>1</u> st time at which release begins 2nd time at which release changes	0	Insert new 1st time and shift down existing	Delete 1st time and associated release data
	100	times and associated release data	and shift up existing data
<u>3</u> rd time at which release changes	200		
<u>4</u> th time at which release changes	300		
5th time at which release changes			
<u>6</u> th time at which release changes			
<u>7</u> th time at which release changes			
8th time at which release changes			
9th time at which release changes			
Number of times at which the release properties are specified	4	Add new 5th time at w	which release changes
Times are in ascending order	-	Close	

Distribution Coefficients			
Radionuclide Ac-227	·		
Location	Distribution coefficient (cm³/g)	Location	Distribution coefficient (cm³/g)
Contaminated medium:	20	Suspended sediment in surface water body	20
<u>C</u> ontaminated zone:	20	Bottom sediment in surface water body	20
Unsaturated zone <u>1</u> :	20	Frui <u>t</u> , grain, nonleafy fields	20
		<u>L</u> eafy vegetable fields	20
		Past <u>u</u> re, silage growing areas	20
		Livestock feed grain fields	20
S <u>a</u> turated zone:	20	Dwelling site	20
Number of unsaturated zone set in preliminary inputs form			
		Save Cancel	

Radionuclide Specific Release							
Radionuclide Ac-227	🔹 Element Ac						
	Transfer mechanism ⊙ First Order Rate Control	led Transfer					
Tim	e at which release begins (or changes (years)	0	100	200	300	Add Next Time
Cumulative fraction of	radionuclide bearing mate	rial that is releasable	1	1	1	1	
Incremental fraction	of radionuclide bearing bea	linearly over time O comes releasable stepwise at time	Θ	0 ©	0 0	0 0	
		Leach rate (1/year)	0	0	0	0	
		linearly over time		0	0	0	
Lea	ch rate of isotope changes	stepwise at time	0	0	0	Θ	
Release from surface layer	Radionuclide becomes a In the same manner a Beginning at time zer	as for release to groun	dwater				
		Save Cancel					

Primary Contamination							
Area of primary contamination: 10000 square meters							
Length of contamination parall	100	meters					
Depth of soil mixing layer:							
Mass loading of all particulate	s:			.15	grams/m³		
Deposition velocity of all partic		pute atmosphe	eric release):	.001	meters/s		
Respirable particulates as a fr	-		,	1			
Deposition velocity of respirab	•		mospheric release);	.001	meters/s		
Irrigation applied per year:	•		. ,	.2	meters in a year		
Evapotranspiration coefficient				.5			
Runoff coefficient:				.2			
				.4			
Cover and management factor:				.003			
Support practice factor:				1			
Fraction of primary contaminat	ion that is subm	nerged		0			
	~						
Soil layer -> Location relative to water table	Clean cover e ->	above	nated zone below				
Thickness:	0	2	meters				
	4	.4	tons/acre				
Drv bulk density:	1.5	1.5	grams/cm ³				
Erosion rate:	1.147E-05	1.147E-05	meters/year				
Total porosity:	.4	.4	-				
Volumetric water content:	.05		_				
Effective porosity:		.4					
Hydraulic conductivity:		10	meters/year				
Field capacity:		.3	-				
<u>b</u> parameter:		5.3	-				
Longitudinal dispersivity:							
			-1				
			Save				
	-	-					
			Cancel				

• Selected "Specify initial activity based on mass of contaminated medium" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients (allowed the specification of Kd for the contaminated medium), Radionuclide Specific Release, and the Primary Contamination (allowed the specification of total mass and volume of the contaminated medium) input forms all displayed expectedly with input parameters associated with this conceptualization option.

Preliminary Inputs	
Radiological units Activity: p Ci v Dose: m v rem v Basic radiation dose limit: 25 mrem/yr Exposure duration (for risk): 30 years Number of unsaturated zones: 1 · · · Submerged fraction of primary Contamination 0 unitless Conceptualization of primary contamination - This choice applies to all the radionuclides in the input file. · · · · · · · · · · · · · · · · · · ·	Description of current conceptualization The properties of the contaminated medium are used to compute the transfer of the radionuclides from the solid to the aqueous phase of the primary contamination, and the properties of both the contaminated medium and the primary contamination are used to compute the transport of the radionuclides through the primary contamination. The three options listed below are available to model the transfer of radionuclides from the contaminated medium to the soil moisture: Equilibrium desorption characterized by a linear distribution coefficient, Equilibrium solubility characterized by a soluble concentration, Far from equilibrium desorption or dissolution characterized by a first order leach rate coefficient.
Save Cancel	is as conductive as the surrounding suil

Times at which Release Properties are Speci	fed (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	Image: Delete 1st time and system Image: Delete 1st time and associated release data and shift up existing data 200 300
<u>9</u> th time at which release changes Number of times at which the release properties are specified	4 <u>Add new 5th time at which release changes</u>
Times are in ascending order	Close

Distribution Coefficients					
Radionuclide Ac-22	7 🌲				
Location	Distribution coefficient (cm³/g)	Loodion	Distribution coefficient (cm³/g)		
Contaminated medium:	20	Suspended sediment in surface water body	20		
<u>C</u> ontaminated zone:	20	Bottom sediment in surface water body	20		
Unsaturated zone <u>1</u> :	20	Frui <u>t</u> , grain, nonleafy fields Leafy vegetable fields Past <u>u</u> re, silage gro wi ng areas Livestock feed grain fields Dwelling site	20 20 20 20 20 20		
S <u>a</u> turated zone:	20				
Number of unsaturated zones: set in preliminary inputs form					
		Save Cancel			

and the second se							
Radionuclide Specific Release							
Radionuclide Ac-227	★ Element Ac						
	Transfer mechanism) First Order Rate Controlled Transfer) <u>Equilibrium Desorption Transfer</u>) Equilibrium Solubility Transfer						
Time	e at which release begins or changes (years)	0	100	200	300	Add Next Time	
Cumulative fraction of	radionuclide bearing material that is releasable	1	1	1	1		
linearly over time Incremental fraction of radionuclide bearing becomes releasable stepwise at time			0	© 0	● 0		
Distribution coefficient in contaminated medium (cm³/g) 20							
Release from surface layer	Radionuclide becomes available for release			1			
	 In the same manner as for release to groun 	dwater					
	O Beginning at time zero						
	Save Cancel						

Primary Contamination					
Area of primary contamination:				10000	square meters
Length of contamination parall	el to aquifer flo	w:		100	meters
Depth of soil <u>mixing</u> layer:				.15	meters
Mass loading of all particulates				.0001	arams/m³
Deposition velocity of all partic	ulates (to com	pute atmosphe	ric release):	.001	meters/s
Respirable particulates as a fra	action of total p	articulates	-	1	
Deposition velocity of respirabl	e particulates	(to compute at	mospheric release):	.001	meters/s
Irrigation applied per year:				.2	meters in a year
Evapotranspiration coefficient:				.5	-
Runoff coefficient:				.2	
Slope-length-steepness factor:				.4	
Cover and management factor:				.003	
Support practice factor:				1	
Fraction of primary contamination that is submerged				0	
Soil layer -> Clean cover Contaminated zone Location relative to water table -> above below				Contaminated medium	
Thickness:	0	2	meters		Total mass 👔 kg
Soil erodibility factor:	.4	.4	tons/acre		otal volume 0 m ³
Dry bulk density:	1.5	1.5	grams/cm ³		
Erosion rate:	1.147E-05	1.147E-05	meters/year		
 Total porosity:	4	.4	-		
Volumetric water content:	.05		_		
Effective porosity:		.4			
Hydraulic conductivity:		10	meters/year		
<u>F</u> ield capacity:		.3			
<u>b</u> parameter:		5.3			
Longitudinal dispersivity:		.05	meters		
			_		
			Save		
			Cancel		

Selected "Specify initial activity based on mass of contaminated medium" as the conceptualization of primary contamination and checked "Model multiple forms of contaminated media" in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients (allowed the specification of Kd for the contaminated medium), Radionuclide Specific Release (fixed the change pattern of releasable fraction and leach rate as stepwise between release time periods), and the Primary Contamination (allowed the specification of total mass and volume of the contaminated medium) input forms all displayed expectedly with input parameters associated with this conceptualization option.

Preliminary Inputs	
Radiological units Activity: □ Basic radiation dose limit: 25 Exposure duration (for risk): 30 Number of unsaturated zones: 1 Submerged fraction of primary Contamination 0	Description of current conceptualization The transfer of radionuclides from the contaminated medium to the moisture within the primary contamination is controlled by first order leach rates. Different leach rates can be specified for the same radionuclide in different fractions of the contaminated medium to model different forms of nuclide bearing
Conceptualization of primary contamination This choice applies to all the radionuclides in the input file. O Use <u>BESRAD-ONSITE</u> exponential release model O Specify initial activity based on mass of entire primary <u>contamination</u> O Specify initial activity based on mass of contaminated medium	material. The properties of the primary contamination and the contaminated medium are used to compute the transport of the radionuclides through the primary contamination.
Joechy initial activity based of mass of contaminated media Model diffusive transport out of contaminated medium	Contaminated medium
Save Cancel	is as conductive as the surrounding suil

Times: are in ascending order stitution Coefficients Radionuclide Ac-227 Location coefficients Pail Suppended sediment in surface water body 20 Bottom seturated zone: 20 <th></th> <th></th>		
Initian a which release changes 00 Initian a which release changes 00 <td< td=""><td>Times at which Release Properties are</td><td>Specifed (years)</td></td<>	Times at which Release Properties are	Specifed (years)
Initian a which release changes 00 Initian a which release changes 00 <td< td=""><td>1st time at which release begins</td><td></td></td<>	1st time at which release begins	
di lime at which release changes 00 hi lime at which release changes 00 hi lime at which release changes 0 hi lime at which release changes 0 hi lime at which release changes 0 Add new 5th lime at which release changes There are in accending order I lime at which release changes Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of these at which release Add new 5th lime at which release changes athick of the at which release Add new 5th lime at which release changes athick of the at which release Add new 5th lime at which release changes athick of the at which release changes Add new 5th lime at which release the at whi		Insert new ist time and shirt down existing Delete ist time and associated release data
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roperties are in ascending order Times are in ascending order stribution Coefficients Redionuclide Ac-227 Coefficients Redionuclide Ac-227 Distribution Location Coefficients 20 Prug, grain, grain, actace water body 20 Prug, grain, grain, grain, grain Distribution Coefficients 20 Prug, grain, grain, grain Distribution Coefficients 20 Distributio		Add new 5th time at which release changes
ativation Coefficients Redionuclide Ac:27 indiaminated moduri: 20 ontaminated moduri: 20 Butger del definient in surface water body 20 ativated zone: 20 Fuit, grain, nonleady fields 20 ativated zone: 20 Butger del moduri 20 ativated zone: 20 Butger del moduri 21 Fuit, grain, nonleady fields 20 Detains ativated zone: 20 Butger del moduri 21 Butger del moduri 22 Butger del moduri 23 Butger del moduri 24 25 Butger del moduri 26 27 Element Ac Cancel 1 1 1 1 1 1 1 26 27 28 29 20 20 20 20 20 20 20	properties are specified	190 ¢
Radionuclide Ac-227 Location Interview Ontaminated andum: 20 Buttom sediment in surface water body 20 Buttom sediment in surface water body 20 Frail, grain, nonleady fields Locaty vegetable fields 20 Pattyre, ilage growing areas Livestock (red grain fields 20 Dwelling site 20 Buttom sediment Ac	Times are in ascending order	Close
Radionuclide Ac-227 Location Interview Ontaminated andum: 20 Buttom sediment in surface water body 20 Buttom sediment in surface water body 20 Frail, grain, nonleady fields Locaty vegetable fields 20 Pattyre, ilage growing areas Livestock (red grain fields 20 Dwelling site 20 Buttom sediment Ac		
Location Distribution containated medium: 20 noriaminated medium: 20 noriaminated ancline: 20 neaturated zone: 20 Pruit, grain, nonleady fields Location fields 20 Partyre, silage growing areas Livestock feed grain fields 20 Puelling site 20 storweit of unsaturated zone: 1 Save Cancel Save Cancel Save Cancel Save Cancel Can	Distribution Coefficients	
Location coefficient coefficient (cm ² /g) suspended sediment in surface water body 20 nontaminated acone: 20 Butom sediment in surface water body 20 Butom sediment for mechanism Cumulative fraction of radionuclide bearing material that is releasable 1 0 100 200 300 <u>Mati New 1</u> Buter butow ret inte ² Buter but beare manner as for release but comes stress stres	Radionuclide Ac-227	
Location coefficient coefficient (cm ² /g) suspended sediment in surface water body 20 nontaminated acone: 20 Butom sediment in surface water body 20 Butom sediment for mechanism Cumulative fraction of radionuclide bearing material that is releasable 1 0 100 200 300 <u>Mati New 1</u> Buter butow ret inte ² Buter but beare manner as for release but comes stress stres		ribution Distribution
ontaminated medium: (cm ² /g) buttom sediment in surface water body 20 glurated zone: 20		efficient Location coefficient
ontaminated zone: 20 Bustoment in sulface water body 20 Bustom sediment in sulface water body 20 Insaturated zone 1: 20 Fruit, grain, nonleady fields 20 Bustom sediment in sulface water body 20 Bustom sediment in sulface water water body 20 Bustom sediment in sulface water body 20 Bustom sediment in sulface water body 20 Cancel Save Transfer mechanism Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 1 Incremental fraction of radionuclide bearing material that is releasable 1 1 1 1 Incremental fraction of radionuclide bearing material that is releasable 1 1 1 1 Leach tate of isotope changes (years) 0 0 0 0 0 Leach tate of isotope changes subject at time 0 0 0 Bustom sulface layer Badonuclide bearing material that is releasable 1 0 Bustom sulface layer Badonuclide bearing material that is releasable 1 0 0 Bustom sulface layer Badonuclide bearing material that is releasable 1 0 0 Bustom sulface layer Badonuclide bearing material that is releasable 1 0 0 Bustom sulface layer Badonuclide bearing material that is releasable 1 0 Bustom sulface layer Badonuclide bearing becomes available for release to groundwater Beginning at time zero Save		
isotion sedurated zone]: 20 Fruit, grain, nonleady fields Pastyre, silage growing areas Livestock feed grain fields 20 Qurated zone: 20 Dwelling site 20 Dwelling site 20 Cancel		Suspended sediment in surface water body 20
Frug. gian, noneary fields 20 Pasture, silage growing areas 20 Livestock feed grain fields 20 Dwelling site 20 Dwelling site 20 is prefininary inputs form 1 Save Cancel Save Cancel Save Cancel Save Cancel Canc	<pre>_ontaminated zone: 20</pre>	Bottom sediment in surface water body 20
Frug. gian, noneary fields 20 Pasture, silage growing areas 20 Livestock feed grain fields 20 Dwelling site 20 Dwelling site 20 is prefininary inputs form 1 Save Cancel Save Cancel Save Cancel Save Cancel Canc	Unsaturated zone <u>1</u> : 20	
Pature, silage growing areas Livestock feed grain fields Dwelling site 20 unber of unsalvated zones: 1 Save Cancel Cancel Conclude Ac-227 Celement Ac Cancel Conclude Ac-227 Celement Ac Calease to ground water Transfer mechanism O first Order Rate Controlled Transfer O first Order Rate Controlled Transfer Cumulative fraction of radionuclide bearing bareing becomes releasable 1 1 1 1 Incremental fraction of radionuclide bearing becomes releasable Leach rate of isotope changes stepwise at time Calease to ground water Release from surface layer Release from surface layer Save	20	
Livestock feed grain fields 20 pweling site 20 uniter of unsaturated zones: at in preliminary inputs form: Save Cancel C		Leafy vegetable fields 20
aturated zone: aturated zone: ati n preliminary inputs for: ati n preliminary inputs for: ationuclide Specific Release Radionuclide Ac-227 Element Ac Belease to ground water Time at which release begins or changes (years) 0 100 200 300 Add Next Time at which release begins or changes (years) 0 100 200 300 Add Next Time at which release begins or changes (years) 0 100 200 300 Add Next Time at which release begins or changes (years) 0 100 200 300 Add Next Time at which release begins or changes (years) 0 0 0 0 0 Leach rate of isotope changes incarly over time Leach rate of isotope changes incarly over time Therefore surface layer Radionuclide becomes available for release Beginning at time zero Save		Past <u>u</u> re, silage growing areas 20
audier of unsaturated zones: 1 save Cancel		Livestock feed grain fields 20
audier of unsaturated zones: 1 save Cancel		Dwelling site
ti in preliminary inputs form	S <u>a</u> turated zone: 20	
Radionuclide Ac-227 Element Ac Release to ground water Time at which release begins or changes (years) 0 100 200 300 Add Next Time Time at which release begins or changes (years) 0 100 200 300 Add Next Time Time at which release begins or changes (years) 0 100 200 300 Add Next Time Time<	set in preliminary inputs form	Save
Release to ground water Transfer mechanism First Order Rate Controlled Transfer First Order Rate Controlled Transfer First Order Rate Controlled Transfer Time at which release begins or changes (years) Leach rate of isotope changes Time at which release to groundwater Time at which release to groundwater Beginning at time zero Save	Radionuclide Specific Release	
First Order Rate Controlled Transfer Time at which release begins or changes (years) 0 100 200 300 Add Next Time Cumulative fraction of radionuclide bearing material that is releasable 1 </td <td>Radionuclide Ac-227</td> <td>Element Ac</td>	Radionuclide Ac-227	Element Ac
Time at which release begins or changes (years) 0 100 200 300 Add Next Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 1 Incremental fraction of radionuclide bearing becomes releasable 0 0 0 0 0 Leach rate (1/year) 0 0 0 0 0 0 Leach rate of isotope changes inearly over time 0 0 0 0 Release from surface layer Radionuclide becomes available for release 0 0 0 0 Save Save Save Save Save Save Save		
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 Incremental fraction of radionuclide bearing becomes releasable 0 0 0 0 Leach rate of isotope changes imearly over time 0 0 0 0 Leach rate of isotope changes stepwise at time 0 0 0 0 Release from surface layer Radionuclide becomes available for release 0 0 0 0 Save Save Save Save Save Save Save) First Order Rate Controlled Transfer
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 Incremental fraction of radionuclide bearing becomes releasable 0 0 0 0 Leach rate of isotope changes imearly over time 0 0 0 0 Leach rate of isotope changes stepwise at time 0 0 0 0 Release from surface layer Radionuclide becomes available for release 0 0 0 0 Save Save Save Save Save Save Save		
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 Incremental fraction of radionuclide bearing becomes releasable 0 0 0 0 Leach rate of isotope changes imearly over time 0 0 0 0 Leach rate of isotope changes stepwise at time 0 0 0 0 Release from surface layer Radionuclide becomes available for release 0 0 0 0 Save Save Save Save Save Save Save		
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 Incremental fraction of radionuclide bearing becomes releasable 0 0 0 0 Leach rate of isotope changes imearly over time 0 0 0 0 Leach rate of isotope changes stepwise at time 0 0 0 0 Release from surface layer Radionuclide becomes available for release 0 0 0 0 Save Save Save Save Save Save Save	Time	Add Next
Incremental fraction of radionuclide bearing becomes releasable stepwise at time O O O O Leach rate of isotope changes inearly over time O O O O Leach rate of isotope changes stepwise at time O O O O Release from surface layer Badionuclide becomes available for release O In the same manner as for release to groundwater Beginning at time zero Save		a which release begins of changes (years)
Incremental fraction of radionuclide bearing becomes releasable stepwise at time	Cumulative fraction of	radionuclide bearing material that is releasable 1 1 1
Stepwise at time O O O O O O O O O O O O O O O O O O O	Incremental fraction	inearly over time O O O O
Leach rate of isotope changes time time time time time time time time	Incremental fraction o	stepwise at time O O O
Leach rate of isotope changes time time time time time time time time		
Leach rate of isotope changes stepwise at time O O O O		
stepwise at time O O O Release from surface layer Badionuclide becomes available for release Beginning at time zero Save Save Save	Leac	h rate of isotone changes
In the same manner as for release to groundwater Beginning at time zero	Looc	stepwise at time 💿 💿 💿
In the same manner as for release to groundwater Beginning at time zero		
O Beginning at time zero	Release from surface layer	
Save		
		O Beginning at time zero
		Church
Cancel		Jave
		Cancel
		Cancel

Primary Contamination				
Area of primary contamination:			10000	square meters
Length of contamination parallel to aquifer flo	W:		100	meters
Depth of soil mixing layer:			.15	meters
Mass loading of all particulates:			.0001	grams/m³
Deposition velocity of all particulates (to compute atmospheric release):			001	meters/s
Respirable particulates as a fraction of total	oarticulates		1	
Deposition velocity of respirable particulates	(to compute atmospheric	release):	.001	meters/s
Irrigation applied per year:			.2	meters in a year
Evapotranspiration coefficient:			.5	
Bunoff coefficient:			.2	
Slope-length-steepness factor:			.4	
Cover and management factor:			.003	
Support practice factor:			1	
Fraction of primary contamination that is submerged			0	
Soil layer -> Clean cover Location relative to water table ->	Contaminated zon above bel			Contaminated medium
Thickness: 0	2 meters			Total mass 👔 kg
Soil erodibility factor:	tons/acr		Т	otal volume 0 m³
Dry bulk density: 1.5	1.5 grams/cr	3		
Erosion rate: 1.147E-05	1.147E-05 meters/y	ar -		
Total <u>p</u> orosity:	.4			
Volumetric water content: .05				
Effective porosity:	.4			
Hydraulic conductivity:	10 meters/y	ar		
<u>F</u> ield capacity:	.3			
<u>b</u> parameter:	5.3			
Longitudinal dispersivity:	.05 meters			
	S	ve		
	Ca	icel		

Selected "Model diffusive transport out of contaminated medium" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients (allowed the specification of Kd for the contaminated medium), Radionuclide Specific Release (fixed the transfer mechanism as Equilibrium Desorption Transfer and allowed the specification of diffusion coefficient in the contaminate medium), and the Primary Contamination (allowed the specification of total mass, volume, and volumetric water content of the contaminated medium, and length, width, and breadth of the individual fragment) input forms all displayed expectedly with input parameters associated with this conceptualization option.

Preliminary Inputs	
Radiological units Activity: p v Ci v Dose: m v rem v	Description of current conceptualization The transfer of radionuclides from the contaminated
Basic radiation dose limit: 25 mrem/yr Exposure duration (for risk): 30 years	medium to the moisture within the contaminated medium is controlled by equilibrium desorption characterized by a linear distribution coefficient.
Number of unsaturated zones: 1 4 Submerged fraction of primary Contamination 0 unitless	The code models the diffusive transport out of the representative fragments of the contaminated medium, and the advective dispersive transport over the primary contamination.
Conceptualization of primary contamination This choice applies to all the radionuclides in the input file.	
Use <u>B</u> ESRAD-ONSITE exponential release model Specify initial activity based on mass of entire primary <u>contamination</u>	
Specify initial activity based on mass of contaminated medium Model diffusive transport out of contaminated medium	No moisture flow
Save Cancel	through contaminated

Times at which Release Properties are Spec	ifed (years)		
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 8th time at which release changes 7th time at which release changes 8th time at which release changes	0 100 200 300	Insert new 1st time and shift down existing times and associated release data	Delete 1st time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	4	Add new 5th time at w	hich release changes
Times are in ascending order	-	Close	

Distribution Coefficients			
Radionuclide Ac-22	7 🌲		
Location	Distribution coefficient (cm³/g)		Distribution coefficient (cm³/g)
Contaminated medium:	20	Suspended sediment in surface water body	20
<u>C</u> ontaminated zone:	20	Bottom sediment in surface water body	20
Unsaturated zone <u>1</u> :	20	Fruit, grain, nonleafy fields Leafy vegetable fields	20 20
		Past <u>u</u> re, silage growing areas	20
		Livestock feed grain fields	20
S <u>a</u> turated zone:	20	Dwelling site	20
Number of unsaturated zone set in preliminary inputs form			
		Save Cancel	

	198 / FM				
Radionuclide Specific Release					
Radionuclide Ac-227	≑ Element Ac				
Release to ground water	ransfer mechanism				
	Equilibrium Desorption Transfer				
	at which release begins or changes (years)	0 100	200	300	Add Next Time
Cumulative fraction of	radionuclide bearing material that is releasable <mark>1</mark>	1	1	1	
Incremental fraction o	linearly over time f radionuclide bearing becomes releasable stepwise at time	0 0	0 0	0 ⊚	
Distributio	n coefficient in contaminated medium (cm³/g) 2				
	n coefficient in contaminated medium (m*m/y)				
Dalaana faan oofaan lawar	– Badionuclide becomes available for release –				
Release from surface layer	 In the same manner as for release to ground 	water			
	O Beginning at time zero				
	Save				
	Cancel				

Primary Contamination								
Area of primary contamination:					10000	square m	eters	
Length of contamination parall	el to aquifer flo	w:			100	meters		
Depth of soil <u>m</u> ixing layer:					.15	meters		
Mass loading of all particulates	:				.0001	grams/m³		
Deposition velocity of all partic	ulates (to com	pute atmosphe	ric release):		.001	meters/s		
Respirable particulates as a fra	action of total p	articulates			1			
Deposition velocity of respirable particulates (to compute atmospheric release):				.001	meters/s			
Irrigation applied per year:					.2	meters in	a year	
<u>Evapotranspiration coefficient:</u>	Evapotranspiration coefficient:				.5			
Runoff coefficient:				.2				
Slope-length-steepness factor:				.4				
Cover and management factor:					.003			
Support practice factor:				1				
Fraction of primary contamination that is submerged				0				
Soil layer ->	Clean cover		nated zone			Contaminat	ed medium	
Location relative to water table		above	below					
Thickness:	0	2	meters			Total mass	0	kg
Soil erodibility factor:	.4	.4	tons/acre			otal volume	0	m ³
Dry bulk density:	1.5	1.5	grams/cm³		Volumetric wa	ter content	0	
E <u>r</u> osion rate:	1.147E-05	1.147E-05	meters/year					
Total porosity: Volumetric water content:	.4	.4			Dimensio	ns of individ	lual fragmer	nt of
Effective porosity:	.05				-	ontaminated		
Hydraulic conductivity:		.4	motoro luo pr		-	of fragment	0	m
Field capacity:		10 .3	meters/year			of fragment	0	m
b parameter:		.3 5.3	-		Breadth	of fragment	0	m
Longitudinal dispersivity:		0.3 .05	meters					
Longkaumar aroporormy.		.03	Inocoro					
			Save	-				
			Cancel					

12.86 TEST CASE 054-001 TESTER'S REPORT

Documented in graph_primary_contamination_c14.csv of 2/18/2020 7:35 AM

CONCENTRATION: C-: CARBON-14_test.ROF Graphics.Asc	14, Primary Contamination 02/17/2020 16:40	CONCENTRATION CARBON-14.ROF Graphics.Asc	: C-14, Primary Contaminati 01/10/2020 15:37	ion
Year	Value	Year	Value	
0	100	0	100	1
0.0625	80.14947	0.0625	80.14947	1
0.125	64.23934	0.125	64.23934	1
0.1875	51.48744	0.1875	51.48744	1
0.25	41.26685	0.25	41.26685	1
0.3125	33.07509	0.3125	33.07509	1
0.375	26.50945	0.375	26.50945	1
0.4375	21.24711	0.4375	21.24711	1
0.5	17.02939	0.5	17.02939	1
0.5625	13.64891	0.5625	13.64891	1
0.625	10.93948	0.625	10.93948	1
0.6875	8.767893	0.6875	8.767893	1
0.75	7.027381	0.75	7.027381	1
0.8125	5.632375	0.8125	5.632375	1
0.875	4.514289	0.875	4.514289	1
0.9375	3.618154	0.9375	3.618154	1
1	2.899909	1	2.899909	1
1.0625	2.324244	1.0625	2.324244	1
1.125	1.862853	1.125	1.862853	1
1.1875	1.493054	1.1875	1.493054	1
1.25	1.196663	1.25	1.196663	1
1.3125	0.95911	1.3125	0.95911	1
1.375	0.768713	1.375	0.768713	1
1.4375	0.616113	1.4375	0.616113	1
1.5	0.493806	1.5	0.493806	1
1.5625	0.395778	1.5625	0.395778	1
1.625	0.31721	1.625	0.31721	1
1.6875	0.254239	1.6875	0.254239	1
1.75	0.203768	1.75	0.203768	1
1.8125	0.163317	1.8125	0.163317	1
1.875	0.130896	1.875	0.130896	1
1.9375	0.104911	1.9375	0.104911	1
2	0.084084	2	0.084084	1
2.0625	0.067392	2.0625	0.067392	1
2.125	0.054013	2.125	0.054013	1

12.87 TEST CASE 054-002 TESTER'S REPORT

Documented in graph_non_leafy_C14.csv of 2/18/2020 7:36 AM

vegetables CARBON-14_test.ROF	L4, Fruit, grain, non-leafy 02/17/2020 16:40	vegetables CARBON-14.ROF	: C-14, Fruit, grain, non-leaf 01/10/2020 15:37	ÿ
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	1088160	0	1088160	1
0.0625	872156.9	0.0625	872156.9	1
0.125	699030.9	0.125	699030.9	1
0.1875	560270.6	0.1875	560270.6	1
0.25	449054.5	0.25	449054.5	1
0.3125	359915.1	0.3125	359915.1	1
0.375	288470.1	0.375	288470.1	1
0.4375	231207.2	0.4375	231207.2	1
0.5	185311.3	0.5	185311.3	1
0.5625	148525.8	0.5625	148525.8	1
0.625	119042.5	0.625	119042.5	1
0.6875	95411.7	0.6875	95411.7	1
0.75	76471.77	0.75	76471.77	1
0.8125	61291.53	0.8125	61291.53	1
0.875	49124.66	0.875	49124.66	1
0.9375	39373	0.9375	39373	1
1	31557.1	1	31557.1	1
1.0625	25292.72	1.0625	25292.72	1
1.125	20271.87	1.125	20271.87	1
1.1875	16247.7	1.1875	16247.7	1
1.25	13022.36	1.25	13022.36	1
1.3125	10437.28	1.3125	10437.28	1
1.375	8365.359	1.375	8365.359	1
1.4375	6704.736	1.4375	6704.736	1
1.5	5373.765	1.5	5373.765	1
1.5625	4307.005	1.5625	4307.005	1
1.625	3452.009	1.625	3452.009	1
1.6875	2766.739	1.6875	2766.739	1
1.75	2217.503	1.75	2217.503	1
1.8125	1777.297	1.8125	1777.297	1
1.875	1424.478	1.875	1424.478	1
1.9375	1141.698	1.9375	1141.698	1
2.0070	915.0533	2	915.0533	1
2.0625	733.4008	2.0625	733.4008	1
2.125	587.809	2.125	587.809	1
2:120	007.000	2.120	007.000	-

CONCENTRATION: C- CARBON-14_test.ROF Graphics.Asc	02/17/2020 16:40		CARBON-14.ROF Graphics.Asc	: C-14, Leafy vegetable 01/10/2020 15:37		
Year	Value		Year	Value		
0		208495.3	0	208495	5.3	1
0.0625		167108.3	0.0625	167108	3.3	1
0.125		133936.8	0.125	133936	6.8	1
0.1875		107349.8	0.1875	107349	9.8	1
0.25		86040.41	0.25	86040.	41	1
0.3125		68960.99	0.3125	68960.	99	1
0.375		55271.89	0.375	55271.	89	1
0.4375		44300.11	0.4375	44300.	11	1
0.5		35506.29	0.5	35506.	29	1
0.5625		28458.07	0.5625	28458.	07	1
0.625		22808.95	0.625	22808.	95	1
0.6875		18281.22	0.6875	18281.	22	1
0.75		14652.26	0.75	14652.	26	1
0.8125		11743.67	0.8125	11743.	67	1
0.875		9412.457	0.875	9412.4	57	1
0.9375		7544.004	0.9375	7544.0	04	1
1		6046.451	1	6046.4	51	1
1.0625		4846.174	1.0625	4846.1	74	1
1.125		3884.161	1.125	3884.1	61	1
1.1875		3113.115	1.1875	3113.1	15	1
1.25		2495.129	1.25	2495.1	29	1
1.3125		1999.819	1.3125	1999.8	19	1
1.375		1602.832	1.375	1602.8	32	1
1.4375		1284.651	1.4375	1284.6	51	1
1.5		1029.632	1.5	1029.6	32	1
1.5625		825.2372	1.5625	825.23	72	1
1.625		661.417	1.625	661.4		1
1.6875		530.1169	1.6875	530.11	69	1
1.75		424.8814	1.75	424.88	14	1
1.8125		340.5364	1.8125	340.53	64	1
1.875		272.935	1.875	272.9	35	1
1.9375		218.7533	1.9375	218.75		1
2		175.3274	2	175.32		1
2.0625		140.5222	2.0625	140.52		1
2.125		112.6263	2.125	112.62		1

Documented in Graph_leafy_vegetable_c14.csv of 2/18/2020 7:37 AM

12.88 TEST CASE 054-003 TESTER'S REPORT

Documented in graph_meat_c14.csv of 2/18/2020 7:38 AM

CONCENTRATION: C-2 CARBON-14_test.ROF Graphics.Asc	02/17/2020 16:40		Graphics.Asc	01/10/2020 15:37	
Year	Value		Year	Value	
0		330987.8	0	330987.8	1
0.0625		265285.7	0.0625	265285.7	1
0.125		212625.6	0.125	212625.6	1
0.1875		170418.6	0.1875	170418.6	1
0.25		136589.8	0.25	136589.8	1
0.3125		109476.1	0.3125	109476.1	1
0.375		87744.52	0.375	87744.52	1
0.4375		70326.75	0.4375	70326.75	1
0.5		56366.48	0.5	56366.48	1
0.5625		45177.38	0.5625	45177.38	1
0.625		36209.38	0.625	36209.38	1
0.6875		29021.56	0.6875	29021.56	1
0.75		23260.57	0.75	23260.57	1
0.8125		18643.16	0.8125	18643.16	1
0.875		14942.34	0.875	14942.34	1
0.9375		11976.16	0.9375	11976.16	1
1		9598.785	1	9598.785	1
1.0625		7693.335	1.0625	7693.335	1
1.125		6166.134	1.125	6166.134	1
1.1875		4942.093	1.1875	4942.093	1
1.25		3961.036	1.25	3961.036	1
1.3125		3174.727	1.3125	3174.727	1
1.375		2544.507	1.375	2544.507	1
1.4375		2039.393	1.4375	2039.393	1
1.5		1634.548	1.5	1634.548	1
1.5625		1310.07	1.5625	1310.07	1
1.625		1050.004	1.625	1050.004	1
1.6875		841.5643	1.6875	841.5643	1
1.75		674.5023	1.75	674.5023	1
1.8125		540.604	1.8125	540.604	1
1.875		433.2862	1.875	433.2862	1
1.9375		347.2724	1.9375	347.2724	1
2		278.3336	2	278.3336	1
2.0625		223.08	2.0625	223.08	1
2.125		178.795	2.125	178.795	1

CONCENTRATION: C-14, Milk CARBON-14_test.ROF 02/17/2020 16:40 Graphics.Asc			CONCENTRATION CARBON-14.ROF Graphics.Asc	: C-14, Milk 01/10/2020 15:37	
Year	Value		Year	Value	
0		78818.34	0	78818.34	1
0.0625		63172.66	0.0625	63172.66	1
0.125		50632.68	0.125	50632.68	1
0.1875		40581.89	0.1875	40581.89	1
0.25		32526.22	0.25	32526.22	1
0.3125		26069.61	0.3125	26069.61	1
0.375		20894.66	0.375	20894.66	1
0.4375		16746.96	0.4375	16746.96	1
0.5		13422.59	0.5	13422.59	1
0.5625		10758.12	0.5625	10758.12	1
0.625		8622.565	0.625	8622.565	1
0.6875		6910.925	0.6875	6910.925	1
0.75		5539.056	0.75	5539.056	1
0.8125		4439.51	0.8125	4439.51	1
0.875		3558.231	0.875	3558.231	1
0.9375		2851.892	0.9375	2851.892	1
1		2285.765	1	2285.765	1
1.0625		1832.019	1.0625	1832.019	1
1.125		1468.346	1.125	1468.346	1
1.1875		1176.864	1.1875	1176.864	1
1.25		943.2442	1.25	943.2442	1
1.3125		755.9999	1.3125	755.9999	1
1.375		605.9253	1.375	605.9253	1
1.4375		485.642	1.4375	485.642	1
1.5		389.2361	1.5	389.2361	1
1.5625		311.9679	1.5625	311.9679	1
1.625		250.0383	1.625	250.0383	1
1.6875		200.4023	1.6875	200.4023	1
1.75		160.6197	1.75	160.6197	1
1.8125		128.7344	1.8125	128.7344	1
1.875		103.1788	1.875	103.1788	1
1.9375		82.69623	1.9375	82.69623	1
2		66.27976	2	66.27976	1
2.0625		53.12218	2.0625	53.12218	1
2.125		42.57657	2.125	42.57657	1

Documented in graph_Milk_c14.csv of 2/18/2020 7:39 AM

12.89 TEST CASE 054-004 TESTER'S REPORT

Documented in graph_primary_Contamination_H3.csv of 2/18/2020 7:44 AM

CONCENTRATION: H-3 HYDROGEN-3_test.RO Graphics.Asc	8, Primary Contamination F 02/17/2020 16:53		l: H-3, Primary Contaminat 01/12/2020 18:07	ion
Year	Value	Year	Value	
0	100	0	100	1
0.0625	91.13956	0.0625	91.13956	1
0.125	83.06419	0.125	83.06419	1
0.1875	75.70432	0.1875	75.70432	1
0.25	68.99655	0.25	68.99655	1
0.3125	62.88312	0.3125	62.88312	1
0.375	57.31136	0.375	57.31136	1
0.4375	52.23329	0.4375	52.23329	1
0.5	47.60515	0.5	47.60515	1
0.5625	43.38708	0.5625	43.38708	1
0.625	39.54275	0.625	39.54275	1
0.6875	36.03905	0.6875	36.03905	1
0.75	32.84579	0.75	32.84579	1
0.8125	29.93546	0.8125	29.93546	1
0.875	27.28301	0.875	27.28301	1
0.9375	24.86557	0.9375	24.86557	1
1	22.66233	1	22.66233	1
1.0625	20.65431	1.0625	20.65431	1
1.125	18.82421	1.125	18.82421	1
1.1875	17.15627	1.1875	17.15627	1
1.25	15.63611	1.25	15.63611	1
1.3125	14.25065	1.3125	14.25065	1
1.375	12.98795	1.375	12.98795	1
1.4375	11.83713	1.4375	11.83713	1
1.5	10.78828	1.5	10.78828	1
1.5625	9.832363	1.5625	9.832363	1
1.625	8.961145	1.625	8.961145	1
1.6875	8.167124	1.6875	8.167124	1
1.75	7.443457	1.75	7.443457	1
1.8125	6.783911	1.8125	6.783911	1
1.875	6.182806	1.875	6.182806	1
1.9375	5.634963	1.9375	5.634963	1
2	5.135662	2	5.135662	1
2.0625	4.680602	2.0625	4.680602	1
2.125	4.265863	2.125	4.265863	1

12.90 TEST CASE 054-005 TESTER'S REPORT

Documented in Graph_leafy_vegetable_h3.csv of 2/18/2020 7:42 AM					
CONCENTRATION: H-3, Leafy vegetable	CONCENTRATION: H-3, Leafy vegetable				
HYDROGEN-3_test.ROF 02/17/2020 16:53	Hydrogen-3.ROF 01/12/2020 18:07				
Graphics.Asc	Graphics.Asc				

HYDROGEN-3_test.RO	F 02/17/2020 16:53			2/2020 18:07	
Graphics.Asc		Graphics.			
Year	Value	Year	Va		
0		6339	0	0.026339	1
0.0625			0.0625	0.026394	1
0.125		5244	0.125	0.025244	1
0.1875	0.02	3599 ().1875	0.023599	1
0.25	0.02	1803	0.25	0.021803	1
0.3125	0.02	0017 ().3125	0.020017	1
0.375	0.01	8317	0.375	0.018317	1
0.4375	0.0	1673 ().4375	0.01673	1
0.5	0.01	5266	0.5	0.015266	1
0.5625	0.01	3922 ().5625	0.013922	1
0.625	0.01	2693	0.625	0.012693	1
0.6875	0.01	1571 ().6875	0.011571	1
0.75	0.01	0547	0.75	0.010547	1
0.8125	0.00	9613 ().8125	0.009613	1
0.875	0.00	8761	0.875	0.008761	1
0.9375	0.00	7985 ().9375	0.007985	1
1	0.00	7278	1	0.007278	1
1.0625	0.00	6633	1.0625	0.006633	1
1.125	0.00	6045	1.125	0.006045	1
1.1875	0.0	0551	1.1875	0.00551	1
1.25	0.00	5021	1.25	0.005021	1
1.3125	0.00	4576	1.3125	0.004576	1
1.375	0.00	4171	1.375	0.004171	1
1.4375	0.00	3801	1.4375	0.003801	1
1.5	0.00	3465	1.5	0.003465	1
1.5625	0.00	3158	1.5625	0.003158	1
1.625	0.00	2878	1.625	0.002878	1
1.6875	0.00	2623	1.6875	0.002623	1
1.75		0239	1.75	0.00239	1
1.8125			1.8125	0.002179	1
1.875		1986	1.875	0.001986	1
1.9375	0.0	0181	1.9375	0.00181	1
2		1649	2	0.001649	1
2.0625			2.0625	0.001503	1
2.125		0137	2.125	0.00137	1
2.120	0.0			0.0010/	-

CONCENTRATION: H-3 vegetables HYDROGEN-3_test.RO		vegetables	N: H-3, Fruit, grain, non-lea	fy
Graphics.Asc	F UZ/1//ZUZU 10.55	Graphics.Asc	01/12/2020 18:07	
Year	Value	Year	Value	
0	0.006495		0.006495	1
0.0625	0.008745	0.0625	0.008745	1
0.125	0.009377	0.125	0.009377	1
0.1875	0.009246	0.1875	0.009246	1
0.25	0.008775	0.25	0.008775	1
0.3125	0.008171	0.3125	0.008171	1
0.375	0.007533	0.375	0.007533	1
0.4375	0.006908	0.4375	0.006908	1
0.5	0.006318	0.5	0.006318	1
0.5625	0.005768	0.5625	0.005768	1
0.625	0.005263	0.625	0.005263	1
0.6875	0.004799	0.6875	0.004799	1
0.75	0.004375	0.75	0.004375	1
0.8125	0.003988	0.8125	0.003988	1
0.875	0.003635	0.875	0.003635	1
0.9375	0.003313	0.9375	0.003313	1
1	0.00302	1	0.00302	1
1.0625	0.002752	1.0625	0.002752	1
1.125	0.002508	1.125	0.002508	1
1.1875	0.002286	1.1875	0.002286	1
1.25	0.002084	1.25	0.002084	1
1.3125	0.001899	1.3125	0.001899	1
1.375	0.001731	1.375	0.001731	1
1.4375	0.001577	1.4375	0.001577	1
1.5	0.001438	1.5	0.001438	1
1.5625	0.00131		0.00131	1
1.625	0.001194	1.625	0.001194	1
1.6875	0.001088	1.6875	0.001088	1
1.75	0.000992	1.75	0.000992	1
1.8125	0.000904	1.8125	0.000904	1
1.875	0.000824		0.000824	1
1.9375	0.000751	1.9375	0.000751	1
2	0.000684		0.000684	1
2.0625	0.000624		0.000624	1
2.125	0.000568	2.125	0.000568	1

Documented in graph_non_leafy_h3.csv of 2/18/2020 7:43 AM

12.91 TEST CASE 054-006 TESTER'S REPORT

Documented in graph_Milk_h3.csv of 2/18/2020 7:41 AM

CONCENTRATION: H-3 HYDROGEN-3_test.RO Graphics.Asc	F 02/17/2020 16:53		CONCENTRATION Hydrogen-3.ROF Graphics.Asc	01/12/2020 18	3:07	
Year	Value		Year	Value		
0		0.002015	0		0.002015	1
0.0625		0.002059	0.0625		0.002059	1
0.125		0.001988	0.125		0.001988	1
0.1875		0.001867	0.1875		0.001867	1
0.25		0.001729	0.25		0.001729	1
0.3125		0.00159	0.3125		0.00159	1
0.375		0.001456	0.375		0.001456	1
0.4375		0.00133	0.4375		0.00133	1
0.5		0.001214	0.5		0.001214	1
0.5625		0.001107	0.5625		0.001107	1
0.625		0.001009	0.625		0.001009	1
0.6875		0.00092	0.6875		0.00092	1
0.75		0.000839	0.75		0.000839	1
0.8125		0.000764	0.8125		0.000764	1
0.875		0.000697	0.875		0.000697	1
0.9375		0.000635	0.9375		0.000635	1
1		0.000579	1		0.000579	1
1.0625		0.000528	1.0625		0.000528	1
1.125		0.000481	1.125		0.000481	1
1.1875		0.000438	1.1875		0.000438	1
1.25		0.000399	1.25		0.000399	1
1.3125		0.000364	1.3125		0.000364	1
1.375		0.000332	1.375		0.000332	1
1.4375		0.000302	1.4375		0.000302	1
1.5		0.000276	1.5		0.000276	1
1.5625		0.000251	1.5625		0.000251	1
1.625		0.000229	1.625		0.000229	1
1.6875		0.000209	1.6875		0.000209	1
1.75		0.00019	1.75		0.00019	1
1.8125		0.000173	1.8125		0.000173	1
1.875		0.000158	1.875		0.000158	1
1.9375		0.000144	1.9375		0.000144	1
2		0.000131	2		0.000131	1
2.0625		0.00012	2.0625		0.00012	1
2.125		0.000109	2.125		0.000109	1

CONCENTRATION: H-3, M HYDROGEN-3_test.ROF (Graphics.Asc		CONCENTRATION Hydrogen-3.ROF (Graphics.Asc		
Year V	/alue	Year	Value	
0	0.001814	0	0.001814	1
0.0625	0.002167	0.0625	0.002167	1
0.125	0.00223	0.125	0.00223	1
0.1875	0.00216	0.1875	0.00216	1
0.25	0.002032	0.25	0.002032	1
0.3125	0.001883	0.3125	0.001883	1
0.375	0.001732	0.375	0.001732	1
0.4375	0.001586	0.4375	0.001586	1
0.5	0.00145	0.5	0.00145	1
0.5625	0.001323	0.5625	0.001323	1
0.625	0.001207	0.625	0.001207	1
0.6875	0.0011	0.6875	0.0011	1
0.75	0.001003	0.75	0.001003	1
0.8125	0.000914	0.8125	0.000914	1
0.875	0.000833	0.875	0.000833	1
0.9375	0.00076	0.9375	0.00076	1
1	0.000692	1	0.000692	1
1.0625	0.000631	1.0625	0.000631	1
1.125	0.000575	1.125	0.000575	1
1.1875	0.000524	1.1875	0.000524	1
1.25	0.000478	1.25	0.000478	1
1.3125	0.000435	1.3125	0.000435	1
1.375	0.000397	1.375	0.000397	1
1.4375	0.000362	1.4375	0.000362	1
1.5	0.00033	1.5	0.00033	1
1.5625	0.0003	1.5625	0.0003	1
1.625	0.000274	1.625	0.000274	1
1.6875	0.00025	1.6875	0.00025	1
1.75	0.000227	1.75	0.000227	1
1.8125	0.000207	1.8125	0.000207	1
1.875	0.000189	1.875	0.000189	1
1.9375	0.000172	1.9375	0.000172	1
2	0.000157	2	0.000157	1
2.0625	0.000143	2.0625	0.000143	1
2.125	0.00013	2.125	0.00013	1

Documented in graph_meat_h3.csv of 2/18/2020 7:42 AM

12.92 TEST CASE 111 TESTER'S REPORT

Documented in Test Case 111-JJCheng.docx of 2/20/2020 8:23 AM

Test Case – 111 – Tests Offsite Activated Metal Case I: new source term

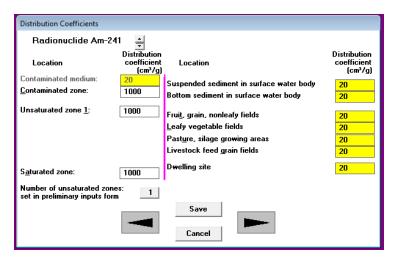
• Suggestions for revising the test descriptions in the Test Cases document -

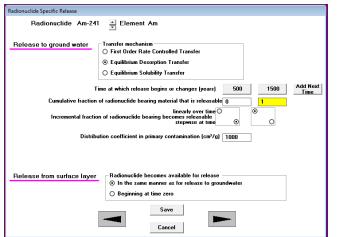
Test Summary	Test OFFSITE's new source term model: Case I - activated metal with uniform release for 1000 years
Test Objective	Test features of OFFSITE new source term model to simulate uniform release for 1000 years after delay for 500 years
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.3

• Launched RESRAD-OFFSITE. Opened the input file, ACTIVATED METAL-500_1000 CONSTANT.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Speci	ied (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 8th time at which release changes 8th time at which release changes	500 Insert new 1st time and shift down existing times and associated release data Delete 1st time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	2 <u>Add new 3rd time at which release changes</u>
Times are in ascending order.	Close

List of Nuclide at the Site	entration: es Present	100 pCi/g contaminated zone	List of ICRP38 Nuclides with half life greater than 30 days
Am-241 C-14 Cs=137 Nb-94 Ni-59 Np-237 Tc-99 Th-229 U-233	3930 290000 561000 42000 7990000 0 86400 0 0	Transfer Mechanism Equilibrium Desorption Equilibrium Solubility First Order Bate Controlled <u>Add Ac-227 21.77y</u> <u>Delete</u> Nuclide Specific Rglease Djstribution Coefficients Deposition <u>V</u> elocities <u>Iransfer Factors</u> All <u>Nuclide Factors</u> Turn on Badon Pathway	Ac-227 Ag-105 Ag-108m Ag-1108m Ag-1108m Al-26 Am-241 Am-242m Am-242m Am-242m Ar-37 No DCFs Ar-39 No DCFs Ar-39 No DCFs Ba-133 Ba-133 Ba-133 Ba-110 Be-7 Bi-207 Ca-11 Ca-113 Cd-1135 V

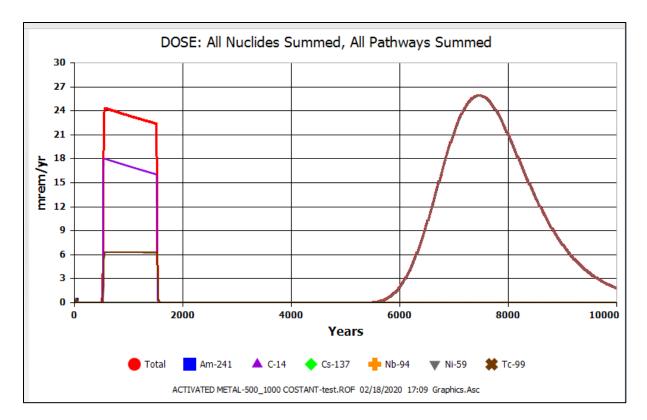




Primary Contamination					
Area of primary contamination.				120	square meters
Length of contamination parallel to aquifer flow:			10.95	meters	
Depth of soil <u>m</u> ixing layer:				.15	meters
Mass loading of all particulates	s:			.0001	grams/m³
Deposition velocity of all partic	culates (to com	pute atmosph	eric release):	.001	meters/s
Respirable particulates as a fra	action of total j	particulates		1	
Deposition velocity of respirab	le particulates	(to compute a	tmospheric release):	.001	meters/s
Irrigation applied per year:				0	meters in a year
Evapotranspiration coefficient:				.6	
Runoff coefficient:				.22	
Slope-length-steepness factor:				.4	
Cover and management factor:				.05	
Support practice factor:				1	
Fraction of primary contaminati	ion that is subr	nerged		0	
Soil layer -> Location relative to water table	Clean cover e ->	Contam above	inated zone below		
<u>I</u> hickness:	5	5	meters		
Soil erodibility factor:	.1	.1	tons/acre		
Dry bulk density:	1.62	1.62	grams/cm ³		
E <u>r</u> osion rate:	4.425E-05	4.425E-05	meters/year		
Total porosity:	.4	.4			
Volumetric water content:	.05		_		
Effective porosity:		.4			
Hydraulic conductivity:		30	meters/year		
<u>F</u> ield capacity:		.3			
<u>b</u> parameter: 4.1					
Longitudinal dispersivity: 0 meters					
	-	-	Save		
			Cancel		

• Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-3 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



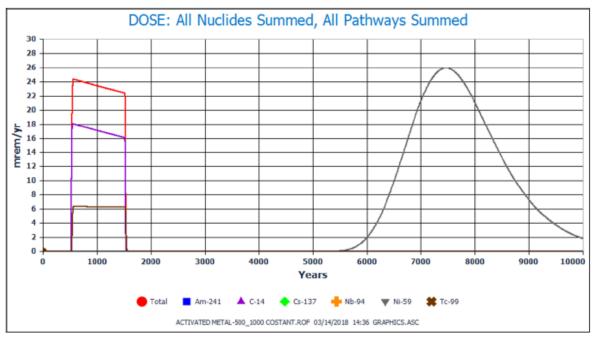


Figure M-3 Potential Radiation Dose Associated with Disposal of Activated Metals-Delayed Releases for 500 years

12.93 TEST CASE 112 TESTER'S REPORT

Documented in Test Case 112-JJCheng.docx of 2/20/2020 8:09 AM

Test Case – 112 – Tests Offsite Activated Metal Case II: new source term

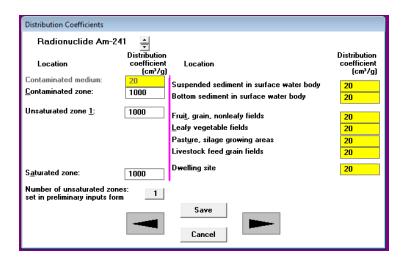
• Suggestions for revising the test descriptions in the Test Cases document -

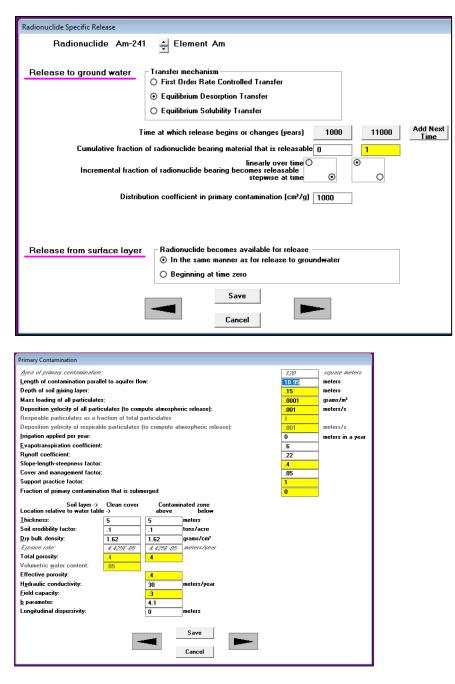
Test Summary	Test OFFSITE's new source term model: Case II - activated metal with uniform release for 10,000 years
Test Objective	Test features of OFFSITE new source term model to simulate uniform release for 10,000 years after delay for 1000 years
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.13

• Launched RESRAD-OFFSITE. Opened the input file, ACTIVATED METAL-1000_10000 CONSTANT.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Speci	ed (years)	
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	1000 Insert new 1st time and shift down existing times and associated release data Delete 1st time and associated release data	sse data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	2 Add new 3rd time at which release changes	
Times are in ascending order	Close	

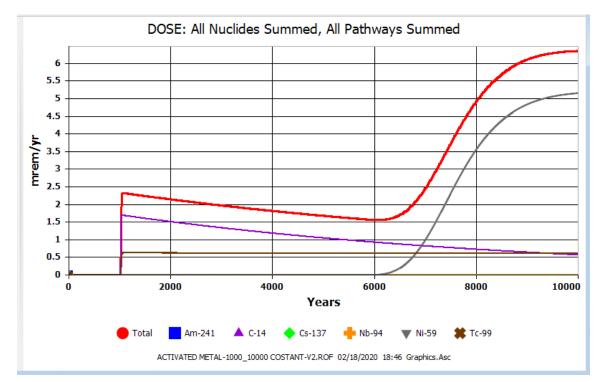
List of Nuclide at the Site	entration: es Present	100 pCi/g contaminated zone	List of ICRP38 Nuclides with half life greater than 30 days
Am-241 C-14 Cs=137 Nb-94 Ni-59 Np-237 Tc-99 Th-229 U-233	3930 290000 561000 42000 7990000 0 86400 0 0	Transfer Mechanism Equilibrium Desorption Equilibrium Solubility First Order Bate Controlled <u>Add Ac-227 21.77y</u> <u>Delete</u> Nuclide Specific Rglease Djstribution Coefficients Deposition <u>V</u> elocities <u>Iransfer Factors</u> All <u>Nuclide Factors</u> Turn on Badon Pathway	Ac-227 Ag-105 Ag-108m Ag-1108m Ag-1108m Al-26 Am-241 Am-242m Am-242m Am-242m Ar-37 No DCFs Ar-39 No DCFs Ar-39 No DCFs Ba-133 Ba-133 Ba-133 Ba-110 Be-7 Bi-207 Ca-11 Ca-113 Cd-1135 V





• Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-24 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix



M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)

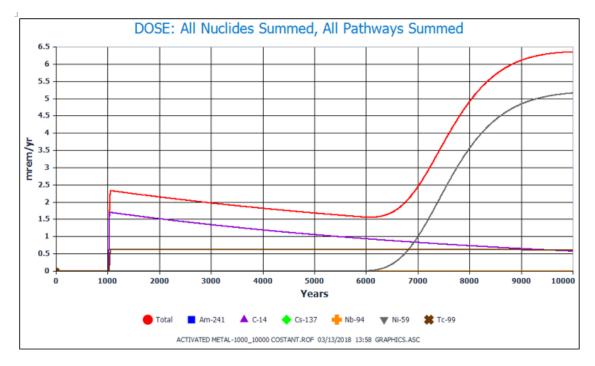


Figure M-13 Potential Radiation Dose Associated with Disposal of Activated Metals—Delayed Releases for 1,000 years

12.94 TEST CASE 113 TESTER'S REPORT

Documented in Test Case 113-JJCheng.docx of 2/20/2020 8:15 AM

Test Case – 113 – Tests Offsite Activated Metal Case III: increasing corrosion rate

• Suggestions for revising the test descriptions in the Test Cases document -

Test Summary	Test OFFSITE's new source term model: Case III - activated metal with increasing uniform release
Test Objective	Test features of OFFSITE new source term model to simulate uniform release with an increasing release rate over time
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.24

• Launched RESRAD-OFFSITE. Opened the input file, ACTIVATED METAL-500_1000 INCREASE.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Specif	d (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	Insert new 1st time and shift down existing times and associated release data 900 1100 1300 1500
<u>9</u> th time at which release changes Number of times at which the release properties are specified	6 <u>A</u> dd new 7th time at which release changes
Times are in ascending order	Close

Initial Concentra Nuclide Conce List of Nuclide at the Site	entration:	100 pCi/g contaminated zone	List of ICRP38 Nuclides with half life greater than 30 days
An -241 C-14 Cs-137 Nb-94 Ni-59 Np-237 TC-99 Tb-229 U-233	3930 290000 561000 42000 7990000 0 86400 0 0	Transfer Mechanism O E Equilibrium Desorption E Equilibrium Solubility First Order Bate Controlled Add Ac-227 21.77y Delete Nuclide Specific Release Distribution Coefficients Deposition Velocities Iransfer Factors All Nuclide Factors Turn on Radon Pathway	Ac-227 ∧ Ag-105 ∧ Ag-108m ∧ Ag-108m ∧ Ag-108m ∧ Ag-108m ∧ Ag-240m ∧ Am-241 ∧ Am-242m ∧ Am-243 ∧ Ar-37 No DCFs Ar-38 No DCFs Ba-133 Be-10 Be-7 Bi-207 Bi-210m Bk-247 Bk-243 Ca-41 Ca-41 Ca-45 Cd-113 Cd-113m
	-	Close	•

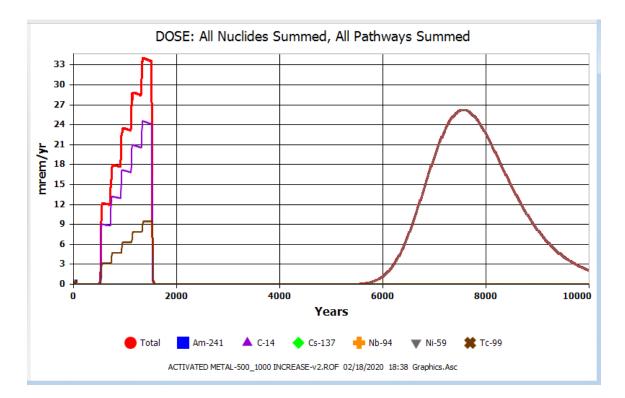
Distribution Coefficients			
Radionuclide Am-24	1		
Location	Distribution coefficient (cm³/g)	Location	Distribution coefficient (cm³/g)
Contaminated medium:	20	Suspended sediment in surface water body	20
<u>C</u> ontaminated zone:	1000	Bottom sediment in surface water body	20
Unsaturated zone <u>1</u> :	1000	Fruit, grain, nonleafy fields Leafy vegetable fields Pasture, silage growing areas Livestock feed grain fields	20 20 20 20 20
S <u>a</u> turated zone:	1000	Dwelling site	20
Number of unsaturated zone set in preliminary inputs form			
	-	Save Cancel	

Radionuclide Specific Release	
Radionuclide Am-241	➡ Element Am
	Transfer mechanism O First Order Rate Controlled Transfer @ Equilibrium Desorption Transfer O Equilibrium Solubility Transfer
Tim	e at which release begins or changes (years) 500 700 900 1100 1300 Add Next Time
Cumulative fraction of	f radionuclide bearing material that is releasable 0 .1 .25 .45 .7 1
Incremental fraction	of radionuclide bearing becomes releasable stepwise at time
Distributi	on coefficient in primary contamination (cm²/g) 1000
Release from surface layer	Radionuclide becomes available for release In the same manner as for release to groundwater Beginning at time zero
	Save Cancel

Primary Contamination						
Area of primary contamination: 120 square meters						
Length of contamination parall	10.95	meters				
Depth of soil mixing layer:				.15	meters	
Mass loading of all particulates	8:			.0001	grams/m³	
Deposition velocity of all partic	ulates (to com	pute atmosphe	eric release):	.001	meters/s	
Respirable particulates as a fra	action of total j	particulates		1		
Deposition velocity of respirab	le particulates	(to compute al	tmospheric release):	.001	meters/s	
Irrigation applied per year:				0	meters in a year	
Evapotranspiration coefficient:				.6		
Runoff coefficient:				.22		
Slope-length-steepness factor:				.4		
Cover and management factor:				.05		
Support practice factor:				1		
Fraction of primary contaminati	ion that is subr	nerged		0		
0.11						
Soil layer -> Location relative to water table	Clean cover e ->	above	inated zone below			
Ihickness:	5	5	meters			
Soil erodibility factor:	1	.1	tons/acre			
Dry bulk density:	1.62	1.62	grams/cm³			
Egosion rate:	4.425E-05	4.425E-05				
Total porosity:	.4	.4				
Volumetric water content:	.05					
Effective porosity:		.4				
Hydraulic conductivity:		30	meters/year			
Field capacity:		.3				
<u>b</u> parameter:		4.1	_			
Longitudinal dispersivity: 0 meters						
			_			
Save						
			Cancel			

• Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-24 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



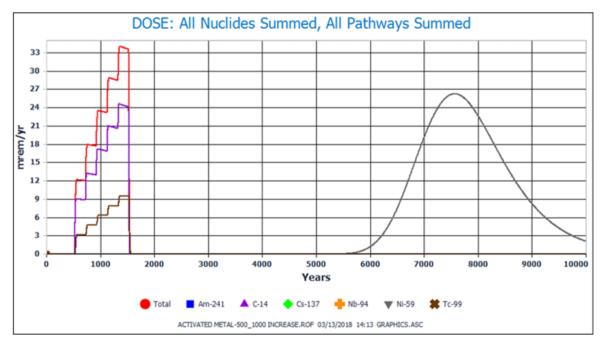


Figure M-24 Potential Radiation Dose Associated with Disposal of Activated Metals—Delayed Releases for 500 Years with an Increasing Corrosion Rate

12.95 TEST CASE 114 TESTER'S REPORT

Documented in Test Case 114-JJCheng.docx of 2/20/2020 8:19 AM

Test Case – 114 – Tests Offsite Activated Metal Case IV: TRU Waste

• Suggestions for revising the test descriptions in the Test Cases document -

Test Summary	Test OFFSITE's new source term model: Case IV - TRU waste with equilibrium desorption release
Test Objective	Test features of OFFSITE new source term model to simulate equilibrium desorption release with no retardation from the contaminated medium
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.35

• Launched RESRAD-OFFSITE. Opened the input file, OTHER WASTE-KD=0_500-V2_DT2.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Specifi	ed (years)				
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	500			iít down existing release data	Delete 2nd time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	1		<u>A</u> d	d new 2nd time at w	hich release changes
Times are in ascending order		d	lose		

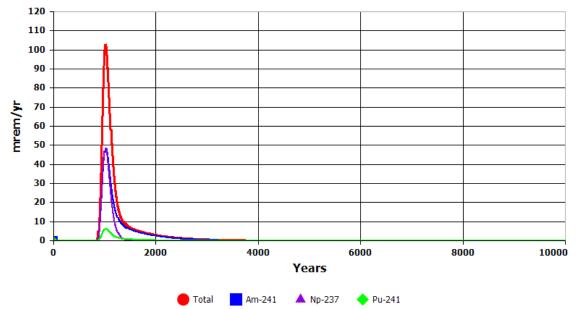
Initial Concentrations				
	100 pCi zor		List of ICRP38 Nuclides with half life greater than 30 days	
Am-241 2730000 Np-237 772 Pu-241 8230000 Th-229 0 U-233 0	⊙ Equilibriun ○ Equilibriun	n <u>D</u> esorption	Ac-227 A Ag-105 Ag-108m Ag-110m Al-26	
	<u>A</u> dd Ac	-227 21.77y	Am-241 Am-242m Am-243	
		Delete	Ar-37 No DCFs Ar-39 No DCFs As-73 Au-195 P-122	
		pecific R <u>e</u> lease	Ba-133 Be-10 Be-7 Bi-207	
		ion <u>V</u> elocities	Bi-210m Bk-247 Bk-249	
	<u> </u>	fer Factors	C-14 Ca-41	
	All <u>N</u> uc	clide Factors	Ca-45 Cd-109 Cd-113	
	Turn on F	adon <u>P</u> athway	Cd-113m Cd-115m ¥	
-	Clos	se		
istribution Coefficients				
Radionuclide Am-24	Distribution coefficient (cm³/g)	Location		Distributio coefficier (cm³/
ontaminated medium: ontaminated zone:	0 1000	-	diment in surface wate nt in surface water boo	
nsaturated zone <u>1</u> :	1000	Frui <u>t</u> , grain, no Leafy yegetab	nleafy fields	20 20 20
		Past <u>u</u> re, silage Livestock feed	e growing areas	20
		Dwelling site	r grain heids	20 20
<u>a</u> turated zone:	1000			20
lumber of unsaturated zone et in preliminary inputs form			-	
		Save Cancel		

Radionuclide Specific Release			
Radionuclide Am-24	1 🛨 Element Am		
Release to ground water	Transfer mechanism O First Order Rate Contro	lled Transfer	
	• Equilibrium Desorption	Transfer	
	O Equilibrium Solubility Tr		
			Add Next
	ime at which release begins		Time
Cumulative fraction	of radionuclide bearing mate		
linearly over time Incremental fraction of radionuclide bearing becomes releasable step w ise at time			
Distrib	ution coefficient in primary c	ontamination (cm³/g) 1000]
Release from surface layer	Radionuclide becomes In the same manner Beginning at time ze Save Cancel	as for release to groundwater	
	•		
Primary Contamination			
Area of primary contamination:		120 square meters	
Length of contamination parallel to aquifer flow:		10.95 meters	
Depth of soil <u>m</u> ixing layer: Mass loading of all particulates:		.15 meters .0001 grams/m ²	
Deposition velocity of all particulates (to compute	atmospheric release);	.001 granter in grante	
Respirable particulates as a fraction of total partic	ulates	1	
Deposition velocity of respirable particulates (to co	ompute atmospheric release):	.001 meters/s	
<u>I</u> rrigation applied per year: Evapotranspiration coefficient:		0 meters in a year	
Runoff coefficient:		.8	
Slope-length-steepness factor:		.4	
Cover and management factor:		.05	
Support practice factor: Fraction of primary contamination that is submerge	4	<u>1</u>	
Soil layer -> Clean cover Location relative to water table ->	Contaminated zone above below		
Thickness: 5 5	meters		
Soil erodibility factor: .1 .1	tons/acre		
Dry bulk density: 1.62 1.6			
	125E-05 meters/year		
Total gorosity: .4 .4 .4 .4			
Volumetric water content: .05 Effective porosity: .4			
Hydraulic conductivity: 30	meters/year		
Field capacity: .3			
<u>b</u> parameter: 4.1			
Longitudinal dispersivity: 0	meters		
	Save Cancel		

Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-35 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix

M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



DOSE: All Nuclides Summed, All Pathways Summed

OTHER WASTE-KD=0_500-V2_DT2-V2.ROF 02/19/2020 13:48 Graphics.Asc

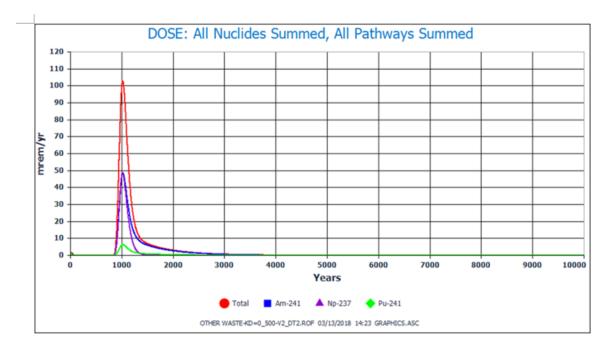


Figure M-35 Potential Radiation Dose Associated with Disposal of TRU Waste-Delayed Releases for 500 Years

12.96 TEST CASE 115 TESTER'S REPORT

Documented in Test Case 115-JJCheng.docx of 2/20/2020 8:23 AM

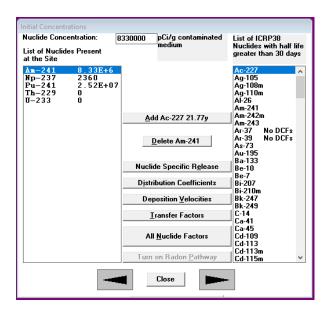
Test Case – 115 – Tests Offsite Activated Metal Case V: Grouted TRU Waste

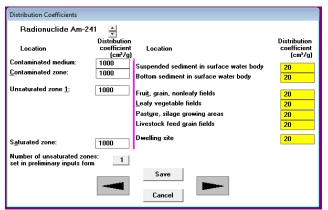
• Suggestions for revising the test descriptions in the Test Cases document -

Test Summary	Test OFFSITE's new source term model: Case V - Grouted TRU waste with equilibrium desorption release
Test Objective	Test features of OFFSITE new source term model to simulate equilibrium desorption release with retardation from the contaminated medium
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.42

• Launched RESRAD-OFFSITE. Opened the input file, OTHER WASTE-KD=CEMENT_500_DT2-DUST-REVISED.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Specif	ed (years)		
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes 9th time at which release changes 9th time at which release changes	500	Insert new 1st time and shift down existing times and associated release data Add new 2nd time at w	Delete 2nd time and associated release data and shift up existing data
Number of times at which the release properties are specified Times are in ascending order	1		
	-		



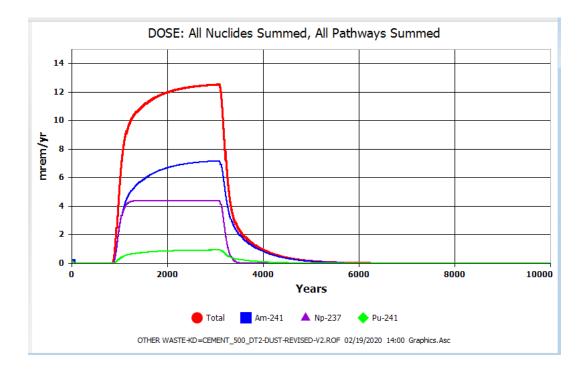


Radionuclide Specific Release	
Radionuclide Am-241 🛓 Element Am	
Release to ground water Transfer mechanism ○ First Order Rate Controlled Transfer ○ Equilibrium Desorption Transfer ○ Equilibrium Solubility Transfer Time at which release begins or changes (years) 500 Cumulative fraction of radionuclide bearing material that is releasable 1 Incremental fraction of radionuclide bearing becomes releasable stepwise at time O Distribution coefficient in primary contamination (cm²/g)	Add Next Time
Release from surface layer Radionuclide becomes available for release Image: Constraint of the same manner as for release to groundwater Image: Constraint of the same manner as for release to groundwater Image: Constraint of the same manner as for release to groundwater Image: Constraint of the same manner as for release to groundwater Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same manner as for release Image: Constraint of the same	
Cancel	

Primary Contamination						
Area of primary contamination: 120 square motors				sauare meters		
Length of contamination parallel to aquifer flow:			10.95	meters		
			15	meters		
Mass loading of all particulates	s:				.0001	grams/m³
Deposition velocity of all partic		pute atmosphe	nic release):		001	meters/s
Respirable particulates as a fra	action of total p	articulates			1	
Deposition velocity of respirab	le particulates	(to compute at	mospheric release):		.001	meters/s
Irrigation applied per year:					0	meters in a year
Evapotranspiration coefficient					.6	
Runoff coefficient:					.22	
Slope-length-steepness factor:					.4	
Cover and management factor:					.05	
Support practice factor:					1	
Fraction of primary contaminat	ion that is subm	nerged			0	
Soil layer -> Clean cover Contaminated zone Location relative to water table -> above below		Contaminated medium				
<u>T</u> hickness:	5	5	meters			Total mass 318000 kg
Soil erodibility factor:	.1	.1	tons/acre		Т	otal volume 120 m³
Dry bulk density:	1.62	1.826	grams/cm ³			
E <u>r</u> osion rate:	4.425E-05	3.926E-05	meters/year			
Total porosity:	.4	.4				
Volumetric water content:	.05	-	-			
Effective porosity:		.4				
Hydraulic conductivity: 30 meters/year						
Field capacity:	capacity: .3					
<u>b</u> parameter:		4.1				
Longitudinal dispersivity:		0	meters			
			Save Cancel			

• Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-35 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



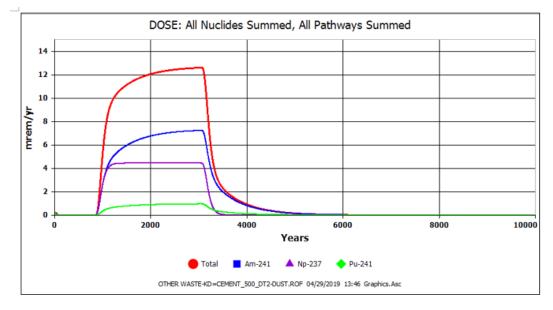


Figure M-42 Potential Radiation Dose Associated with Disposal of Grouted TRU Waste

12.97 TEST CASE 116 TESTER'S REPORT

Documented in Test Case 116-JJCheng.docx of 2/20/2020 8:26 AM

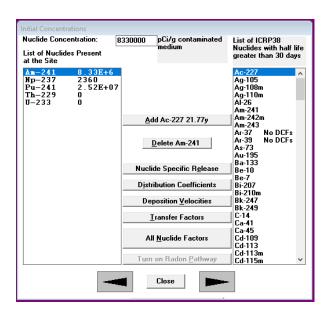
Test Case – 116 – Tests Offsite Activated Metal Case VI: Grouted TRU Waste

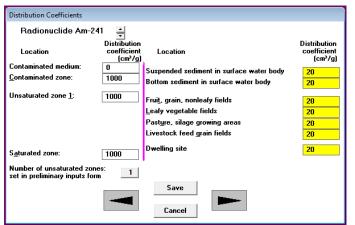
• Suggestions for revising the test descriptions in the Test Cases document -

Test Summary	Test OFFSITE's new source term model: Case VI - Grouted TRU waste with diffusion controlled release
Test Objective	Test features of OFFSITE new source term model to simulate diffusion controlled release
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.49

• Launched RESRAD-OFFSITE. Opened the input file, OTHER WASTE-KD=0_500_DT1-DIF-DUST-REVISED.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Specifed (years)		
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes 9th time at which release changes	Insert new 1st time and shift down existing times and associated release data Delete 2nd time and associated release data and shift up existing data	
Surfame at which release changes Number of times at which the release properties are specified	1 <u>A</u> dd new 2nd time at which release changes	
Times are in ascending order		



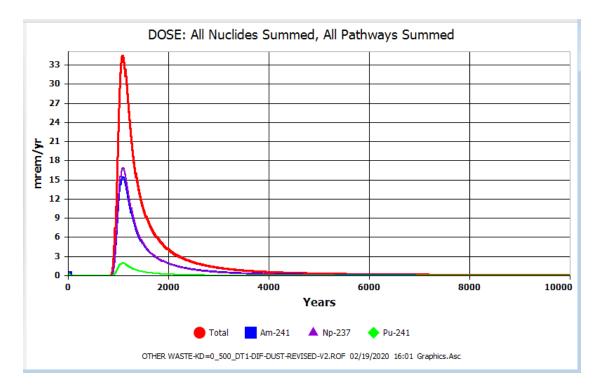


Radionuclide Specific Release
Radionuclide Am-241 🚔 Element Am
Release to ground water Transfer mechanism
 Equilibrium Desorption Transfer
Time at which release begins or changes (years) 500 Add Next
Cumulative fraction of radionuclide bearing material that is releasable 1
linearly over time Incremental fraction of radionuclide bearing becomes releasable stepwise at time O
Distribution coefficient in contaminated medium (cm³/g) 0
Diffusion coefficient in contaminated medium (m*m/y) 1.58E-09
Release from surface layer Radionuclide becomes available for release
 In the same manner as for release to groundwater
O Beginning at time zero
Save Cancel

Primary Contamination								
Area of primary contamination: 120 square meters								
	Length of contamination parallel to aguifer flow:					meters		
Depth of soil mixing layer:					10.95 .15	meters		
Mass loading of all particulate	s:				.0001	arams/m ³		
Deposition velocity of all parti		pute atmosphe	eric release):		.001	meters/s		
Respirable particulates as a fr	action of total p	particulates			1			
Deposition velocity of respirat	le particulates	(to compute at	mospheric release)		.001	meters/s		
Irrigation applied per year:					0	meters in a year		
Evapotranspiration coefficient					.6	1	-,	
Runoff coefficient:					.22			
Slope-length-steepness factor	:				.4			
Cover and management factor	:				.05			
Support practice factor:					1			
Fraction of primary contaminal	ion that is subm	nerged			0			
Soil layer ->	Clean cover		nated zone			Contaminal	ed medium	
Location relative to water tabl		above	below					_
<u>T</u> hickness:	5	5	meters			Total mass	318000	kg
Soil erodibility factor:	.1	.1	tons/acre		120			_m ³
<u>D</u> ry bulk density:	1.62	1.826	grams/cm ³		Volumetric wa	ter content	.08	
Enosion rate:	4.425E-05	3.926E-05	meters/year					
Total <u>p</u> orosity:	.4	.4			Dimensio	ns of individ	lual fragment	of
Volumetric <u>w</u> ater content:	.05				c	ontaminated		
Effective porosity:		.4			Length of fragment 1			m
Hydraulic conductivity:		30	meters/year		Width	of fragment	.1	m
Field capacity:		.3			Breadth	of fragment	.1	m
<u>b</u> parameter:		4.1						_
Longitudinal dispersivity:		0	meters					
			-					
Save								
			Cancel					

• Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-49 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



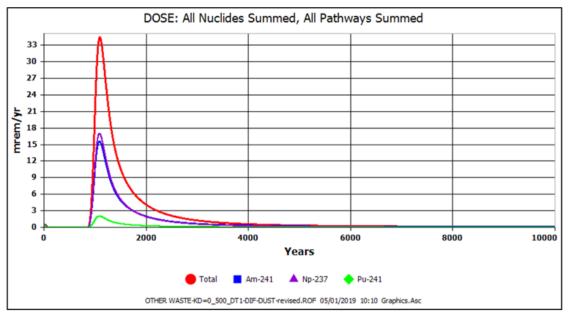


Figure M-49 Potential Radiation Dose Associated with Disposal of TRU Waste— Diffusion Controlled Release with 10-cm Fragments

12.98 TEST CASE 117 TESTER'S REPORT

Documented in Test Case 117-JJCheng.docx of 2/20/2020 8:33 AM

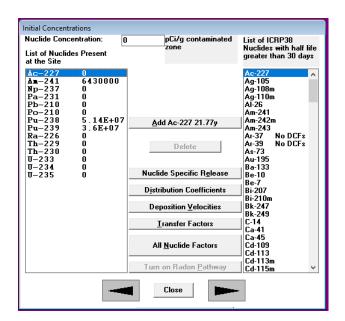
Test Case – 117 – Tests Offsite Activated Metal Case VI: Grouted TRU Waste with diffusion

• Suggestions for revising the test descriptions in the Test Cases document -

Test Summary	Test OFFSITE's new source term model: Case VII - Sealed sources with 1st order rate controlled release
Test Objective	Test features of OFFSITE new source term model to simulate 1 st order rate controlled release
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.56

• Launched RESRAD-OFFSITE. Opened the input file, SEALED SOURCES-TRENCH-LEACH_300-800-V2.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Specif	d (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes	BOD Insert new 1st time and shift down existing times and associated release data Delete 1st time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	2 <u>Add new 3rd time at which release changes</u>
Times are in ascending order	Close



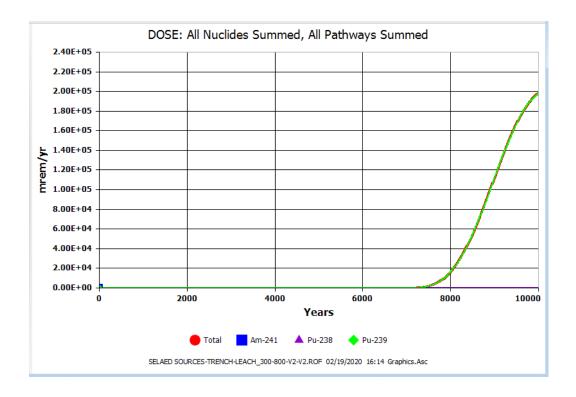
Distribution Coefficients			
Radionuclide Ac-22	7 🌲		
Location	Distribution coefficient (cm³/g)	Location	Distribution coefficient (cm³/g)
Contaminated medium:	1000	Suspended sediment in surface water body	20
<u>C</u> ontaminated zone:	100	Bottom sediment in surface water body	20
Unsaturated zone <u>1</u> :	100	Fruit, grain, nonleafy fields Leafy vegetable fields Pastyre, silage growing areas Livestock feed grain fields	20 20 20 20 20
S <u>a</u> turated zone:	100	Dwelling site	20
Number of unsaturated zone set in preliminary inputs form			
		Save Cancel	

Radionuclide Specific Release		
Radionuclide Ac-227	Element Ac	
Release to ground water	Transfer mechanism Transfer mechanism First Order Rate Controlled Transfer Equilibrium Desorption Transfer Equilibrium Solubility Transfer	
т	ime at which release begins or changes (years) 300 8	00 Add Next Time
Cumulative fraction	of radionuclide bearing material that is releasable 1	
Incremental fractio	linearly over time OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	0
L.	Leach rate [1/year] .00208 .002 linearly over time stepwise at time O	208 D
Release from surface layer	Radionuclide becomes available for release ③ In the same manner as for release to groundwater ③ Beginning at time zero	
	Save Cancel	

Primary Contamination								
Area of primary contamination:	Area of primary contamination: 120 square meters							
Length of contamination parall	el to aquifer flo	W:		10.95	meters			
Depth of soil <u>mixing</u> layer:				.15	meters			
Mass loading of all particulates	r:			.0001	grams/m³			
Deposition velocity of all partic	ulates (to com	pute atmosphe	ric release):	.001	meters/s			
Respirable particulates as a fra	action of total p	particulates		1				
Deposition velocity of respirable	e particulates	(to compute al	mospheric release):	.001	meters/s			
Irrigation applied per year:				0	meters in a year			
Evapotranspiration coefficient:				.6	j			
Runoff coefficient:				.22	1			
Slope-length-steepness factor:				.4				
Cover and management factor:				.05				
Support practice factor:				1				
Fraction of primary contaminati	on that is subm	nerged		0				
Soil layer -> Location relative to water table	Clean cover e ->	Contami above	nated zone belo w					
Thickness:	5	5	meters					
Soil erodibility factor:	.1	.1	tons/acre					
Dry bulk density:	1.62	1.62	grams/cm³					
E <u>r</u> osion rate:	4.425E-05	4.425E-05	meters/year					
Total porosity:	.4	.4						
Volumetric water content:	.05		_					
Effective porosity:		.3]					
Hydraulic conductivity:		30	meters/year					
Field capacity:		.3						
<u>b</u> parameter: 4.1								
Longitudinal dispersivity: 0 meters								
Save Cancel								

• Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-49 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone, i.e., the waster disposal area.



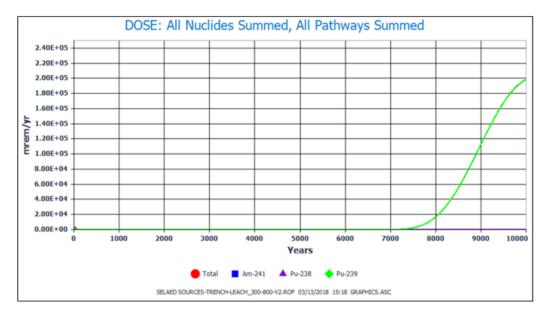


Figure M-56 Potential Radiation Dose Associated with Disposal of Sealed Sources Waste—First-Order Rate-Controlled Release

12.99 TEST CASE 118 TESTER'S REPORT

Documented in Test Case 118-JJCheng.docx of 2/20/2020 8:35 AM

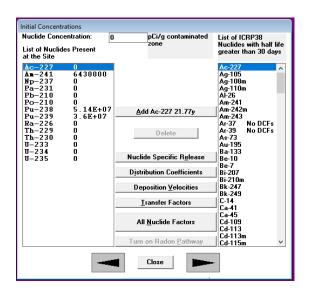
Test Case – 118 – Tests Offsite Activated Metal Case VI: Grouted TRU Waste with solubility-controlled release

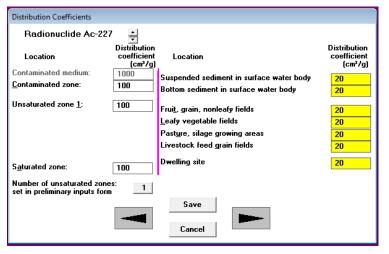
• Suggestions for revising the test descriptions in the Test Cases document -

Test Summary	Test OFFSITE's new source term model: Case VIII - Sealed sources with solubility controlled release
Test Objective	Test features of OFFSITE new source term model to simulate solubility controlled release
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.59

• Launched RESRAD-OFFSITE. Opened the input file, SEALED SOURCES-TRENCH-SOLUBILITY_300-800-V2.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

Times at which Release Properties are Specif	ed (years)
1st time at which release begins 2nd time at which release changes 3rd time at which release changes 4th time at which release changes 5th time at which release changes 6th time at which release changes 7th time at which release changes 8th time at which release changes 8th time at which release changes	300 Insert new 1st time and shift down existing times and associated release data Delete 1st time and associated release data and shift up existing data
<u>9</u> th time at which release changes Number of times at which the release properties are specified	2 <u>Add new 3rd time at which release changes</u>
Times are in ascending order	



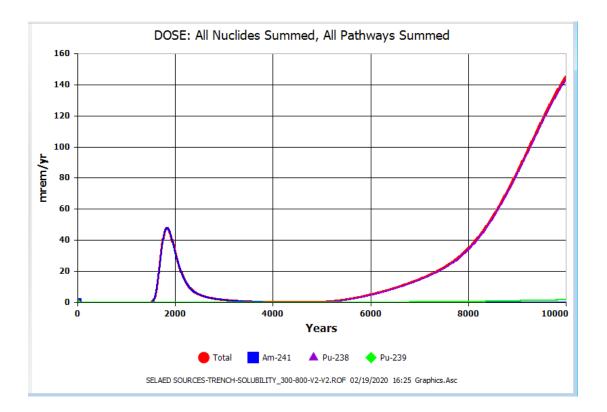


Radionuclide Specific Release			
Radionuclide Pu-238	🚔 Element Pu		
	Transfer mechanism O First Order Rate Controlled Transfer O Equilibrium Desorption Transfer O Equilibrium Solubility Transfer		
Tim	e at which release begins or changes (years) 300	800	Add Next Time
Cumulative fraction o	f radionuclide bearing material that is releasable 1	1	
Incremental fraction	linearly over time of radionuclide bearing becomes releasable stepwise at time	0 0	
Soluble	e concentration of element (g atomic weight/L) 1E-10	1E-10	
Total soluble concer	linearly over time tration of isotope changes stepwise at time	0 ⊚	
Release from surface layer	Radionuclide becomes available for release		
	In the same manner as for release to groundwater		
	O Beginning at time zero		
[Save Cancel		

Primary Contamination								
Area of primary contamination:	Area of primary contamination: 120 square meters							
Length of contamination parall	el to aquifer flo	W:		10.95	meters			
Depth of soil <u>mixing</u> layer:				.15	meters			
Mass loading of all particulates	r:			.0001	grams/m³			
Deposition velocity of all partic	ulates (to com	pute atmosphe	ric release):	.001	meters/s			
Respirable particulates as a fra	action of total p	particulates		1				
Deposition velocity of respirable	e particulates	(to compute al	mospheric release):	.001	meters/s			
Irrigation applied per year:				0	meters in a year			
Evapotranspiration coefficient:				.6	j			
Runoff coefficient:				.22	1			
Slope-length-steepness factor:				.4				
Cover and management factor:				.05				
Support practice factor:				1				
Fraction of primary contaminati	on that is subm	nerged		0				
Soil layer -> Location relative to water table	Clean cover e ->	Contami above	nated zone belo w					
Thickness:	5	5	meters					
Soil erodibility factor:	.1	.1	tons/acre					
Dry bulk density:	1.62	1.62	grams/cm³					
E <u>r</u> osion rate:	4.425E-05	4.425E-05	meters/year					
Total porosity:	.4	.4						
Volumetric water content:	.05		_					
Effective porosity:		.3]					
Hydraulic conductivity:		30	meters/year					
Field capacity:		.3						
<u>b</u> parameter: 4.1								
Longitudinal dispersivity: 0 meters								
Save Cancel								

Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-59 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



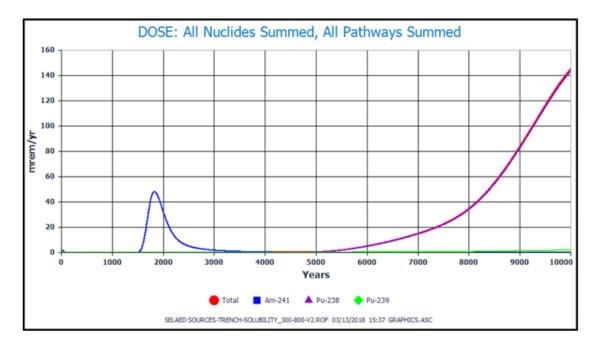


Figure M-59 Potential Radiation Dose Associated with Disposal of Sealed Sources Waste—Solubility Controlled Release for Pu

12.100 TEST CASE 401 TESTER'S REPORT

Documented in Results-Test-401.docx of 2/18/2020 2:48 AM

RESOFF-TEST-401

Objective: Test offsite plant concentrations

The following steps were taken for Test-401

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-401.ROF

Step 3 Ran Test-401.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Selected different plant type Media Concentration

Step 7 Compared different plant type concentrations with the values in Figure 1 -4 in the V&V report

Result: Test Passes

Plant concentrations for different plant types in V&V Report matched with Test-401 plant concentrations as shown in the following figures.

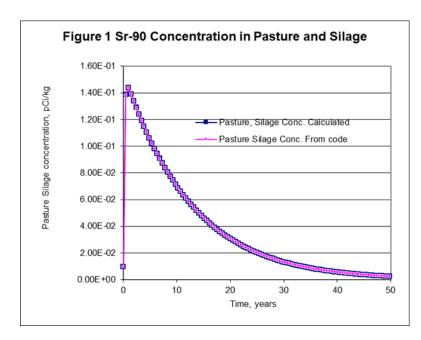


Figure Concentrations in Pasture and Silage Plant Type from V&V Report

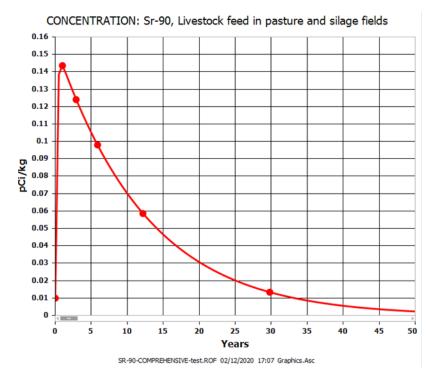


Figure Concentration in Pasture and Silage Plant Type from Test-401

Practically no difference in V&V results for pasture and silage concentrations and Test 401 results

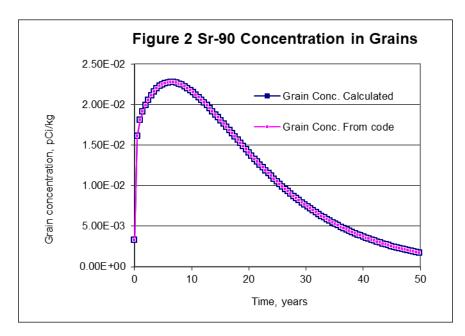
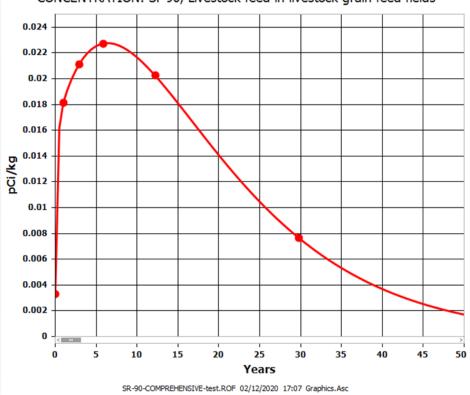


Figure Concentration in Grain Plant Type from V&V Report



CONCENTRATION: Sr-90, Livestock feed in livestock grain feed fields

Figure Concentration in Grain Plant Type from Test-401

Practically no difference in V&V results for grain concentration and Test 401 results

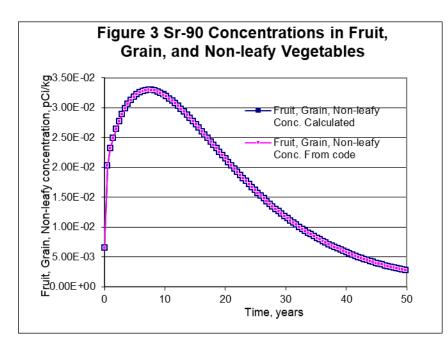


Figure Concentration in Fruit, Grain, Non-leafy Vegetables Plant Type from V&V Report

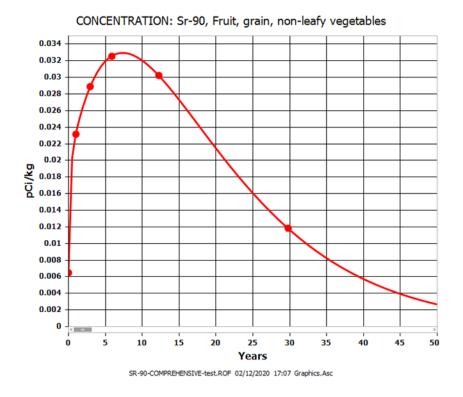
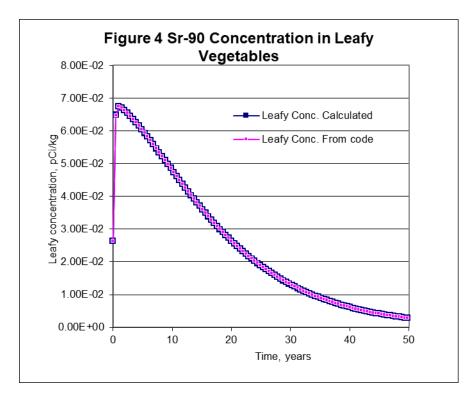


Figure Concentration in Fruit, Grain, Non-leafy Vegetables Plant Type from Test-401

Practically no difference in V&V results for fruit, grain, non-leafy vegetable concentrations and Test 401 results





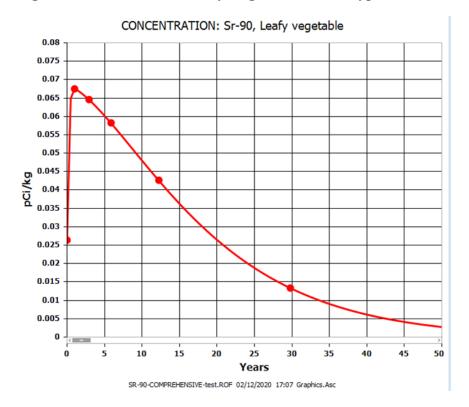


Figure Concentration in Leafy Vegetables Plant Type from Test-401

Practically no difference in V&V results for leafy vegetable concentrations and Test 401 results

12.101 TEST CASE 402 TESTER'S REPORT

Documented in Results-Test-402.docx of 2/17/2020 1:46 PM

RESOFF-TEST-402

Objective: Test offsite meat and milk concentrations

The following steps were taken for Test-402

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-402.ROF

Step 3 Ran Test-402.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Selected Meat Media Concentration

Step 7 Compared meat concentration with the values in Figure 5 in the V&V report

Step 8 Selected Milk Media Concentration

Step 9 Compared milk concentration with the values in Figure 6 in the V&V report

Result: Test Passes

Meat and milk concentrations in V&V Report matched with Test-402 meat and milk concentration as shown in the following figures.

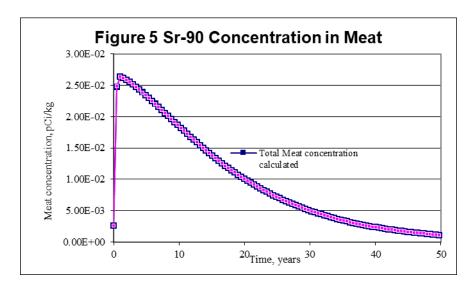


Figure Meat Concentration from V&V

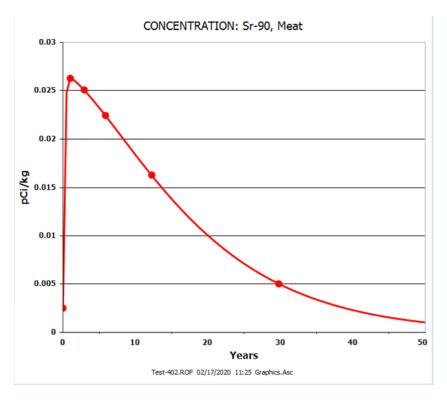


Figure Meat Concentration from Test-402

Practically no difference in V&V results for meat concentration and Test 402 meat concentration results

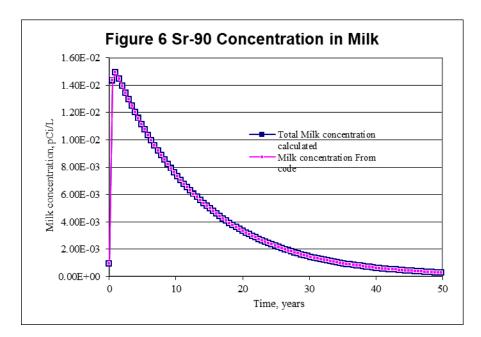


Figure Milk Concentration from V&V Report

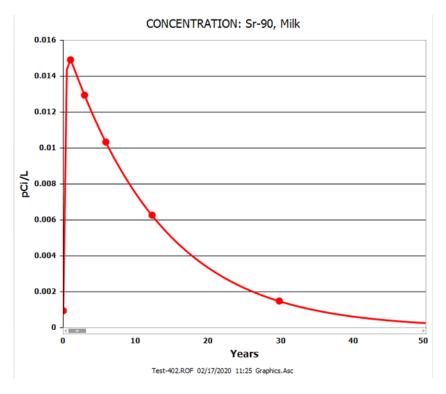


Figure Milk Concentration from Test-402

Practically no difference in V&V results for milk concentration and Test 402 milk concentration results

12.102 TEST CASE 403 TESTER'S REPORT

Documented in Results-Test-403.docx of 2/17/2020 1:39 PM

RESOFF-TEST-403

Objective: Test offsite aquatic food concentrations

The following steps were taken for Test-403

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-403.ROF

Step 3 Ran Test-403.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Selected Fish Media Concentration

Step 7 Compared Fish concentration with the values in Figure 7 in the V&V report

Step 8 Selected Crustacean Media Concentration

Step 9 Compared crustacean concentration with the values in Figure 8 in the V&V report

Result: Test Passes

Aquatic food concentrations in V&V Report matched with Test-403 aquatic food concentrations as shown in the following figures.

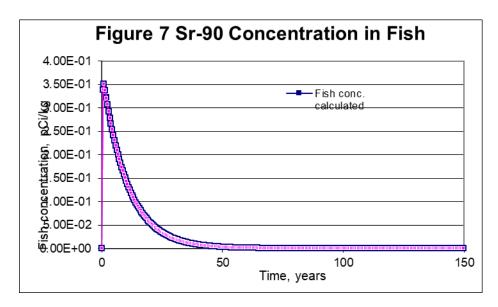


Figure Fish Concentration from V&V Report

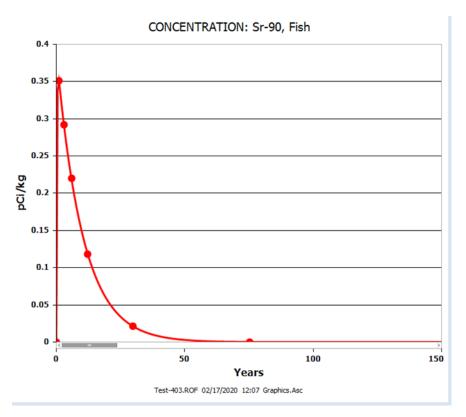


Figure Fish Concentration from Test-403

Practically no difference in V&V results for fish concentrations and Test 403 fish concentration results

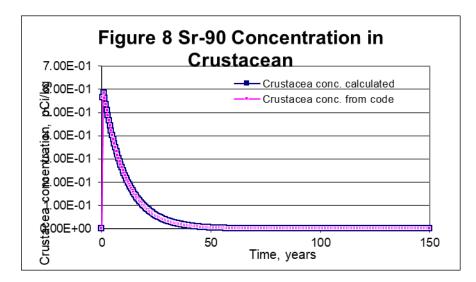


Figure Crustacean Concentration from V&V Report

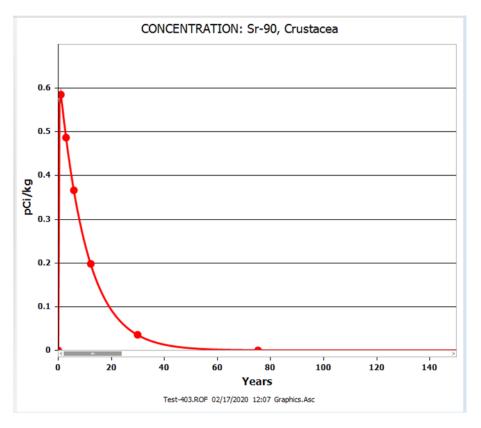


Figure Crustacean Concentration from Test-403

Practically no difference in V&V results for crustacean concentrations and Test 403 crustacean concentration results

12.103 TEST CASE 404 TESTER'S REPORT

Documented in Results-Test-404.docx of 2/17/2020 1:25 PM

RESOFF-TEST-404

Objective: Test offsite plant ingestion dose

The following steps were taken for Test-404

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-404.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Plant Ingestion pathway active

Step 4 Saved File

Step 5 Ran Test-404.ROF file

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 9 in the V&V report (Since only plant ingestion pathway was active summed pathways gave plant ingestion dose)

Result: Test Passes

Plant ingestion pathway dose in V&V Report matched with Test-404 plant ingestion pathway dose as shown in the following figures.

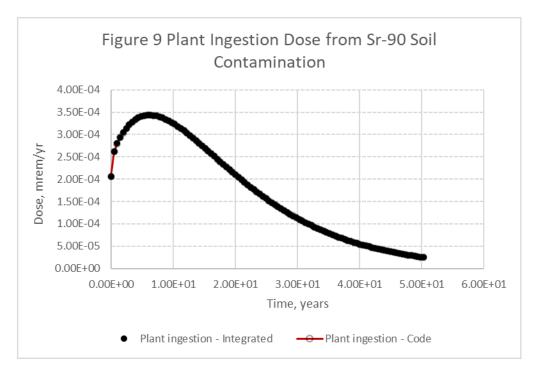


Figure Plant Ingestion Dose from V&V Report

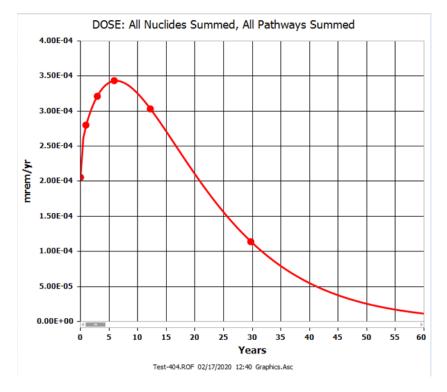


Figure Plant Ingestion Dose from Test-404

Practically no difference in V&V results for plant ingestion dose and Test 404 plant ingestion dose results

12.104 TEST CASE 405 TESTER'S REPORT

Documented in Results-Test-405.docx of 2/17/2020 1:32 PM

RESOFF-TEST-405

Objective: Test offsite meat and milk dose

The following steps were taken for Test-405

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-405-meat.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Meat Ingestion pathway active and Saved File

Step 5 Ran Test-405-meat.ROF file

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 10 in the V&V report (Since only meat ingestion pathway was active summed pathways gave meat ingestion dose)

Step 8 Opened SR-90-COMPREHENSIVE.ROF

Step 9 Saved as Test-405-milk.ROF

Step 10 Selected Set Pathways from the left Navigation Panel

Step 11 Only kept Milk Ingestion pathway active

Step 12 Saved File

Step 13 Ran Test-405-milk.ROF file

Step 14 Viewed Deterministic Graphic

Step 15 Compared summed pathway dose with the values in Figure 11 in the V&V report (Since only milk ingestion pathway was active summed pathways gave milk ingestion dose)

Result: Test Passes

Meat and milk doses in V&V Report matched with Test-405 meat and milk doses as shown in the following figures.

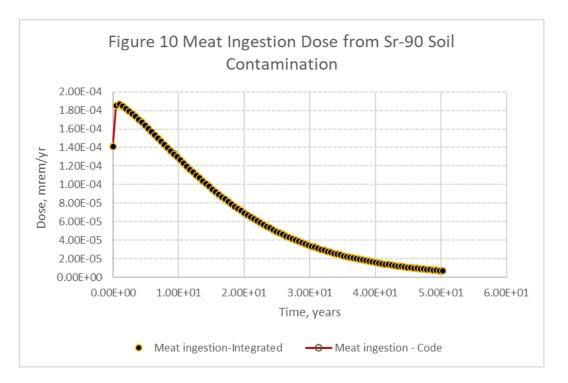


Figure Meat Ingestion Dose from V&V Report

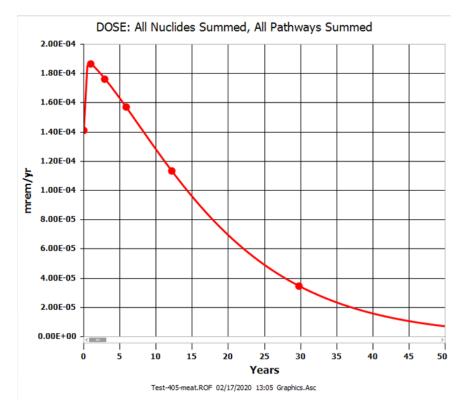


Figure Meat Ingestion Dose from Test-405-Meat

Practically no difference in V&V results for meat dose and Test 405 meat dose results

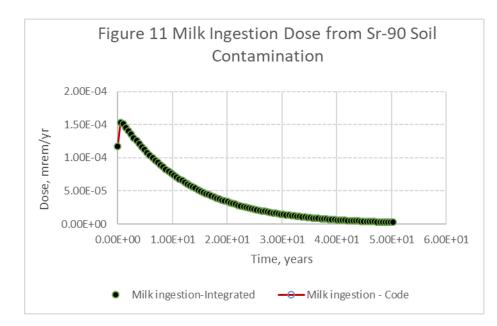


Figure Milk Ingestion Dose from V&V Report

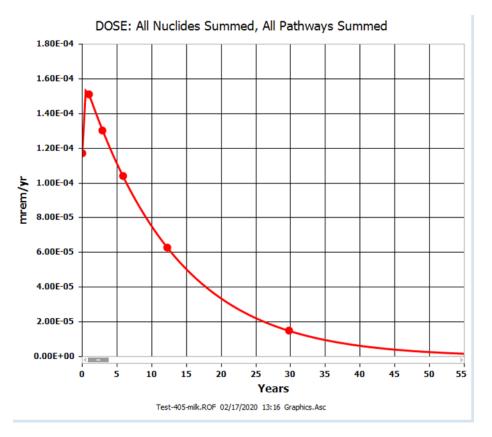


Figure Milk Ingestion Dose from Test-405-Milk

Practically no difference in V&V results for milk dose and Test 405 milk dose results

12.105 TEST CASE 406 TESTER'S REPORT

Documented in Results-Test-406.docx of 2/17/2020 1:18 PM

RESOFF-TEST-406

Objective: Test offsite aquatic pathway doses

The following steps were taken for Test-406

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-406.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Aquatic Foods pathway active

Step 4 Saved File

Step 5 Ran Test-406.ROF

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 12 in the V&V report (Since only aquatic foods pathway was active summed pathways gave aquatic foods dose)

Result: Test Passes

Aquatic pathway dose in V&V Report matched with Test-406 aquatic pathway dose as shown in the following figures.

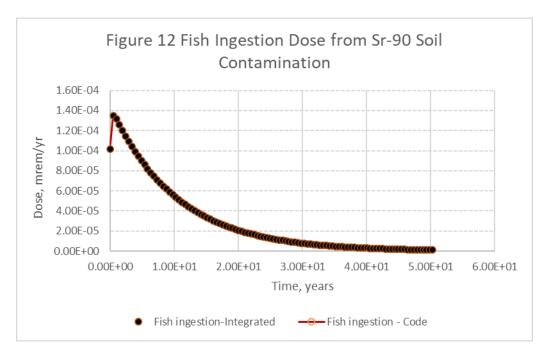


Figure Aquatic Foods Ingestion Dose from V&V Report

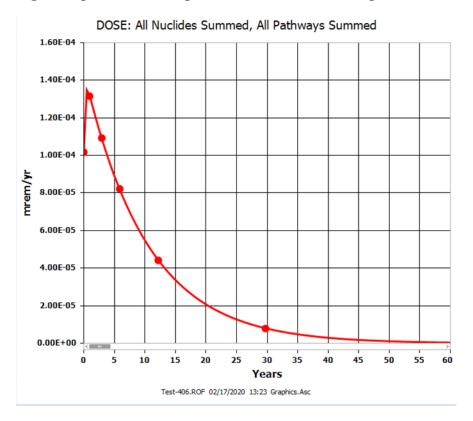


Figure Aquatic Foods Ingestion Dose from Test-406

Practically no difference in V&V aquatic food ingestion dose results and Test 406 dose results

12.106 TEST CASE 407 TESTER'S REPORT

Documented in Results-Test-407.docx of 2/17/2020 1:57 PM

RESOFF-TEST-407

Objective: Test offsite drinking water pathway doses

The following steps were taken for Test-407

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-407.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Drinking water pathway active

Step 4 Saved File

Step 5 Ran Test-407.ROF

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 13 in the V&V report (Since only drinking water pathway was active summed pathways gave drinking water dose)

Result: Test Passes

Drinking water pathway dose in V&V Report matched with Test-407 drinking pathway dose as shown in the following figures.

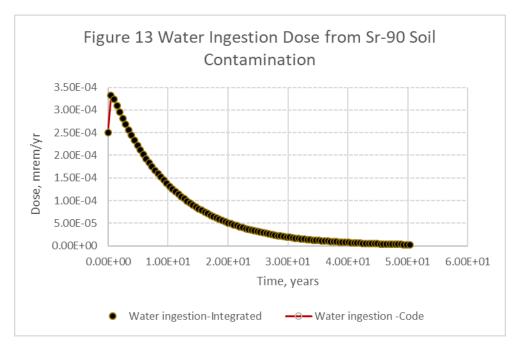


Figure Drinking Water Ingestion Dose from V&V Report

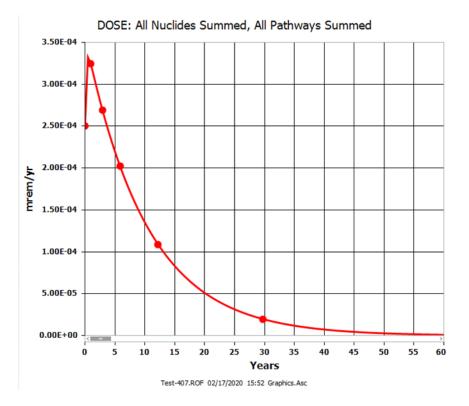


Figure Drinking Water Ingestion Dose from Test-407

Practically no difference in V&V drinking water dose results and Test 407 dose results

12.107 TEST CASE 411 TESTER'S REPORT

Documented in Results-Test-411.docx of 2/17/2020 2:19 PM

RESOFF-TEST-411

Objective: Test offsite soil concentration in leafy vegetable agricultural field

The following steps were taken for Test-411

Step 1 Opened offsite-accumulation-test1.ROF

Step 2 Saved as Test-411.ROF

Step 3 Ran Test-411.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in leafy vegetable field with the values in Figure 1 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in leafy vegetable field in V&V Report matched with Test-411 soil concentration as shown in the following figures.

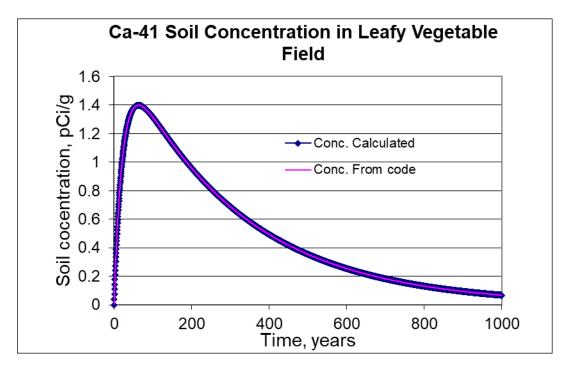


Figure Surface soil Concentration in Leafy Vegetable Field from V&V Report

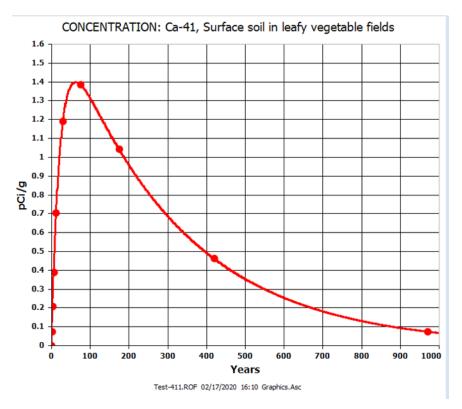


Figure Surface Soil Concentration in Leafy Vegetable Field from Test-411

Practically no difference in V&V results for surface soil concentration in leafy vegetable field and Test 411 results

12.108 TEST CASE 412 TESTER'S REPORT

Documented in Results-Test-412.docx of 2/17/2020 2:43 PM

RESOFF-TEST-412

Objective: Test offsite soil concentration in pasture agricultural field

The following steps were taken for Test-412

Step 1 Opened offsite-accumulation-test2.ROF

Step 2 Saved as Test-412.ROF

Step 3 Ran Test-412.ROF file

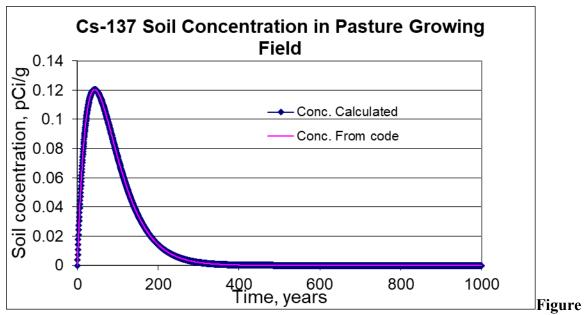
Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in pasture field with the values in Figure 2 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in pasture field in V&V Report matched with Test-412 soil concentration as shown in the following figures.



Surface soil Concentration in Pasture Growing Field from V&V Report

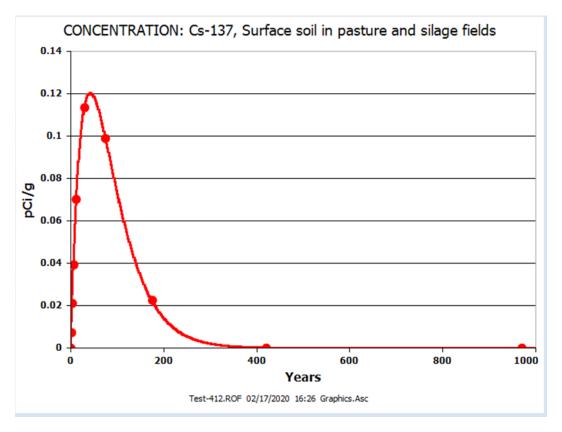


Figure Surface Soil Concentration in Pasture and Silage Field from Test-412

Practically no difference in V&V results for surface soil concentration in pasture and silage field and Test 412 results

12.109 TEST CASE 413 TESTER'S REPORT

Documented in Results-Test-413.docx of 2/17/2020 2:41 PM

RESOFF-TEST-413

Objective: Test offsite soil concentration in grain agricultural field

The following steps were taken for Test-413

Step 1 Opened offsite-accumulation-test3.ROF

Step 2 Saved as Test-413.ROF

Step 3 Ran Test-413.ROF file

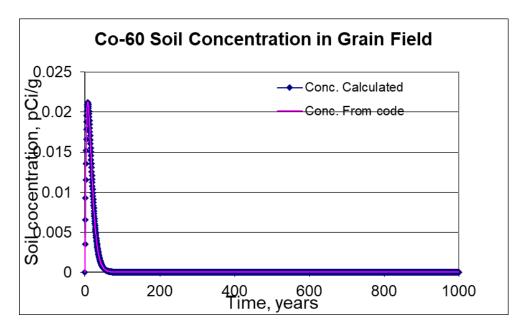
Step 4 Viewed Deterministic Graphic

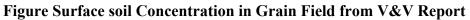
Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in grain field with the values in Figure 3 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in grain field in V&V Report matched with Test-413 soil concentration as shown in the following figures.





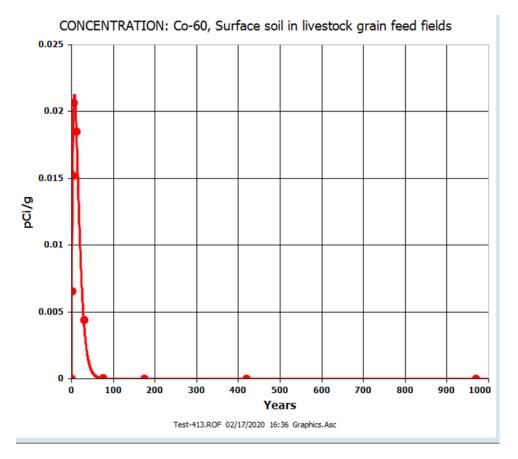


Figure Surface Soil Concentration in Grain Field from Test-413

Practically no difference in V&V results for surface soil concentration in livestock grain field and Test 413 results

12.110 TEST CASE 414 TESTER'S REPORT

Documented in Results-Test-414.docx of 2/17/2020 3:05 PM

RESOFF-TEST-414

Objective: Test offsite soil concentration in non-leafy vegetable field

The following steps were taken for Test-414

Step 1 Opened offsite-accumulation-test4.ROF

Step 2 Saved as Test-414.ROF

Step 3 Ran Test-414.ROF file

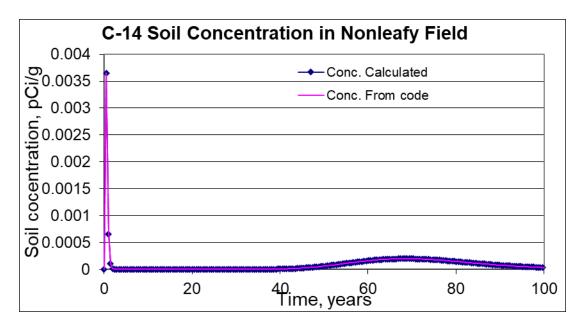
Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

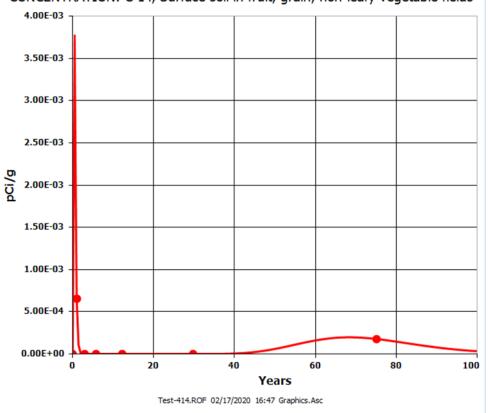
Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 4 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-414 soil concentration as shown in the following figures.







CONCENTRATION: C-14, Surface soil in fruit, grain, non-leafy vegetable fields

Figure Surface Soil Concentration in Non-leafy Field from Test-414

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field and Test 414 results

12.111 TEST CASE 415 TESTER'S REPORT

Documented in Results-Test-415.docx of 2/17/2020 3:04 PM

RESOFF-TEST-415

Objective: Test features of offsite soil concentration in non-leafy vegetable agricultural field contributed by erosion

The following steps were taken for Test-415

Step 1 Opened offsite-accumulation-test4-erosion-only.ROF

Step 2 Saved as Test-415.ROF

Step 3 Ran Test-415.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 5 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-415 soil concentration as shown in the following figures.

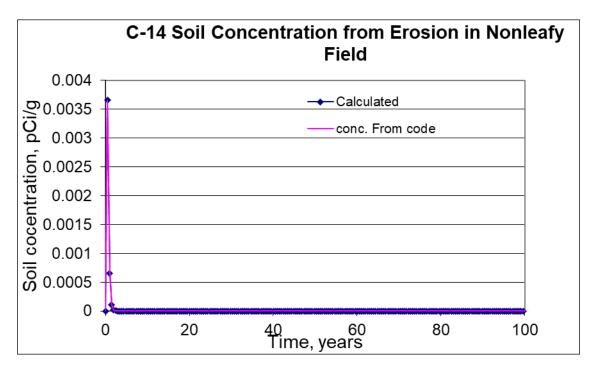
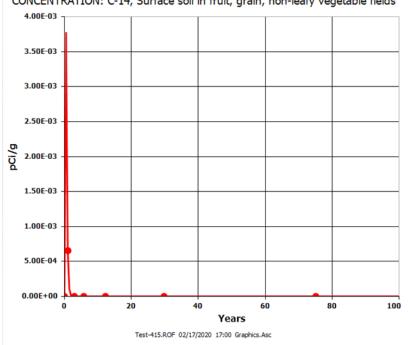


Figure Surface soil Concentration in Non-leafy Field from Erosion in V&V Report



CONCENTRATION: C-14, Surface soil in fruit, grain, non-leafy vegetable fields

Figure Surface Soil Concentration in Non-leafy Field from Test-415

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field from erosion and Test 415 results

12.112 TEST CASE 416 TESTER'S REPORT

Documented in Results-Test-416.docx of 2/17/2020 6:39 PM

RESOFF-TEST-416

Objective: Test features of offsite soil concentration in non-leafy vegetable agricultural field contributed by air deposition

The following steps were taken for Test-416

Step 1 Opened offsite-accumulation-test4-air-dep-only.ROF

Step 2 Saved as Test-416.ROF

Step 3 Ran Test-416.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 6 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-416 soil concentration as shown in the following figures.

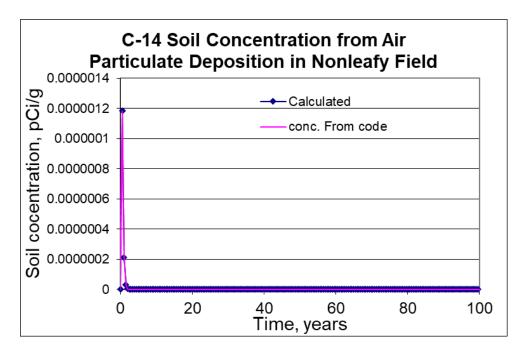
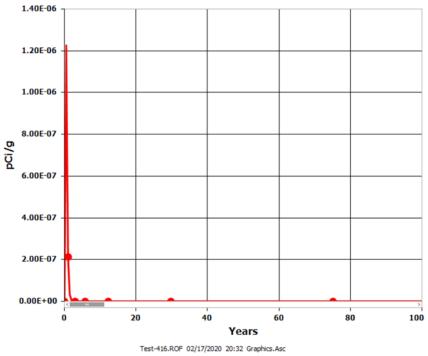


Figure Surface soil Concentration in Non-leafy Field from Air Particulate Deposition in V&V Report



CONCENTRATION: C-14, Surface soil in fruit, grain, non-leafy vegetable fields

Figure Surface Soil Concentration in Non-leafy Field from Test-416

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field from air deposition and Test 416 results

12.113 TEST CASE 417 TESTER'S REPORT

Documented in Results-Test-417.docx of 2/17/2020 6:58 PM

RESOFF-TEST-417

Objective: Test features of offsite soil concentration in non-leafy vegetable agricultural field contributed by surface water irrigation

The following steps were taken for Test-417

Step 1 Opened offsite-accumulation-test4-irrigation-only.ROF

Step 2 Saved as Test-417.ROF

Step 3 Ran Test-417.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 7 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-417 soil concentration as shown in the following figures.

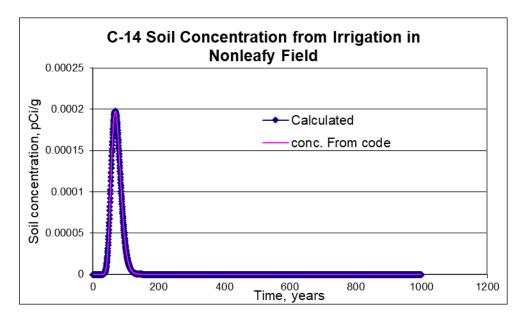
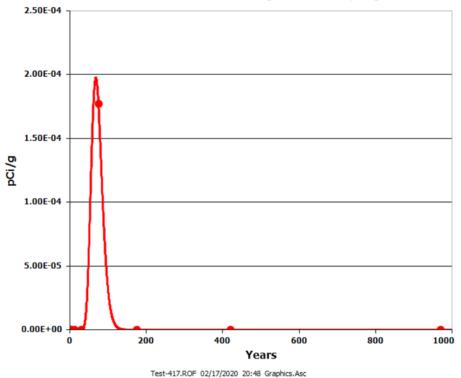


Figure Surface soil Concentration in Non-leafy Field from Irrigation in V&V Report



CONCENTRATION: C-14, Surface soil in fruit, grain, non-leafy vegetable fields

Figure Surface Soil Concentration in Non-leafy Field from Test-417

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field from irrigation and Test 417 results

12.114 TEST CASE 421 TESTER'S REPORT

Documented in Results-Test-421.docx of 2/18/2020 3:12 AM

RESOFF-TEST-421

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Briggs Rural Coefficients Based on Rural Windspeed Terrain

The following steps were taken for Test-421

Step 1 Opened Air Dispersion Run1.ROF

Step 2 Saved as Test-421.ROF

Step 3 Ran Test-421.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 1 listed in last column of Table 2 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 1 in Table 2 matched with Test-421 normalized air concentrations as shown in the following screenshots.

Plume Rise) with RESRAD-OF	FSITE Version 4	, , , , , , , , , , , , , , , , , , ,	,	
	Val	ues from V&V Report Table 4	-2	
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs rural dispersion co	efficients, no dry or	wet deposition		
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion	on coefficient with c	lry deposition, no wet deposition	on	
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion	on coefficient with c	ry deposition and wet depositi	on	
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain Field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07
Note: The spreadsheet calculation	s do not include the	directional wind frequency.		

Table 2 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m ³) in V&V Report	ort (with
Plume Rise) with RESRAD-OFFSITE Version 4	

RESRAD - OFFSITE Test-421.ROF (Unmodified Pathways Site Data View Form Op File Home Share View								
	Move Co		■〕 Rename	New item *		Select all	one	
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		^	Name		Date n	nodified	Туре	Size
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ile Edit Format View Help		*		tRun.dat		2020 9:05 PM		1 K
AGRI = 1 Ac-227 5.597E-05	~	*		SRADOF.INI		2020 9:05 PM	-	1 k
AGRI = 1 AC-227 5.597E-05		*		UDOSE.REP		2020 9:05 PM		16 k
AGRI = 2 AC-227 1.681E-05 AGRI = 2 AC-227 1.681E-05		*	i for			2020 9:05 PM		1 K
AGRI = 3 AC-227 6.379E-06		*		APHICS.ASC		2020 9:05 PM		1,821 K
AGRI = 3 AC-227 6.379E-06		~	_	RISK.REP		2020 9:05 PM		29 K
AGRI = 4 Ac-227 1.226E-06				SSAGE.FIL		2020 9:05 PM		1 k
AGRI = 4 Ac-227 1.226E-06 WELLING Ac-227 2.087E-07				FSITE.RA		2020 9:05 PM		121 k
WELLING AC-227 2.087E-07				FSITE.RB		2020 9:05 PM		121 K
URFACE Wtr Ac-227 9.465E-07				FSITE.RC		2020 9:05 PM		241 K 2 K
			📄 out	tput.fil MMARY.REP		2020 9:05 PM		2 K 213 K
				IUXIN.DAT		2020 9:05 PM		
						2020 9:05 PM		55 K
				FLUXIN.DAT		2020 9:05 PM		53 K
				TRANIN.DAT		2020 9:05 PM		53 K
				IOVERQ.OUT		2020 9:05 PM		1 K
				rrent.lib		2020 9:05 PM		88 K
				rrent_External_DCF.txt	2/1//2	2020 9:05 PM		3 K

Look normalized air concentrations in CHIOVERQ.OUT file on the left side of the screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

12.115 TEST CASE 422 TESTER'S REPORT

Documented in Results-Test-422.docx of 2/18/2020 6:04 AM

RESOFF-TEST-422

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill Gifford Coefficients Based on Rural Windspeed Terrain with Release heat flux of 90 cal/s and with only dry deposition

The following steps were taken for Test-422

Step 1 Opened Air Dispersion Run2.ROF

Step 2 Saved as Test-422.ROF

Step 3 Ran Test-422.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 2 listed in last column of Table 2 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 2 in Table 2 matched with Test-422 normalized air concentrations as shown in the following screenshots.

Plume Rise) with RESRAD-OF	FSITE Version 4	, , , , , , , , , , , , , , , , , , ,	,	
	Valu	ues from V&V Report Table 4	-2	
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs rural dispersion co	efficients, no dry or	wet deposition		-
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion	on coefficient with d	ry deposition, no wet deposition	on	
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion	on coefficient with d	ry deposition and wet depositi	on	
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain Field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07
Note: The spreadsheet calculation	s do not include the	directional wind frequency.		

Table 2	Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m ³) in V&V Report (w	ith
Plume	Rise) with RESRAD-OFFSITE Version 4	

🧾 CHIOVERQ.OUT - Notepad

File Edit Form	at View H	lelp
IAGRI = 1	Ac-227	7.688E-05
IAGRI = 1	Ac-227	7.688E-05
IAGRI = 2	Ac-227	1.984E-05
IAGRI = 2	Ac-227	1.984E-05
IAGRI = 3	Ac-227	7.785E-06
IAGRI = 3	Ac-227	7.785E-06
IAGRI = 4	Ac-227	1.448E-06
IAGRI = 4	Ac-227	1.448E-06
DWELLING	Ac-227	1.743E-07
DWELLING	Ac-227	1.743E-07
SURFACE Wtr	Ac-227	5.837E-07
1		

Look normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 2 for run 2 matched with air concentrations in CHIOVERQ.OUT file.

12.116 TEST CASE 423 TESTER'S REPORT

Documented in Results-Test-423.docx of 2/18/2020 6:03 AM

RESOFF-TEST-423

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain and Release heat flux of 90 cal/s for Dry and Wet Deposition

The following steps were taken for Test-423

Step 1 Opened Air Dispersion Run3.ROF

Step 2 Saved as Test-423.ROF

Step 3 Ran Test-423.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 3 listed in last column of Table 2 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 3 in Table 2 matched with Test-423 normalized air concentrations as shown in the following screenshots.

Plume Rise) with RESRAD-OF	FSITE Version 4	, , , , , , , , , , , , , , , , , , ,	,	
	Val	ues from V&V Report Table 4	-2	
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs rural dispersion co	oefficients, no dry or	r wet deposition		
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion	on coefficient with c	lry deposition, no wet deposition	on	
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion	on coefficient with c	lry deposition and wet depositi	on	
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain Field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07
Note: The spreadsheet calculation	is do not include the	directional wind frequency.		

Table 2	Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m ³) in V&V Report (w	ith
Plume	Rise) with RESRAD-OFFSITE Version 4	

CHIOVERQ.OUT - Notepad

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File Edit F	ormat View	Help
IAGRI =	1 Ac-227	7.561E-05
IAGRI =	1 Ac-227	7.561E-05
IAGRI =	2 Ac-227	1.960E-05
IAGRI =	2 Ac-227	1.960E-05
IAGRI =	3 Ac-227	7.702E-06
IAGRI =	3 Ac-227	7.702E-06
IAGRI =	4 Ac-227	1.401E-06
IAGRI =	4 Ac-227	1.401E-06
DWELLING	Ac-227	1.717E-07
DWELLING	Ac-227	1.717E-07
SURFACE N	Wtr Ac-227	5.217E-07

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 2 for run 3 matched with air concentrations in CHIOVERQ.OUT file.

12.117 TEST CASE 424 TESTER'S REPORT

Documented in Results-Test-424.docx of 2/18/2020 3:44 AM

RESOFF-TEST-424

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain and Release heat flux of 90 cal/s for Dry and Wet Deposition

The following steps were taken for Test-424

Step 1 Opened Air Dispersion Run4.ROF

Step 2 Saved as Test-424.ROF

Step 3 Ran Test-424.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 4 listed in last column of Table 3 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 4 in Table 3 matched with Test-424 normalized air concentrations as shown in the following screenshots.

Table 3 Comparison of F (without Plume Rise) wit		2 Normalized Air Concentratio	ons (s/m ³) in V&V	Report	
(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Values from V&V Report Table 4-3				
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4	
Run 4 - Pasquill-Gifford r	ural dispersion coeff	icients, no dry or wet deposition	l		
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05	
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05	
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06	
Grain Field	7.34E-06	1.47E-06	1.47E-06	1.47E-06	
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07	
Run 5 - Pasquill-Gifford d	lispersion coefficient	t with dry deposition, no wet dep	oosition		
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05	
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05	
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06	
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06	
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07	
Run 6 - Pasquill-Gifford d	lispersion coefficient	t with dry deposition and wet de	position		
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05	
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05	
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06	
Grain Field	7.03E-06	1.41E-06	1.40E-06	1.40E-06	
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07	

Table 3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m ³) in V&V Report
(without Plume Rise) with Version 4

CHIOVERQ.OUT - Notepad

File Edit	Format	View F	lelp
IAGRI =	1 AC	-227	7.860E-05
IAGRI =	1 AC	-227	7.860E-05
IAGRI =	2 AC	-227	2.003E-05
IAGRI =	2 Ac	-227	2.003E-05
IAGRI =	3 AC	-227	7.855E-06
IAGRI =	3 AC	-227	7.855E-06
IAGRI =	4 Ac	-227	1.466E-06
IAGRI =	4 Ac	-227	1.466E-06
DWELLIN	G AC	-227	1.809E-07
DWELLIN	G AC	-227	1.809E-07
SURFACE	Wtr Ac	-227	5.971E-07

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 3 for run 4 match with air concentrations in CHIOVERQ.OUT file.

12.118 TEST CASE 425 TESTER'S REPORT

Documented in Results-Test-425.docx of 2/18/2020 3:52 AM

RESOFF-TEST-425

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain for Dry Deposition

The following steps were taken for Test-425

Step 1 Opened Air Dispersion Run5.ROF

Step 2 Saved as Test-425.ROF

Step 3 Ran Test-425.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 5 listed in last column of Table 3 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 5 in Table 3 matched with Test-425 normalized air concentrations as shown in the following screenshots.

Table 3 Comparison of F (without Plume Rise) wit		C Normalized Air Concentratio	ons (s/m ³) in V&V	Report
(alues from V&V Report Table 4	-3	
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 4 - Pasquill-Gifford r	ural dispersion coeff	icients, no dry or wet deposition	L	
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07
Run 5 - Pasquill-Gifford d	lispersion coefficient	t with dry deposition, no wet dep	oosition	
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07
Run 6 - Pasquill-Gifford d	lispersion coefficient	t with dry deposition and wet de	position	
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06
Grain Field	7.03E-06	1.41E-06	1.40E-06	1.40E-06
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07

Table 3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m ³) in V&V Report
(without Plume Rise) with Version 4

🧾 CHIOVERQ.OUT - Notepad

File Edit F	orma	t View	Help
IAGRI =	1 /	Ac-227	7.731E-05
IAGRI =	1 /	Ac-227	7.731E-05
IAGRI =	2	Ac-227	1.984E-05
IAGRI =	2	Ac-227	1.984E-05
IAGRI =	3 /	Ac-227	7.787E-06
IAGRI =	3 /	Ac-227	7.787E-06
IAGRI =	4	Ac-227	1.449E-06
IAGRI =	4	Ac-227	1.449E-06
DWELLING		Ac-227	1.744E-07
DWELLING		Ac-227	1.744E-07
SURFACE I	Mtr /	Ac-227	5.811E-07
I			

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 3 for run 5 match with air concentrations in CHIOVERQ.OUT file.

12.119 TEST CASE 426 TESTER'S REPORT

Documented in Results-Test-426.docx of 2/18/2020 3:57 AM

RESOFF-TEST-426

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain for Dry and Wet Deposition

The following steps were taken for Test-426

Step 1 Opened Air Dispersion Run6.ROF

Step 2 Saved as Test-426.ROF

Step 3 Ran Test-426.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 6 listed in last column of Table 3 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 6 in Table 3 matched with Test-426 normalized air concentrations as shown in the following screenshots.

Table 3 Comparison of F (without Plume Rise) wit		2 Normalized Air Concentratio	ons (s/m ³) in V&V	Report
(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		alues from V&V Report Table 4	-3	
	Spreadsheet	OFFSITE Version 4		
Run 4 - Pasquill-Gifford r	ural dispersion coeff	icients, no dry or wet deposition	L	
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07
Run 5 - Pasquill-Gifford d	ispersion coefficient	t with dry deposition, no wet dep	oosition	
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07
Run 6 - Pasquill-Gifford d	ispersion coefficient	t with dry deposition and wet de	position	
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06
Grain Field	7.03E-06	1.41E-06	1.40E-06	1.40E-06
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07

Table 3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m ³) in V&V Report
(without Plume Rise) with Version 4

CHIOVERQ.OUT - Notepad

File Edit	Forma	at View	Help
IAGRI =	1	Ac-227	7.603E-05
IAGRI =	1	Ac-227	7.603E-05
IAGRI =	2	Ac-227	1.960E-05
IAGRI =	2	Ac-227	1.960E-05
IAGRI =	3	Ac-227	7.704E-06
IAGRI =	3	Ac-227	7.704E-06
IAGRI =	4	Ac-227	1.402E-06
IAGRI =	4	Ac-227	1.402E-06
DWELLIN	G	Ac-227	1.717E-07
DWELLIN	G	Ac-227	1.717E-07
SURFACE	Wtr	Ac-227	5.193E-07

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 3 for run 6 match with air concentrations in CHIOVERQ.OUT file.

12.120 TEST CASE 427 TESTER'S REPORT

Documented in Results-Test-427.docx of 2/18/2020 4:05 AM

RESOFF-TEST-427

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain for Wet Deposition

The following steps were taken for Test-427

Step 1 Opened Air Dispersion Run7.ROF

Step 2 Saved as Test-427.ROF

Step 3 Ran Test-427.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 7 listed in last column of Table 4 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 7 in Table 4 matched with Test-427 normalized air concentrations as shown in the following screenshots.

Table 4 Comparison of RESRAD-OFFSITESpreadsheet Calculations	(Version 4) Normaliz	ed Air Concentrati	on with New
	New Spreadsheet	Spreadsheet x directional frequency	Version 4.0
Run 1 - Briggs rural dispersion coefficients, no	dry or wet deposition		-
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.60E-05
Leafy vegetables plot	1.69E-04	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06
Dwelling site	5.21E-07	2.09E-07	2.09E-07
Run 4 - Pasquill-Gifford rural dispersion coeffi	cients, no dry or wet de	eposition	
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.85E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07
Run 7 - Pasquill-Gifford dispersion coefficient	with wet deposition		
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.73E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.98E-05
Pasture, silage growing area	3.11E-05	7.77E-06	<mark>7.77E-06</mark>
Grain Field	7.10E-06	1.42E-06	1.42E-06
Dwelling site	4.45E-07	1.78E-07	1.78E-07

CHIOVERQ.OUT - Notepad

File	Edit	Form	at V	iew	Help
IAGR	I =	1	Ac-	227	7.730E-05
IAGR	I =	1	Ac-	227	7.730E-05
IAGR	I =	2	Ac-	227	1.979E-05
IAGR	I =	2	Ac-	227	1.979E-05
IAGR	I =	3	Ac-	227	7.771E-06
IAGR	I =	3	Ac-	227	7.771E-06
IAGR	I =	4	Ac-	227	1.418E-06
IAGR	I =	4	Ac-	227	1.418E-06
DWEL	LIN	G	Ac-	227	1.782E-07
DWEL	LIN	G	Ac-	227	1.782E-07
SURF	ACE	Wtr	Ac-	227	5.336E-07

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 4 for run 7 match with air concentrations in CHIOVERQ.OUT file.

12.121 TEST CASE 428 TESTER'S REPORT

Documented in FW_ Test Case 428.msg of 2/26/2020 12:40 PM

FW: Test Case 428

LePoire, David J.

Wed 2/26/2020 12:40 PM

(Table copied from test spreadsheet because the tester's email report could not be reformatted to fit on this page.)

	Dist\time	5.00E-02	0.4	0.25	0.1	0.2		Calc dep	letion				North (0.89		North East - F (9.61 m/s)		South - B (2.46 m/s)	West - C (4.47 m/s)	Co	mpari	ison of	V&V to	o currer	nt run
	20.29988	4.96E-02	0.399916	0.249801	9.97E-02	0.199697		0.993	1.000	0.999	0.997	0.998	9.	93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	1	.00	1.00	1.00	1.00	1.0
	52.19969	4.94E-02	0.399308	0.24937	9.95E-02	0.199323		0.988	0.998	0.997	0.995	0.997	9.	88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	1	.00	1.00	1.00	1.00	1.0
	101.4994	4.92E-02	0.39853	0.248984	9.93E-02	0.199022		0.984	0.996	0.996	0.993	0.995	_	84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	1	.00	1.00	1.00	1.00	1.0
Dry	200.0988	4.90E-02	0.39753	0.248555	9.91E-02	0.198692		0.979	0.994	0.994	0.991	0.993	_	79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	1	.00	1.00	1.00	1.00	1.0
un 5	501.6971			0.247901		0.198211		0.975	0.990	0.992	0.988	0.991	_	75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	1	.00	1.00	1.00	1.00	1.0
	1000.494			0.247324		0.197824		0.973	0.986	0.989	0.986	0.989	_	73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	1	.00	1.00	1.00	1.00	1.0
	1499.291			0.246936		0.197586		0.972	0.983	0.988	0.985	0.988	_	72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01		.00	1.00	1.00	1.00	1.0
	2000.988	4.86E-02	0.392598	0.246628	9.84E-02	0.197411		0.972	0.981	0.987	0.984	0.987	9.	72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	1	.00	1.00	1.00	1.00	1.0
													North (0.89		North East - F (9.61 m/s)		South - B (2.46 m/s)	West - C (4.47 m/s)						
	20.29988	4.98E-02	0.399987	0.249891	9.99E-02	0.199865		0.997	1.000	1.000	0.999	0.999	9.	97E-01	1.00E+00	1.00E+00	9.99E-01	9.99E-01	1	.00	1.00	1.00	1.00	1.
	52.19969	4.96E-02	0.399968	0.249721	9.97E-02	0.199654		0.991	1.000	0.999	0.997	0.998	9.	91E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	1	.00	1.00	1.00	1.00	1.
	101.4994	4.92E-02	0.399937	0.249458	9.94E-02	0.199328		0.983	1.000	0.998	0.994	0.997	9.	83E-01	1.00E+00	9.98E-01	9.94E-01	9.97E-01	1	.00	1.00	1.00	1.00	1.
Vet	200.0988	4.84E-02	0.399877	0.248932	9.88E-02	0.198677		0.967	1.000	0.996	0.988	0.993	9.	67E-01	1.00E+00	9.96E-01	9.88E-01	9.93E-01	1	.00	1.00	1.00	1.00	1.
Run6	498.7971	4.60E-02	0.399692	0.247346	9.70E-02	0.196718		0.920	0.999	0.989	0.970	0.984	9.3	20E-01	9.99E-01	9.89E-01	9.70E-01	9.83E-01	1	.00	1.00	1.00	1.00	1.0
	1000.494	4.23E-02	0.399383	0.244704	9.41E-02	0.19347		0.846	0.998	0.979	0.941	0.967	8.	46E-01	9.98E-01	9.79E-01	9.41E-01	9.67E-01	1	.00	1.00	1.00	1.00	1.0
	1499.291	3.89E-02	0.399076	0.242106	9.14E-02	0.190295		0.779	0.998	0.968	0.914	0.951	7.	79E-01	9.98E-01	9.68E-01	9.14E-01	9.51E-01	1	.00	1.00	1.00	1.00	1.
	2000.988	3.58E-02	3.99E-01	2.40E-01	8.86E-02	1.87E-01	_	0.716	0.997	0.958	0.886	0.936	7.	16E-01	9.97E-01	9.58E-01	8.86E-01	9.36E-01	1	.00	1.00	1.00	1.00	1.
	Revised 2/	26/2020: R	esults fror	n using ing	out fileR	un7.ROF ins	stead	d ofRur	6.ROF.	This inp	ut file sh	ould be st	tated ir	n the t	test case.									

Test Case 428.msg of 2/20/2020 11:12 AM

Test Case 428

LePoire, David J.

Thu 2/20/2020 11:06 AM

Test Case 428

LePoire, David J.

4

	Dist\time	5.00E-02	0.4	0.25	0.1	0.2	Calc deple	Calc depletion		Calc depletion				North (0.89 r	North - A (0.89 m/s)	North East - F (9.61 m/s)			West - C (4.47 m/s)	Compa	ison of V&	/ to current	run	
	20.29988	4.96E-02	0.399916	0.249801	9.97E-02	0.199697	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.9	93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
	52.19969	4.94E-02	0.399308	0.24937	9.95E-02	0.199323	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	9.8	38E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+		
	101.4994	4.92E-02	0.39853	0.248984	9.93E-02	0.199022	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	9.8	34E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
)ry	200.0988	4.90E-02	0.39753	0.248555	9.91E-02	0.198692	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	9.7	79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
un 5	501.6971	4.87E-02	0.395883	0.247901	9.88E-02	0.198211	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	9.7	75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
	1000.494	4.86E-02	0.394389	0.247324	9.86E-02	0.197824	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	9.7	73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
	1499.291	4.86E-02	0.393395	0.246936	9.85E-02	0.197586	9.72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	9.7	72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
	2000.988	4.86E-02	0.392598	0.246628	9.84E-02	0.197411	9.72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	9.7	72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	1.00E+	00 1.00E+0	0 1.00E+00	1.00E+00	1.00E+0		
												North (0.89 r		North East - F (9.61 m/s)	East - D (6.93 m/s)		West - C (4.47 m/s)							
	20.29988	4.95E-02	0.399903	0.249692	9.96E-02	0.199563	9.90E-01	1.00E+00	9.99E-01	9.96E-01	9.98E-01	9.9	97E-01	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.92E-	01 1.00E+0	0 9.99E-01	9.97E-01	9.99E-0		
	52.19969	4.89E-02	0.399276	0.249091	9.92E-02	0.198978	9.79E-01	9.98E-01	9.96E-01	9.92E-01	9.95E-01	9.9	91E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.88E-	01 9.98E-0	1 9.97E-01	9.95E-01	9.97E-0		
	101.4994	4.84E-02	0.398467	0.248444	9.87E-02	0.198353	9.67E-01	9.96E-01	9.94E-01	9.87E-01	9.92E-01	9.8	B3E-01	1.00E+00	9.98E-01	9.94E-01	9.97E-01	9.84E-	01 9.96E-0	1 9.96E-01	9.93E-01	9.95E-0		
Vet	200.0988	4.74E-02	0.397407	0.247493	9.79E-02	0.197377	9.47E-01	9.94E-01	9.90E-01	9.79E-01	9.87E-01	9.6	67E-01	1.00E+00	9.96E-01	9.88E-01	9.93E-01	9.79E-	01 9.94E-0	1 9.94E-01	9.91E-01	9.94E-0		
Run6	498.7971	4.48E-02	0.395589	0.245273	9.59E-02	0.194961	8.97E-01	9.89E-01	9.81E-01	9.59E-01	9.75E-01	9.2	20E-01	9.99E-01	9.89E-01	9.70E-01	9.83E-01	9.75E-	01 9.90E-0	1 9.92E-01	9.88E-01	9.92E-0		
	1000.494	4.12E-02	0.393781	0.242085	9.28E-02	0.191365	8.23E-01	9.84E-01	9.68E-01	9.28E-01	9.57E-01	8.4	46E-01	9.98E-01	9.79E-01	9.41E-01	9.67E-01	9.73E-	9.86E-0	1 9.89E-01	9.86E-01	9.89E-0		
	1499.291	3.79E-02	0.392486	0.239139	9.00E-02	0.187998	7.57E-01	9.81E-01	9.57E-01	9.00E-01	9.40E-01	7.7	79E-01	9.98E-01	9.68E-01	9.14E-01	9.51E-01	9.72E-	9.83E-0	1 9.88E-01	9.84E-01	9.88E-0		
	2000.988	3.48E-02	0.391388	0.23629	8.72E-02	0.184731	6.96E-01	9.78E-01	9.45E-01	8.72E-01	9.24E-01	7.1	16E-01	9.97E-01	9.58E-01	8.86E-01	9.36E-01	9.73E-	01 9.81E-0	1 9.87E-01	9.84E-01	9.87E-0		

Ran the two cases (note that the second part requires run6). The results from the specified files (for he distances and directions) were compared to table 5 & 6 of the report. The Dry deposition matched perfectly. The wet deposition compared to within 3%.

12.122 TEST CASE 431 TESTER'S REPORT

Documented in Results-Test-431.docx of 2/18/2020 6:34 PM

Objective: Test offsite surface water body accumulation with cover for Tc-99

The following steps were taken for Test-431

Step 1 Opened SURF-WATER-CHECK-TC99-TEST1.ROF

Step 2 Saved as Test-431.ROF

Step 3 Ran Test-431.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 1 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-431 surface water concentration as shown in the following figures.

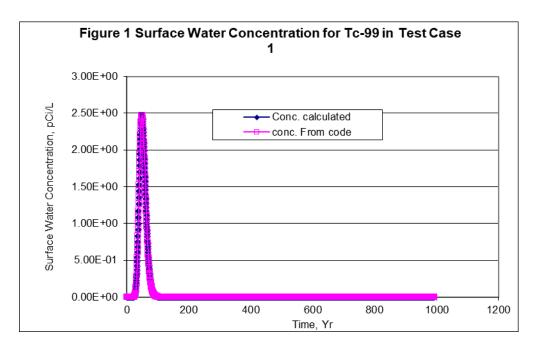


Figure Surface Water Concentration from V&V Report

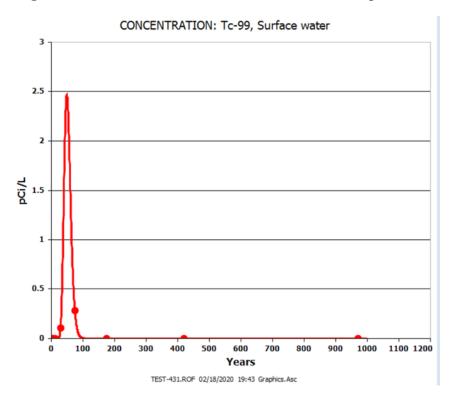


Figure Surface Water Concentration from Test-431

Practically no difference in V&V results for surface water concentration and Test 431 results

12.123 TEST CASE 432 TESTER'S REPORT

Documented in Results-Test-432.docx of 2/18/2020 6:34 PM

RESOFF-TEST-432

Objective: Test offsite surface water body accumulation without cover for Tc-99

The following steps were taken for Test-432

Step 1 Opened SURF-WATER-CHECK-TC99-TEST2.ROF

Step 2 Saved as Test-432.ROF

Step 3 Ran Test-432.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 2 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-432 surface water concentration as shown in the following figures.

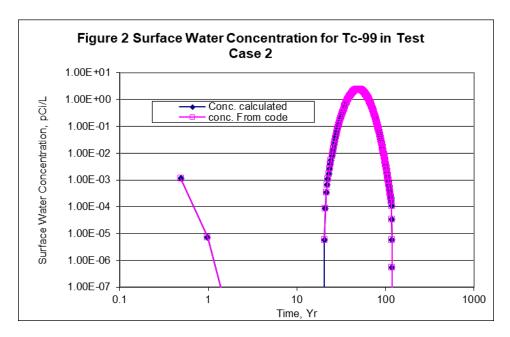
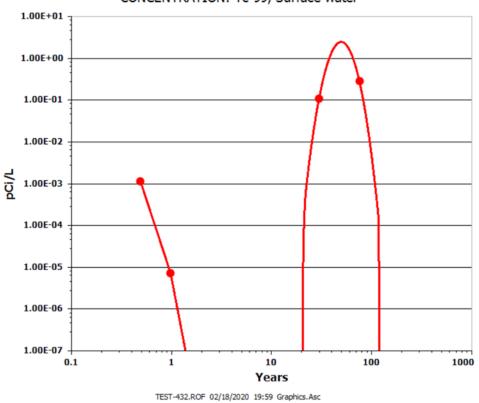


Figure Surface Water Concentration from V&V Report



CONCENTRATION: Tc-99, Surface water

Figure Surface Water Concentration from Test-432

Practically no difference in V&V results for surface water concentration and Test 432 results

12.124 TEST CASE 433 TESTER'S REPORT

Documented in Results-Test-433.docx of 2/18/2020 6:22 PM

RESOFF-TEST-433

Objective: Test offsite surface water body accumulation with cover for U-234

The following steps were taken for Test-433

Step 1 Opened SURF-WATER-CHECK-U234-TEST1.ROF

Step 2 Saved as Test-433.ROF

Step 3 Ran Test-433.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 3 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-433 surface water concentration as shown in the following figures.

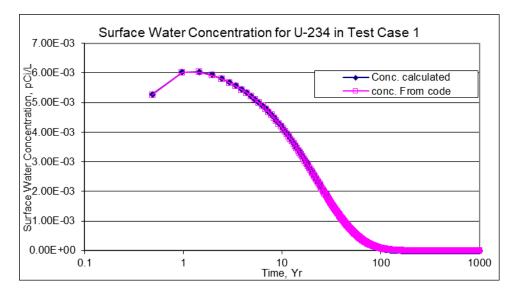


Figure Surface Water Concentration from V&V Report

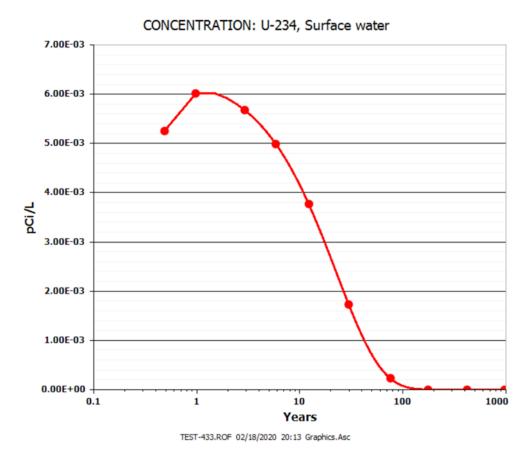


Figure Surface Water Concentration from Test-433

Practically no difference in V&V results for surface water concentration and Test 433 results

12.125 TEST CASE 434 TESTER'S REPORT

Documented in Results-Test-434.docx of 2/18/2020 6:31 PM

RESOFF-TEST-434

Objective: Test offsite surface water body accumulation with no cover for U-234

The following steps were taken for Test-434

Step 1 Opened SURF-WATER-CHECK-U234-TEST2.ROF

Step 2 Saved as Test-434.ROF

Step 3 Ran Test-434.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 4 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-434 surface water concentration as shown in the following figures.

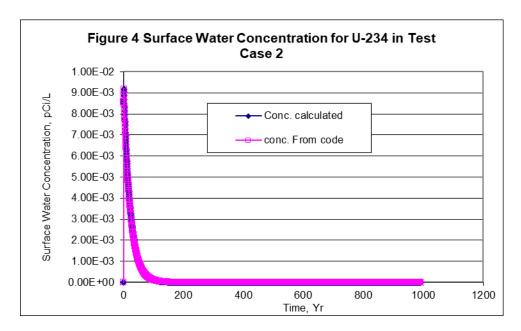


Figure Surface Water Concentration from V&V Report

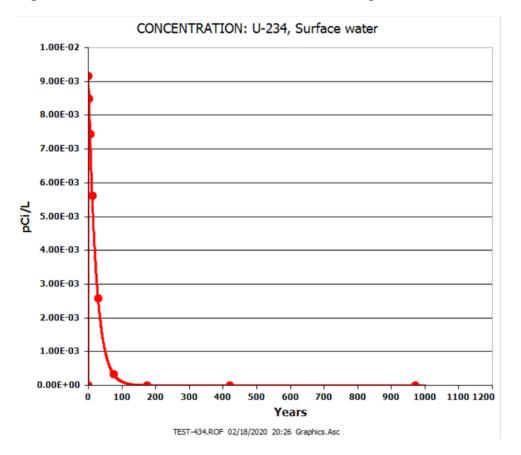


Figure Surface Water Concentration from Test-434

Practically no difference in V&V results for surface water concentration and Test 434 results

12.126 TEST CASE 435 TESTER'S REPORT

Documented in Results-Test-435.docx of 2/19/2020 7:33 AM

RESOFF-TEST-435

Objective: Test features of offsite's release to air

The following steps were taken for Test-435

Step 1 Opened AIR RELEASE COMP CASE1.ROF

- Step 2 Saved as Test-435-1.ROF
- Step 3 Ran Test-435-1.ROF file
- Step 4 Opened AIFLUXIN.DAT file from the main RESRAD-OFFSITE directory
- Step 5 Saved as AIFLUXIN-Test435-1.DAT
- Step 6 Compared with AIFLUXIN-case1.DAT file in the V&V\Air release folder
- Step 7 Opened AIR RELEASE COMP CASE2.ROF
- Step 8 Saved as Test-435-2.ROF
- Step 9 Ran Test-435-2.ROF file
- Step 10 Opened AIFLUXIN.DAT file from the main RESRAD-OFFSITE directory
- Step 11 Saved as AIFLUXIN-Test435-2.DAT
- Step 12 Compared with AIFLUXIN-case2.DAT file in the V&V\Air release folder
- Step 13 Saved AIFLUXIN-Test435-1.DAT and AIFLUXIN-Test435-2.DAT in the results folder
- Step 14 Saved Test435-1-FC and Test435-2-FC in the results folder

Result: Test Passes

Offsite release to air in V&V Report matched with Test-435 air release.

12.127 TEST CASE 436 TESTER'S REPORT

Documented in Results-Test-436.docx of 2/19/2020 7:33 AM

RESOFF-TEST-436

Objective: Test features of offsite's release to erosion

The following steps were taken for Test-436

Step 1 Opened EROSION RELEASE COMP CASE1.ROF

Step 2 Saved as Test-436-1.ROF

Step 3 Ran Test-436-1.ROF file

Step 4 Opened SWFLUXIN.DAT file from the main RESRAD-OFFSITE directory

Step 5 Saved as SWFLUXIN-Test436-1.DAT

Step 6 Compared with SWFLUXIN-case1.DAT file in the V&V\Erosion release folder

Step 7 Opened EROSION RELEASE COMP CASE2.ROF

Step 8 Saved as Test-436-2.ROF

Step 9 Ran Test-436-2.ROF file

Step 10 Opened SWFLUXIN.DAT file from the main RESRAD-OFFSITE directory

Step 11 Saved as SWFLUXIN-Test436-2.DAT

Step 12 Compared with SWFLUXIN-case2.DAT file in the V&V\Erosion release folder

Step 13 Saved SWFLUXIN-Test436-1.DAT and SWFLUXIN-Test436-2.DAT in the results folder

Step 14 Saved Test436-1-FC and Test436-2-FC in the results folder

Result: Test Passes

Offsite release to erosion in V&V Report matched with Test-436 erosion release.

12.128 TEST CASE 437 TESTER'S REPORT

Documented in Results-Test-437.docx of 2/19/2020 8:23 AM

RESOFF-TEST-437

Objective: Test features of offsite's external radiation model

The following steps were taken for Test-437

Step 1 Opened External-1.ROF

Step 2 Saved as Test-437-1.ROF

Step 3 Ran Test-437-1.ROF file

Step 4 Opened Summary report from the main RESRAD-OFFSITE directory

Step 5 Noted external pathway dose for different radionuclides from page 44

Step 6 Compared with Yearly dose (code) column for source area 1000000 m2 results in Table 1 of the report Verification of External Model and External Exposure Pathway Dose.docx file in the V&V\External-Pathway folder

Step 7 Opened External-2.ROF

Step 8 Saved as Test-437-2.ROF

Step 9 Ran Test-437-2.ROF file

Step 10 Opened Summary report from the main RESRAD-OFFSITE directory

Step 11 Noted external pathway dose for different radionuclides from page 44

Step 12 Compared with Yearly dose (code) column for source area 100 m2 results in Table 1 of the report Verification of External Model and External Exposure Pathway Dose.docx file in the V&V\External-Pathway folder

Step 13 Saved Summary-Test437-1.rep and Summary-Test437-2.rep in the results folder

Result: Test Passes

External pathway dose in V&V Report for two test cases matched with Test-437 results as shown below.

				Source area = 50 cm	= 1000000 m², t	hickness =	Source radiu	s = 100 m², thic	kness = 5 cm
Radionu clide	Half-life, yr	decay constant (/yr)	Yearly average concentrati on, pCi/g	Yearly dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD /TM-84, mrem/yr	Yearly dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/T M-84, mrem/yr
Al-26	7.16E+05	9.68E-07	1.00E+00	<mark>1.73E+01</mark>	1.73E+01	1.73E+01	5.82E+00	5.92E+00	5.92E+00
Co-57	7.42E-01	9.35E-01	6.50E-01	3.31E-01	3.26E-01	5.01E-01	1.87E-01	1.84E-01	2.83E-01
Co-60	5.27E+00	1.32E-01	9.37E-01	1.51E+01	1.52E+01	1.62E+01	5.20E+00	5.20E+00	5.55E+00
Cs-137	3.00E+01	2.31E-02	9.89E-01	3.37E+00	3.37E+00	3.41E+00	1.32E+00	1.31E+00	1.33E+00
Mn-54	8.56E-01	8.10E-01	6.85E-01	3.57E+00	3.54E+00	5.16E+00	1.34E+00	1.32E+00	1.93E+00
U-234	2.45E+05	2.83E-06	1.00E+00	4.01E-04	4.02E-04	4.02E-04	2.71E-04	2.86E-04	2.86E-04
U-235	7.04E+08	9.85E-10	1.00E+00	7.57E-01	7.57E-01	7.57E-01	3.90E-01	3.85E-01	3.85E-02

Note: Used high Kd in contaminated zone (atleast 1,000 cm3/g), very less erosion (support practice factor = 0.001)

The code results are taken from the summary report (page 44) at time zero after the run.

The dose results in ANL/EAD/TM-84 are at time zero for instantaneous dose (do not account for yearly average)

The calculated results correct ANL/EAD/TM-84 results for yearly average dose

Summary Report Results for Test437-1

RZSRAD-OFFSITZ, Version 4.0 T+ Limit = 30 days 02/15/2020 10:05 Page 44 Parent Dose Report Title : RZSRAD-OFFSITZ Default Parameters File : Test437-1.ROF Total Dose Contributions TDOSZ(i,p,t) for Individual Radionuclides (i) and Pathways (p)

otal Dose Contributions IDOS2(1,p,t) for Individual Radionuclides (1) and Pathways (p in mrem/yr and as a Percentage of Total Dose at t = 0 years

					Fro	m re	leases to	grou	und water a	and t	o surface	wate	r			
	Ground	ı	Fish		Radon	L I	Plant		Meat		Milk		Soil		Water	
Radio- Nuclide	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	÷	Dose	8	Dose	8
A1-26	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Co-57	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Co-60	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Cs-137	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
Mn-54	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
U-234	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
U-235	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0
		_		_				_		_		_				_
Total	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p) in mrem/yr and as a Percentage of Total Dose at t = 0 years

	Ground	i i	Inhalati	.on	Radon	L I	Plant		Meat		Milk		Soil		All Pathw	ays
Radio- Nuclide	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8	Dose	8
A1-26	1.732+01	43	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.732+01	43
Co-57	3.31E-01	1	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.312-01	1
Co-60	1.512+01	37	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	1.512+01	37
Cs-137	3.372+00	8	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.372+00	8
Mn-54	3.572+00	9	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	3.572+00	9
U-234	4.01E-04	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	4.012-04	0
0-235	7.572-01	2	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	7.572-01	2
Total	4.052+01	100	0.002+00	0	0.002+00		0.002+00	0	0.002+00		0.002+00	0	0.002+00		4.052+01	100

*Sum of dose from all releases and from primary contamination.

Results match with the Yearly dose (code) column for source area 1000000 m2 results in Table 1 of the report (highlighted in yellow)

								-								
					Fro	m re	leases to	grou	nd water a	nd t	o surface	wate	r			
Radio-	Ground	i	Fish		Radon		Plant		Meat		Milk		Soil		Water	
Nuclide	Dose	\$	Dose	•	Dose	8	Dose	8	Dose	•	Dose	8	Dose	8	Dose	•
A1-26	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	_
0-57	0.002+00	ō	0.002+00	ō	0.002+00	ō	0.002+00	0	0.002+00	ō	0.002+00	ō	0.002+00	ō	0.002+00	
Co-60	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	
Cs-137	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	
in-54	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	
J-234	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	
7-235	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	0	0.002+00	
otal	0.002+00															
		Ū	0.002+00 Total Dos				0.00E+00 OSE(i,p,t)							0 Ways	0.002+00 (p)	
		y fr	Total Dos	e Co i com	ntribution n mrem/yr tamination	and and and	OSE(i,p,t) as a Perces from relea	for	Individua e of Total to atmosph	l Ra Dos	dionuclide se at t = 0 (Inhalatio	s (i yea) and Path Is cludes rad	ways	(g)	
Radio-	Ground	y fr	Total Dos com primary Inhalati	e Co i con	ntribution n mrem/yr tamination Radon	and and	OSZ(i,p,t) as a Percer from rele- Plant	for ntag ase	Individua e of Total to atmosph Meat	1 Ra Dos ere	dionuclide e at t = 0 (Inhalatio Milk	s (i yea n ex) and Path rs cludes rad Soil	ways	(p) All Pathw	ay
		y fr	Total Dos	e Co i com	ntribution n mrem/yr tamination	and and and	OSE(i,p,t) as a Perces from relea	for	Individua e of Total to atmosph	l Ra Dos	dionuclide se at t = 0 (Inhalatio	s (i yea) and Path Is cludes rad	ways	(g)	
luclide	Ground	y fr	Total Dos com primary Inhalati	e Co i con	ntribution n mrem/yr tamination Radon	and and	OSZ(i,p,t) as a Percer from rele- Plant	for ntag ase	Individua e of Total to atmosph Meat	1 Ra Dos ere	dionuclide e at t = 0 (Inhalatio Milk	s (i yea n ex) and Path rs cludes rad Soil	ways	(p) All Pathw	ay
Radio- Muclide	Ground	y fr	Total Dos om primary Inhalati Dose	e Co i con	ntribution n mrem/yr tamination Radon Dose	and and	OSE(i,p,t) as a Percer from relea Plant Dose	for ntag ase	Individua e of Total to atmosph Meat Dose	l Ra Dos ere	dionuclide se at t = 0 (Inhalatio Milk Dose	s (i yea n ex) and Path rs cludes rad Soil Dose	ion)	(p) All Pathw Dose	ay:
Al-26	Ground Dose 15_822+00	y fr	Total Dos om primary Inhalati Dose 0.002+00	e Co i con on 0	ntribution n mrem/yr tamination Radon Dose 0.002+00	and and and a	OSE(i,p,t) as a Perces from relea Plant Dose 0.002+00	for ntag ase	Individua e of Total to atmosph Meat Dose 0.002+00	l Ra Dos ere	$\frac{\text{dionuclide}}{\text{(Inhalation)}}$ $\frac{\text{Milk}}{\text{Dose}}$ $0.002+00$	s (i yea n ex) and Path rs cludes rad <u>Soil</u> <u>Dose</u> 0.002+00	(ways (on) 	(p) <u>All Path</u> <u>Dose</u> <u>5.822+00</u>	4 y
Al-26 Co-57 Co-60 Cs-137	Ground Dose 15_822+00 1.872-01 5.202+00 1.322+00	Ly fr 41	Total Dos om primary Inhalati 0.002+00 0.002+00 0.002+00 0.002+00	e Co i con on 0 0	ntribution n mrem/yr tamination Dose 0.002+00 0.002+00 0.002+00	and and and and and and a and a and a and a a a a	OSZ(i,p,t) as a Percei from relev Dose 0.002+00 0.002+00 0.002+00	for ntag ase • •	Individua e of Total to atmosph <u>Meat</u> 0.002+00 0.002+00	1 Ra Dos ere 3 0 0	dionuclide e at t = 0 (Inhalatic Dose 0.002+00 0.002+00	s (i yea n ex) and Path rs cludes rad <u>Dose</u> 0.002+00 0.002+00 0.002+00 0.002+00	(on) (on) 	(p) <u>All Pathy</u> <u>Dose</u> <u>5.822+00</u> 1.872-01	4 3
Al-26 Co-57 Co-60 Cs-137 An-54	Ground Dose 15_822+00 1.872-01 5.202+00 1.322+00 1.342+00	Ly fr 41	Total Dos om primary Inhalati 0.002+00 0.002+00	e Co i con 0 0 0	ntribution n mrem/yr tamination Dose 0.002+00 0.002+00	and and and and and and and and and and	OSE(i,p,t) as a Percei from rele- plant Dose 0.002+00 0.002+00	for ntag ase • • 0 0	Individua e of Total to atmosph <u>Meat</u> 0.002+00 0.002+00 0.002+00	1 Ra Dos ere 0 0 0	dionuclide e at t = 0 (Inhalatic <u>Milk</u> 0.002+00 0.002+00 0.002+00	s (i yea n ex 0 0 0) and Path rs ccludes rad <u>Dose</u> 0.002+00 0.002+00	(on) (on) 	(p) All Pathy Dose 5.822+00 1.872-01 5.202+00	*ay • 4 3
Auclide Al-26 Co-57 Co-60 Cs-137 An-54 U-234	Ground Dose 15_822+00 1.872-01 5.202+00 1.322+00 1.342+00 1.342+00 2.712-04	41 41 36 5 0	Total Dos om primary Inhalati 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	e Con i con 0 0 0 0 0 0 0	ntribution n mrem/yr tamination 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	and and and 0 0 0 0	OSE(i,p,t) as a Perces from rele- Dose 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	for ntag ase 0 0 0 0 0 0	Individua e of Total to atmosph Dose 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	1 Ra Dos ere 0 0 0	dionuclide e at t = 0 (Inhalatic Dose 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	s (i yea n ex 0 0 0 0 0 0 0) and Path rs cludes rad <u>Dose</u> 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	(on) (on) (0 0 0 0 0 0 0 0	(p) All Pathy Dose 5.822+00 1.872-01 5.202+00 1.342+00 2.712-04	4 3
Al-26 Co-57	Ground Dose 15_822+00 1.872-01 5.202+00 1.322+00 1.342+00	Ly fr 41	Total Dos om primary Inhalati 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	e Co i con 0 0 0 0 0 0 0	ntribution n mrem/yr tamination Dose 0.002+00 0.002+00 0.002+00 0.002+00	and and and 0 0 0 0 0 0	OSZ(i,p,t) as a Perces from relev Plant Dose 0.002+00 0.002+00 0.002+00 0.002+00	for ntag ase 0 0 0 0 0	Individua e of Total to atmosph Meat 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	1 Ra Dos ere 0 0 0 0 0	dionuclide e at t = 0 (Inhalatio <u>Milk</u> 0.002+00 0.002+00 0.002+00 0.002+00 0.002+00	s (i yea n ex 0 0 0 0 0 0) and Path rs cludes rad <u>Soil</u> <u>Dose</u> 0.002+00 0.002+00 0.002+00 0.002+00	(0 m) (0 m)	(p) <u>All Pathy</u> <u>Dose</u> <u>5.822+00</u> <u>1.872-01</u> <u>5.202+00</u> <u>1.322+00</u> <u>1.342+00</u>	4 3

Report Results for Test437-2

Results match with the Yearly dose (code) column for source area 100 m2 results in Table 1 of the report (highlighted in green)

12.129 TEST CASE 438 TESTER'S REPORT

Documented in Results-Test-438.docx of 2/19/2020 9:09 AM

RESOFF-TEST-438

Objective: Test features of OFFSITE's external radiation model

The following steps were taken for Test-438

Step 1 Opened EXTERNAL-3.ROF

Step 2 Saved as Test-438-1.ROF

Step 3 Ran Test-438-1.ROF file

Step 4 Noted only external exposure pathway is active and receptor is located 100% time in Pasture-Silage Field

Step 5 Viewed Deterministic Graphic

Step 6 Selected Individual Radionuclide Dose Plot Type

Step 7 Compared dose results with the values in Figure 1 and 2 in the V&V report (Verification of External Model and external pathway.docx)

Step 8 Opened EXTERNAL-4.ROF

Step 9 Saved as Test-438-2.ROF

Step 10 Ran Test-438-2.ROF file

Step 11 Noted only external exposure pathway is active and receptor is located 100% time in Non-leafy Vegetable Field

Step 12 Viewed Deterministic Graphic

Step 13 Selected Individual Radionuclide Dose Plot Type

Step 14 Compared dose results with the values in Figure 3 and 4 in the V&V report (Verification of External Model and external pathway.docx)

Result: Test Passes

External pathway doses in V&V Report matched with Test-438 external dose results as shown in the following figures.

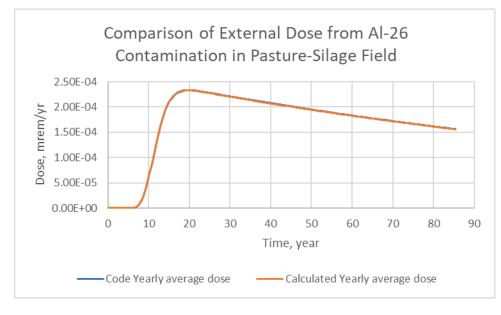


Figure External Dose from Al-26 Contamination in Pasture Silage Field from V&V Report

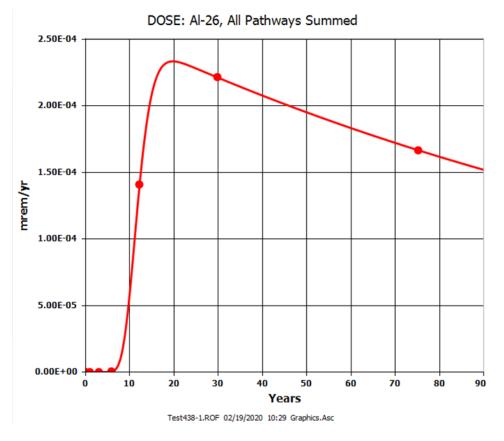


Figure External Dose from Al-26 Contamination in Pasture Silage Field from Test438-1

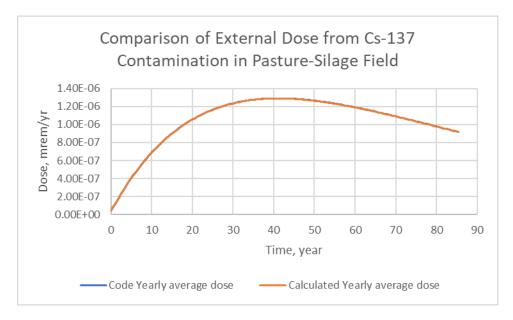


Figure External Dose from Cs-137 Contamination in Pasture Silage Field from V&V Report

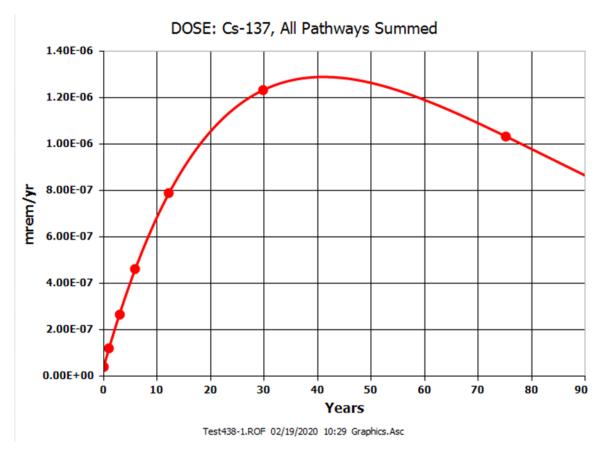
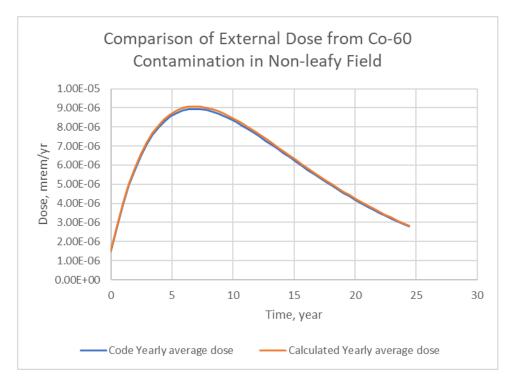
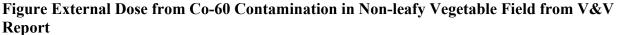


Figure External Dose from Cs-137 Contamination in Pasture Silage Field from Test438-1





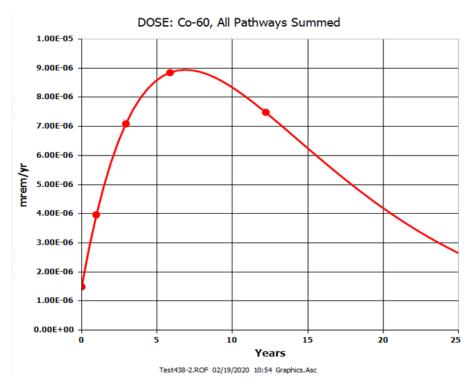


Figure External Dose from Co-60 Contamination in Non-leafy Vegetable Field from Test438-2

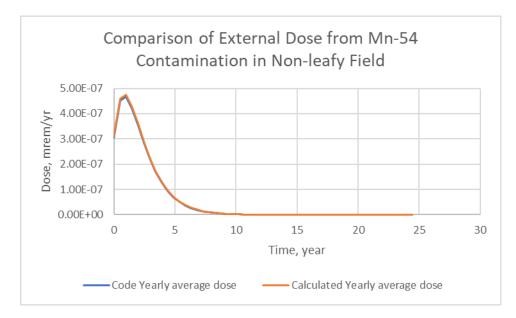


Figure External Dose from Mn-54 Contamination in Non-leafy Vegetable Field from V&V Report

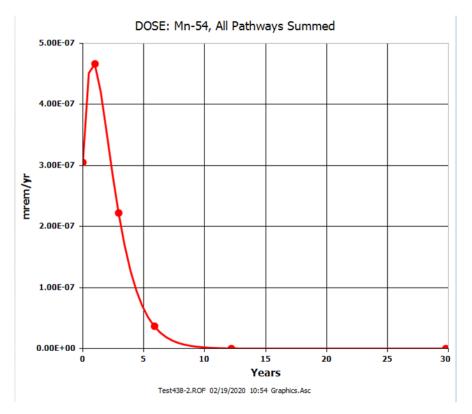


Figure External Dose from Mn-54 Contamination in Non-leafy Vegetable Field from Test438-2

Practically no difference in V&V dose results for external exposure and Test 438 results

12.130 TEST CASE 439 TESTER'S REPORT

Documented in Results-Test-439.docx of 2/19/2020 2:47 PM

RESOFF-TEST-439

Objective: Test features of OFFSITE's particulate inhalation

The following steps were taken for Test-439

Step 1 Opened INHALATION-1.ROF

Step 2 Saved as Test-439-1.ROF

Step 3 Ran Test-439-1.ROF file

Step 4 Noted only inhalation exposure pathway is active and receptor is located 100% time outside on primary contamination

Step 5 Viewed Deterministic Graphic

Step 6 Selected Individual Radionuclide Dose Plot Type

Step 7 Compared dose results with the values in Figure 1 and 2 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Step 8 Opened INHALATION-2.ROF

Step 9 Saved as Test-439-2.ROF

Step 10 Ran Test-439-2.ROF file

Step 11 Noted only inhalation exposure pathway is active and receptor is located 100% time inside on primary contamination

Step 12 Viewed Deterministic Graphic

Step 13 Selected Individual Radionuclide Dose Plot Type

Step 14 Compared dose results with the values in Figure 3 and 4 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Step 15 Opened INHALATION-3.ROF

Step 16 Saved as Test-439-3.ROF

Step 17 Ran Test-439-3.ROF file

Step 18 Noted only inhalation exposure pathway is active and receptor is located 100% time outside on the Dwelling

Step 19 Viewed Deterministic Graphic

Step 20 Selected Individual Radionuclide Dose Plot Type

Step 21 Compared dose results with the values in Figure 5 and 6 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Step 22 Opened INHALATION-4.ROF

Step 23 Saved as Test-439-4.ROF

Step 24 Ran Test-439-4.ROF file

Step 25 Noted only inhalation exposure pathway is active and receptor is located 100% time inside on the Dwelling

Step 26 Viewed Deterministic Graphic

Step 27 Selected Individual Radionuclide Dose Plot Type

Step 28 Compared dose results with the values in Figure 7 and 8 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Result: Test Passes

Inhalation pathway doses in V&V Report matched with Test-439 inhalation dose results as shown in the following figures.

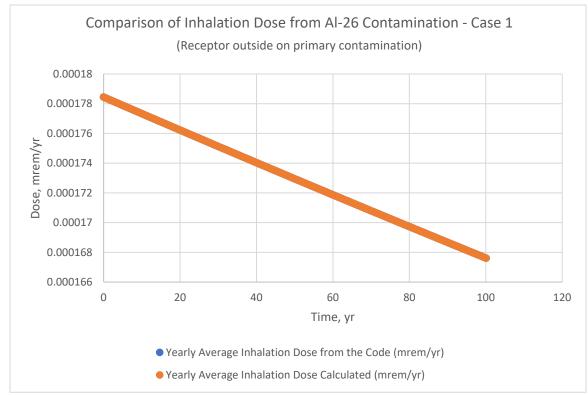


Figure Inhalation Dose from Al-26 Contamination outside on Primary Contamination from V&V Report

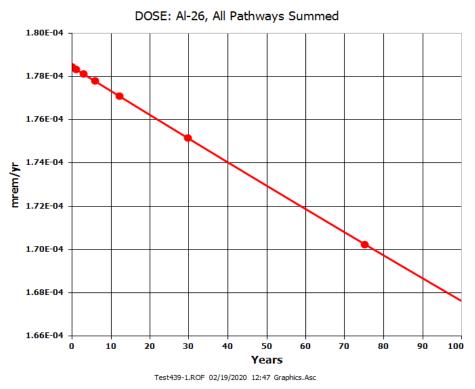


Figure Inhalation Dose from Al-26 Contamination outside on Primary Contamination from Test439-1

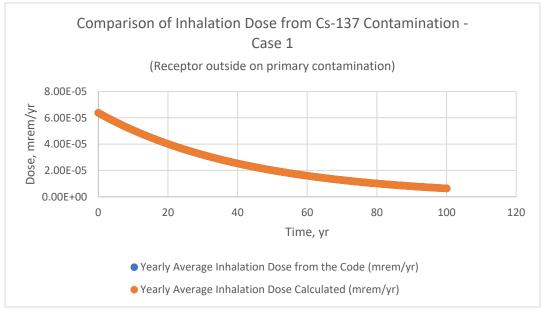


Figure Inhalation Dose from Cs-137 Contamination Outside on Primary Contamination from V&V Report

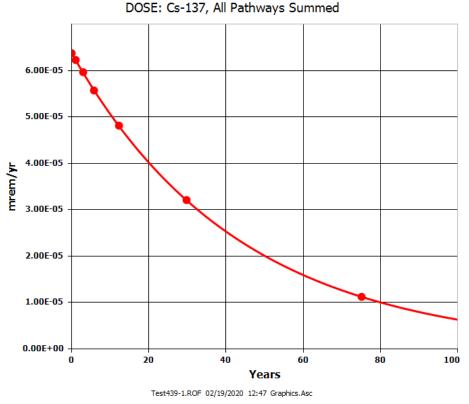


Figure Inhalation Dose from Cs-137 Contamination Outside on Primary Contamination from Test439-1

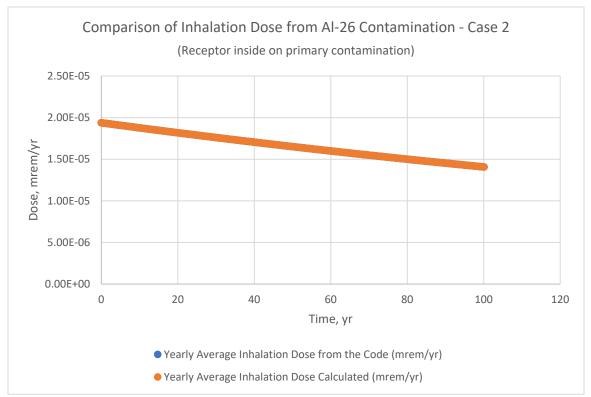


Figure Inhalation Dose from Al-26 Contamination inside on Primary Contamination from V&V Report

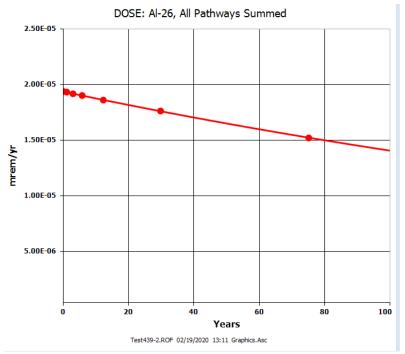


Figure Inhalation Dose from Al-26 Contamination inside on Primary Contamination from Test439-2

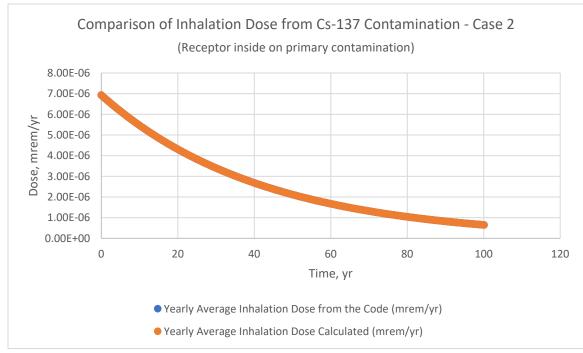


Figure Inhalation Dose from Cs-137 Contamination inside on Primary Contamination from V&V Report

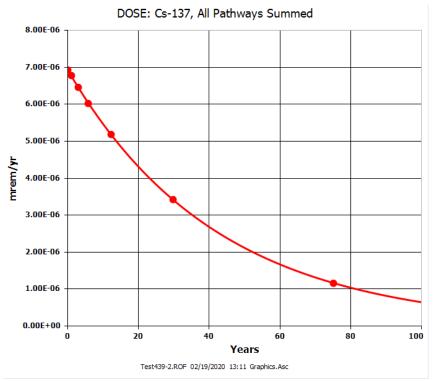


Figure Inhalation Dose from Cs-137 Contamination inside on Primary Contamination from Test439-2

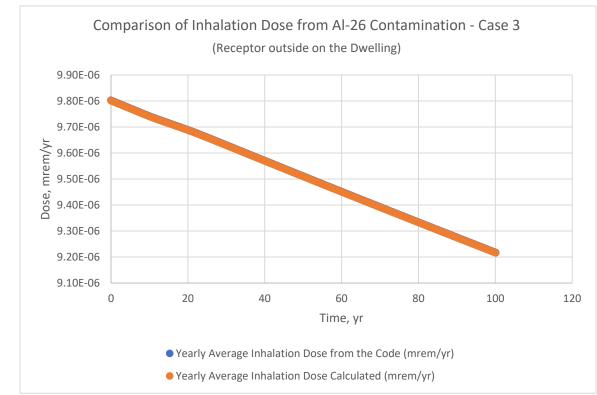


Figure Inhalation Dose from Al-26 Contamination outside on Dwelling from V&V Report

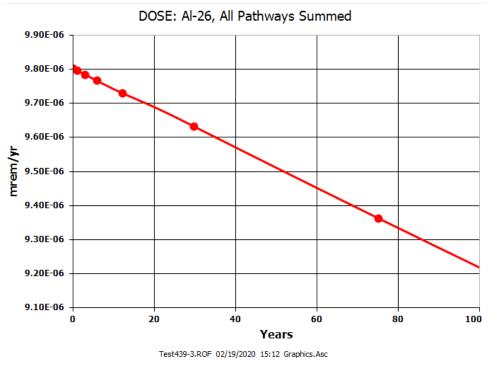


Figure Inhalation Dose from Al-26 Contamination outside on Dwelling from Test439-3

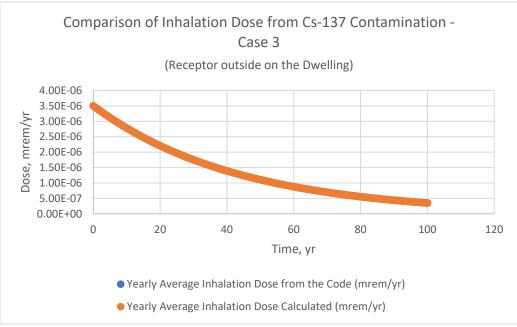


Figure Inhalation Dose from Cs-137 Contamination outside on Dwelling from V&V Report

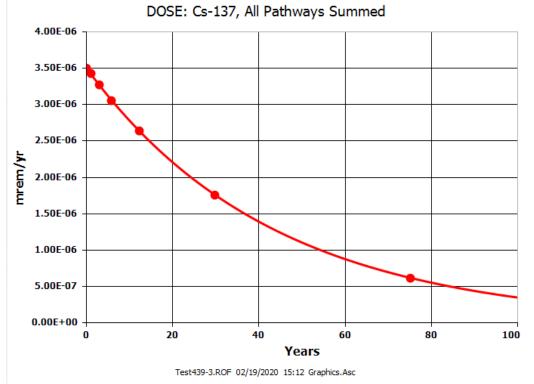


Figure Inhalation Dose from Cs-137 Contamination outside on Dwelling from Test439-3

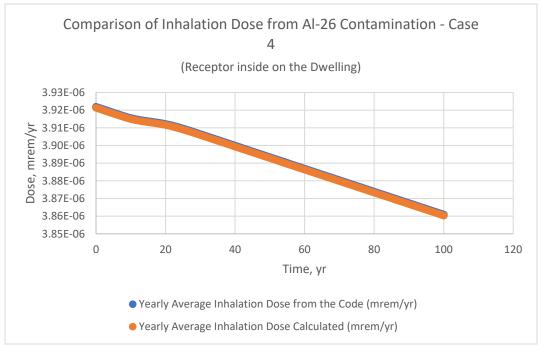


Figure Inhalation Dose from Al-26 Contamination inside on Dwelling from V&V Report

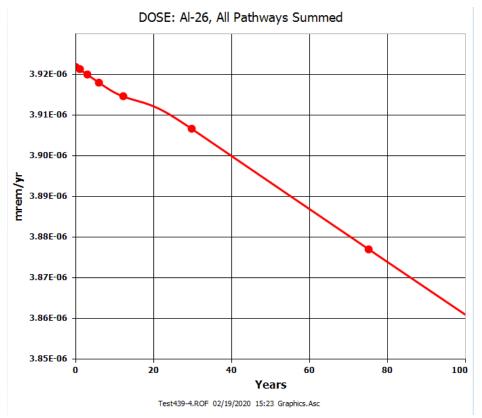


Figure Inhalation Dose from Al-26 Contamination inside on Dwelling from Test439-4

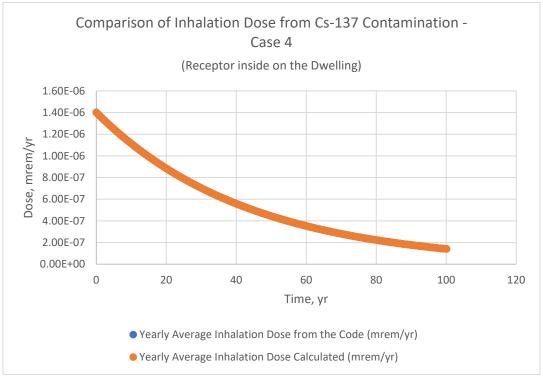


Figure Inhalation Dose from Cs-137 Contamination inside on Dwelling from V&V Report

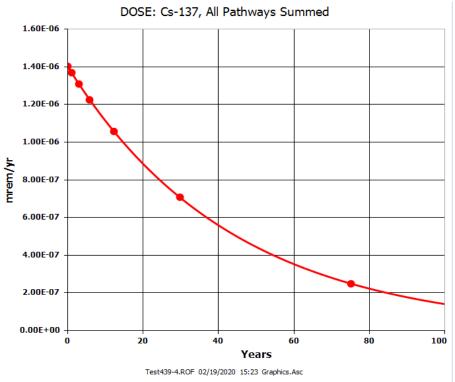


Figure Inhalation Dose from Cs-137 Contamination inside on Dwelling from Test439-4

Practically no difference in V&V dose results for inhalation pathway and Test 439 results

12.131 TEST CASE 440 TESTER'S REPORT

Documented in Results-Test-440.docx of 2/19/2020 2:44 PM

RESOFF-TEST-440

Objective: Test features of OFFSITE's soil ingestion

The following steps were taken for Test-440

Step 1 Opened SOIL-INGESTION-1.ROF

Step 2 Saved as Test-440-1.ROF

Step 3 Ran Test-440-1.ROF file

Step 4 Noted only SOIL INGESTION pathway is active and receptor is located 100% time outside on primary contamination

Step 5 Viewed Deterministic Graphic

Step 6 Selected Individual Radionuclide Dose Plot Type

Step 7 Compared dose results with the values in Figure 1 and 2 in the V&V report (Verification of SOIL-INGESTION pathway dose.docx)

Step 8 Opened SOIL-INGESTION-2.ROF

Step 9 Saved as Test-440-2.ROF

Step 10 Ran Test-440-2.ROF file

Step 11 Noted only SOIL-INGESTION exposure pathway is active and receptor is located 100% time outside on primary contamination

Step 12 Viewed Deterministic Graphic

Step 13 Selected Individual Radionuclide Dose Plot Type

Step 14 Compared dose results with the values in Figure 3 and 4 in the V&V report (Verification of particulate SOIL-INGESTION pathway dose.docx)

Step 15 Opened SOIL-INGESTION-3.ROF

Step 16 Saved as Test-440-3.ROF

Step 17 Ran Test-440-3.ROF file

Step 18 Noted only SOIL-INGESTION exposure pathway is active and receptor is located 100% time outside on the Pasture and Silage field

Step 19 Viewed Deterministic Graphic

Step 20 Selected Individual Radionuclide Dose Plot Type

Step 21 Compared dose results with the values in Figure 5 and 6 in the V&V report (Verification of particulate SOIL-INGESTION pathway dose.docx)

Step 22 Opened SOIL-INGESTION-4.ROF

Step 23 Saved as Test-440-4.ROF

Step 24 Ran Test-440-4.ROF file

Step 25 Noted only SOIL-INGESTION exposure pathway is active and receptor is located 100% time outside on the Non-Leafy Vegetable field

Step 26 Viewed Deterministic Graphic

Step 27 Selected Individual Radionuclide Dose Plot Type

Step 28 Compared dose results with the values in Figure 7 and 8 in the V&V report (Verification of particulate SOIL-INGESTION pathway dose.docx)

Result: Test Passes

Soil ingestion pathway doses in V&V Report matched with Test-440 ingestion dose results as shown in the following figures.

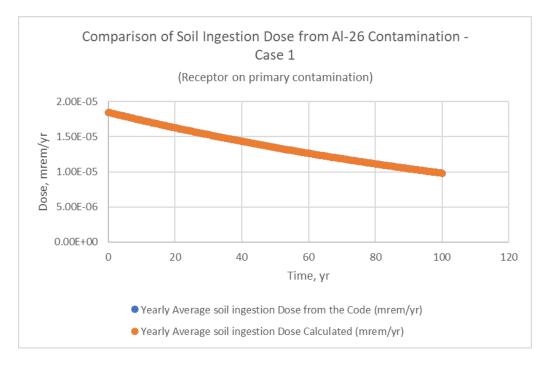


Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from V&V Report

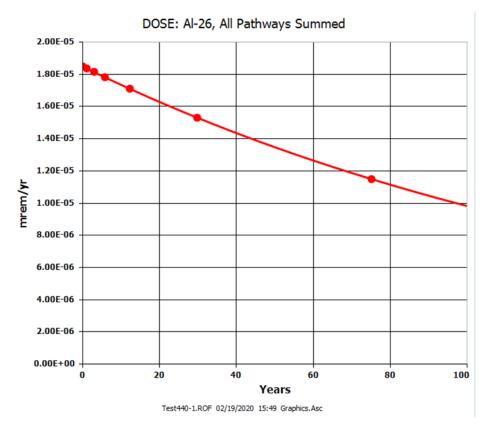


Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from Test440-1

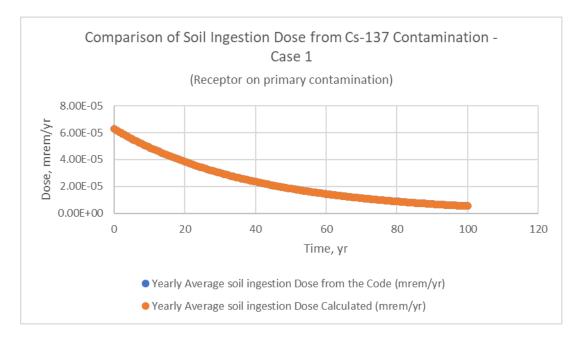


Figure Soil Ingestion Dose from Cs-137 Contamination Outside on Primary Contamination from V&V Report

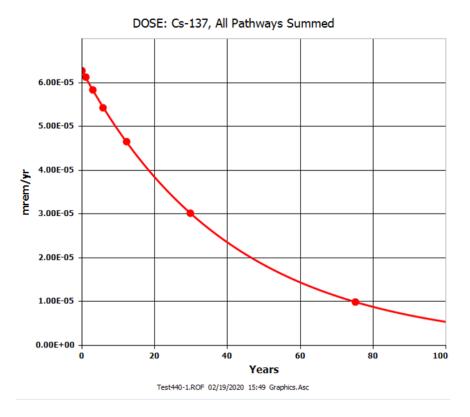


Figure Soil Ingestion Dose from Cs-137 Contamination Outside on Primary Contamination from Test440-1

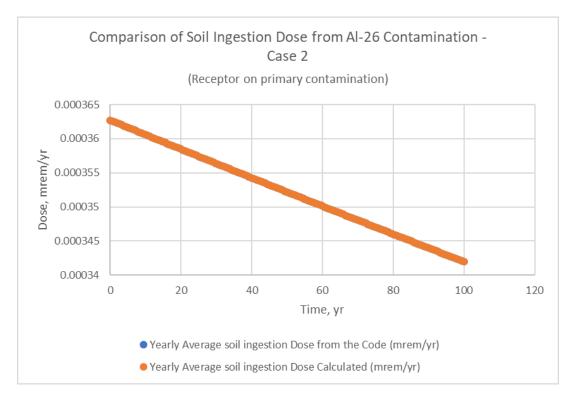


Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from V&V Report

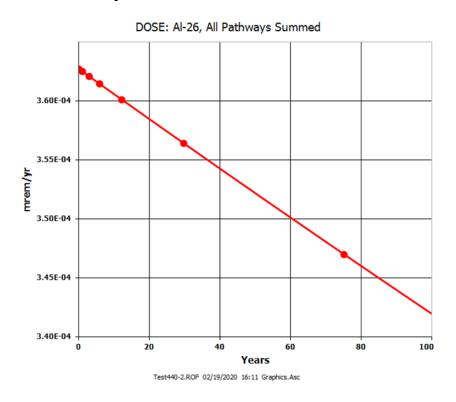


Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from Test440-2

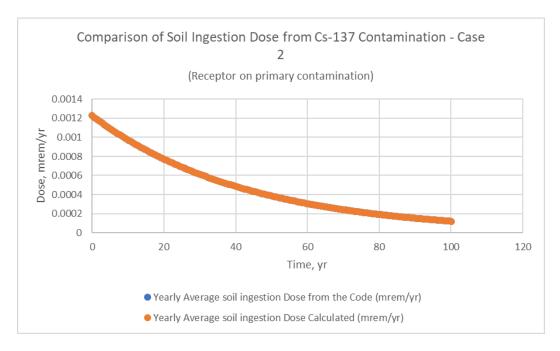


Figure Soil Ingestion Dose from Cs-137 Contamination outside on Primary Contamination from V&V Report

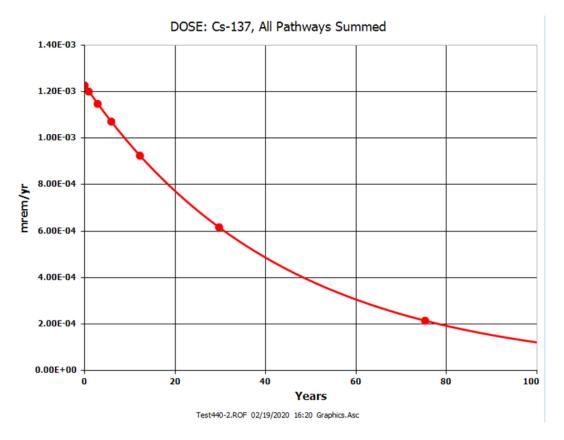


Figure Soil Ingestion Dose from Cs-137 Contamination outside on Primary Contamination from Test440-2

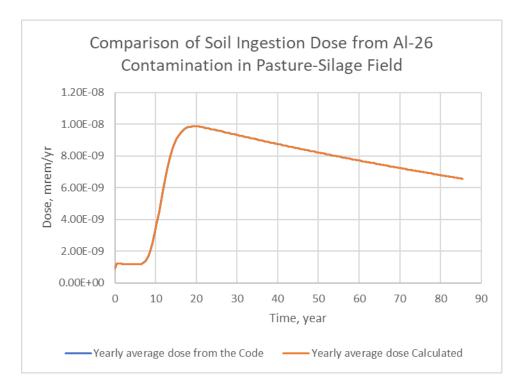


Figure Soil Ingestion Dose from Al-26 Contamination outside on Pasture and Silage Field from V&V Report

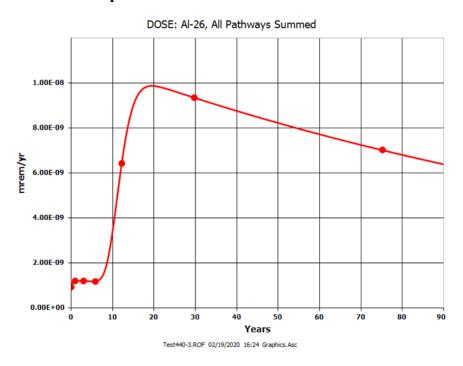


Figure Soil Ingestion Dose from Al-26 Contamination outside on Pasture and Silage Field from Test440-3

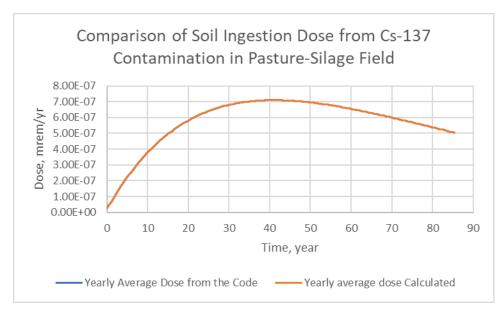


Figure Soil Ingestion Dose from Cs-137 Contamination outside on Pasture and Silage Field from V&V Report

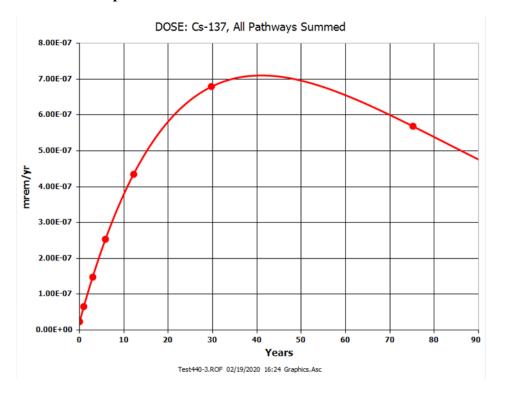


Figure Soil Ingestion Dose from Cs-137 Contamination outside on Pasture and Silage Field from Test440-3

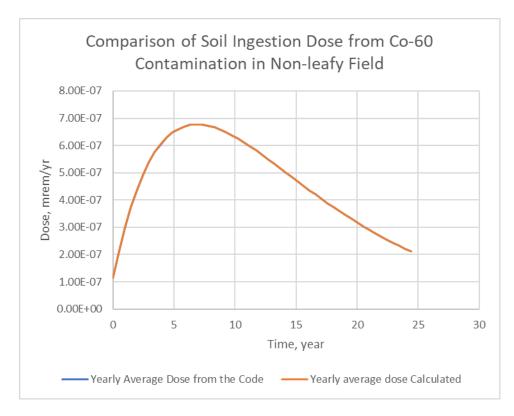


Figure Soil Ingestion Dose from Co-60 Contamination outside on Non-leafy Vegetable Field from V&V Report

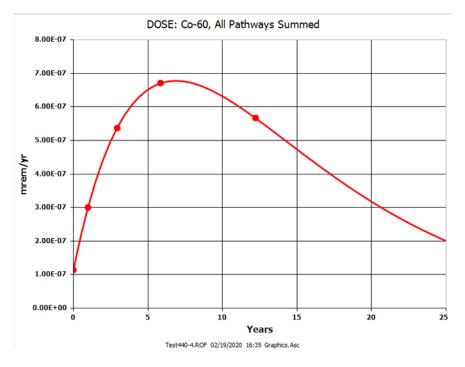


Figure Soil Ingestion Dose from Co-60 Contamination outside on Non-leafy Vegetable Field from Test440-4

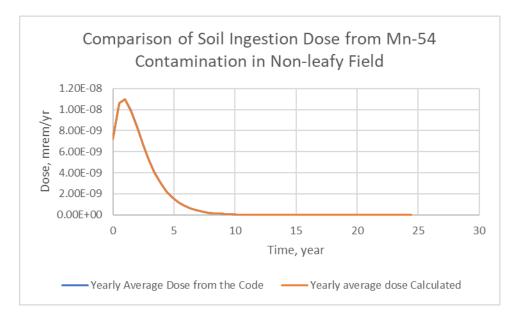


Figure Soil Ingestion Dose from Mn-54 Contamination outside on Non-Leafy Vegetable Field from V&V Report

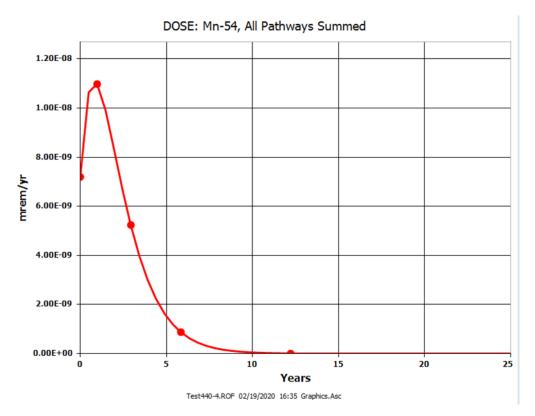


Figure Soil Ingestion Dose from Mn-54 Contamination outside on Non-Leafy Vegetable Field from Test440-4

Practically no difference in V&V dose results for inhalation pathway and Test 440 results

12.132 TEST CASES 441 THROUGH 447

The test reports for each of these 7 tests are spreadsheets comparing the candidate RESRAD-OFFSITE Version 4.0 output of the test run against the development RESRAD-OFFSITE Version 4.0 output for one of the verification runs described in Section 3. Each of these spreadsheets has three tabs, the one tab has the output of the test (129 row and 17 columns of output), another has the output of the verification run with column headers added (131 rows and 17 columns), the third compares the data in the other two tabs, cell by cell, and shows that there is no difference between those two tabs. They are not in a format that can be easily incorporated into this report. They are a sub-set of the verification documented and illustrated in Section 3.

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Gnanapragasam, E, S. Kamboj, Yu, C., D. LePoire, J.-J. Cheng, and C. Wang, K. Beckman, 2020, *User's Manual for RESRAD-OFFSITE Code Version 4 Vol 2*, NUREG/CR-7268, ANL/EVS/TM-19/2, Argonne National Laboratory, Lemont, Illinois, February.

Kamboj, S., C. Yu, and D.J. LePoire, 1998, *External Exposure Model Used in the RESRAD Code for Various Geometries of Contaminated Soil*, ANL/EAD/TM-84, prepared by Argonne National Laboratory, Lemont, Ill., for U.S. Department of Energy, Washington, D.C.

ICRP, 1983, *Radionuclide Transformations: Energy and Intensity of Emissions*, Publication 38, Annals of the ICRP, Vols. 11–13, Pergamon Press, New York, N.Y.

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