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Description of Multimedia Environmental Pollutant Assessment System (MEPAS) Version 3.2 Modification for the Nuclear Regulatory Commission

Prepared by
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Pacific Northwest National Laboratory

Prepared for
U.S. Nuclear Regulatory Commission

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Abstract

The Multimedia Environmental Pollutant Assessment System (MEPAS) is a software tool developed by Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE) to allow DOE to conduct human health risk analyses nation-wide. This report describes modifications to the MEPAS to meet the requirements of the U.S. Nuclear Regulatory Commission (NRC) staff in their analyses of Site Decommissioning Management Plan sites. In general, these modifications provide the MEPAS, Version 3.2, with the capability of calculating and reporting annual dose/risk information. Modifications were made to the exposure pathway and health impact modules and the water and atmospheric transport modules. Several example cases used to test the MEPAS, Version 3.2, are also presented.

The MEPAS, Version 3.2, also contains a new source-term release component that includes models for estimating contaminant loss from three different types of source zones (contaminated aquifer, contaminated pond/surface impoundment, and contaminated vadose zone) due to decay/degradation, leaching, wind suspension, water erosion, overland flow, and/or volatilization. When multiple loss routes are assumed to occur simultaneously, the models account for their interaction and calculate an appropriate pollutant mass budget to each loss route over time.

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Foreword

This technical report, NUREG/CR-6566, was prepared by Pacific Northwest National Laboratory[1] (PNNL) to document work conducted for the Waste Management Branch, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission (JOBCODE W6503). The report describes modifications made to the Multimedia Environmental PollutantAssessment System (MEPAS) Code, an analytical tool for calculating and documenting annual dose/risk assessments. These modifications were specifically requested by the NRC licensing staff to enhance the MEPAS Code for their use in Site Decommissioning Management Plan (SDMP) site reviews. The report provides detailed documentation of the modifications made to the MEPAS Code; specifically the source-term release module, exposure pathway and health impact modules, and water and atmospheric transport modules. The report also provides example cases, including the computer code input files, used to test the modified MEPAS Code, Version 3.2. The MEPAS Code, as documented in this report, may also have value in the development of decision-based systems for assessing radionuclide transport in the environment.

NUREG/CR-6566 is not a substitute for NRC regulations, and compliance is not required. The approaches and/or methods described in this NUREG/CR are provided for information only. Publication of this report does not necessarily constitute NRC approval or agreement with the information contained herein. Use of product or trade names is for identification purposes only and does not constitute endorsement by the NRC or PNNL.

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1 Introduction

1.1 Background

The Multimedia Environmental Pollutant Assessment System (MEPAS) integrates and evaluates transport and exposure pathways for chemical and radioactive releases according to their potential human health impacts (multimedia in this context refers to multiple environmental transport media). The MEPAS takes the nontraditional approach of combining all major exposure pathways into a multimedia computational tool for public health impact. The MEPAS is a physics-based approach that couples contaminant release, migration and fate in environmental media (groundwater, surface water, air) with exposure routes (inhalation, ingestion, dermal contact, external dose) and risk/health consequences for radiological and non-radiological carcinogenic and non-carcinogenic contaminants.

The MEPAS is a software tool developed by Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE) to allow DOE to conduct human health risk analysis nation-wide. The multimedia model concept was presented to DOE by PNNL in 1984 and the initial mathematical formulations were completed and peer reviewed in 1987 (Whelan et. al., 1987). Version 1.0 was completed in 1989 and applied for the first time from 1989 to 1991 for the DOE Environmental Survey Project (DOE, 1988). Since then several versions have been designed and constructed. The current MEPAS, Version 3.1 (Buck et al. 1995), has been modified to meet the requirements of the U.S. Nuclear Regulatory Commission (NRC). This report provides a description of these modifications associated with this new version of MEPAS (Version 3.2).

The MEPAS (V3.2) was jointly developed by the DOE and the NRC to meet the future needs for risk analysis of these agencies. In particular, the NRC required modifications to MEPAS's analysis of radionuclides in the environment to be consistent with agency needs. This report describes the changes made in response to requests from the NRC. The changes have been made with joint funding from the NRC and from the DOE. Figure 1-1 provides the general structure of MEPAS 3.2.

Further information on MEPAS and its applications can be obtained via the following ways:

Internet - http://mepas.pnl.gov:2080
Email - (MEPAS@pnl.gov)
Fax - (509-373-0335), or phone (509-376-6104).

1.2 Objectives

The general objective was to modify the Multimedia Environmental Pollutant Assessment System (MEPAS) code, Version 3.1, to enable calculation and reporting of annual dose/risk information. This required the following specific tasks.

- Modification of the MEPAS user interface to (1) allow for dose/risk calculations for each individual year of the 70-year lifetime of the radionuclides of concern and (2) output the yearly dose/risk results and the maximum annual dose over the period of simulation.
- Modification of the MEPAS atmospheric and waterborne transport models to enable calculations of annual dose/risk for all pathways.
- Modification of the MEPAS exposure model to allow for individual pathway and total dose/risk output and reporting. The decay factor routines used in MEPAS, Version 3.1 were used in the modified code.
- Testing of the modified transport and exposure models and verification of the modified MEPAS code, including all QA/QC documentation and assurances.

In addition, technology transfer was necessary to instruct NRC staff in the use of the code. This involved the following tasks.

- Providing a copy of the modified MEPAS code to NRC staff.
- Documentation of the MEPAS code modifications in this report.
- Revision of the MEPAS Code User Manual.
- Conducting a seminar on the revised MEPAS code for NRC staff.

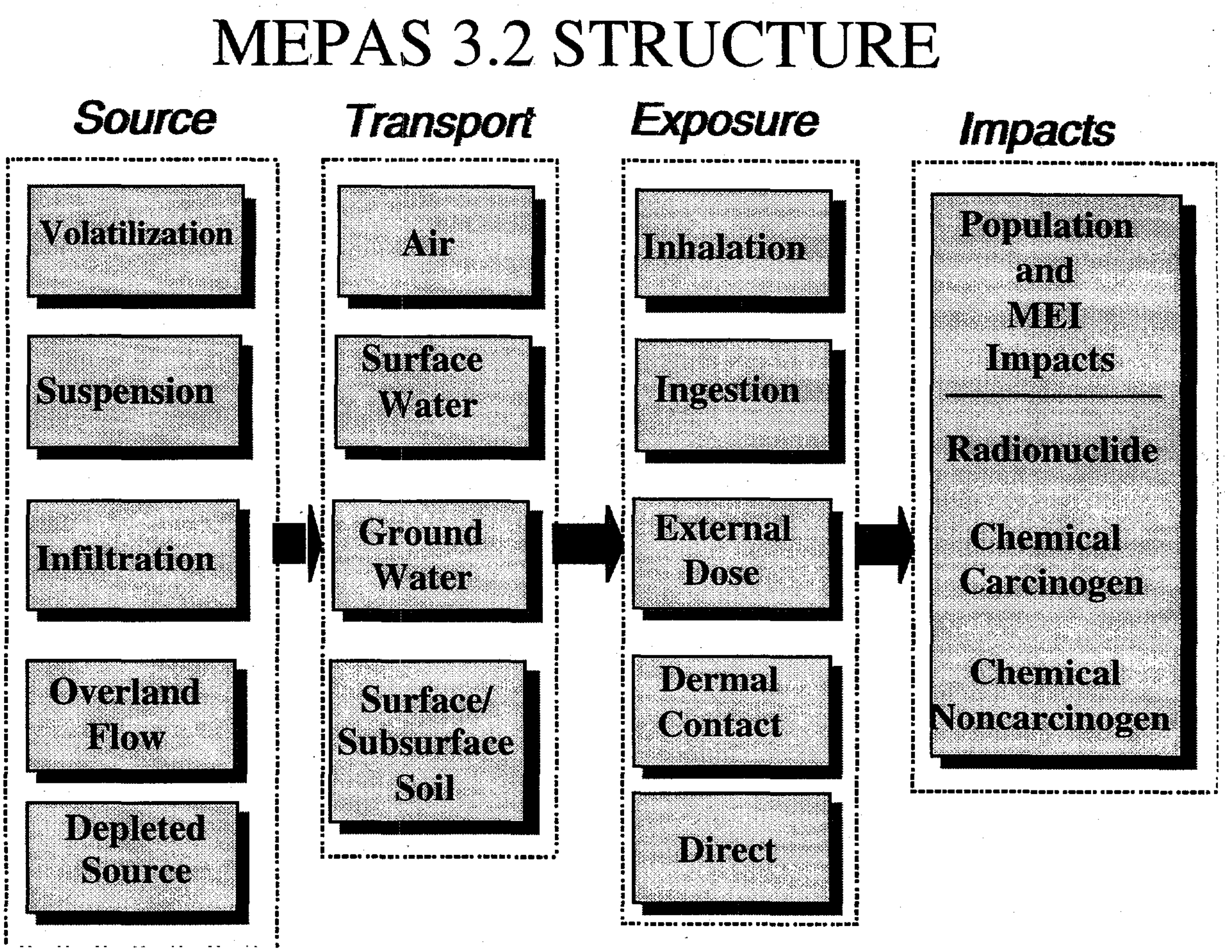

Figure 1-1. General structure of MEPAS Version 3.2.

2 Description of Modifications

This chapter documents the modifications that a part of MEPAS Version 3.2. Primary emphasis is on the modifications required to fulfill the objectives stated previously. Additional modifications made to some of the modules are also described, however, to provide a complete picture of the capabilities of MEPAS 3.2. The modifications are discussed by module: the exposure pathway and health impact modules followed by the water and atmospheric transport modules. The example cases used to test MEPAS Version 3.2 are discussed at the end of the chapter.

2.1 Exposure Pathway and Health Impact Modules

Several modifications have been implemented for the exposure pathway and health impact modules (Strenge and Chamberlain, 1995) for MEPAS 3.2. These modifications include

(1) use of a user-defined time scheme for evaluating the impacts,

(2) use of time-varying water and air concentrations averaged over a user-defined time increment,

(3) use of a leach rate constant from user-defined surface soil properties and absorption coefficients (K_d) values, and

(4) explicitly evaluating accumulation, leaching, and radioactive chain decay in surface soils over time (100,000 years or less).

Each of these items is discussed in the following paragraphs.

The definition of time periods for evaluation of health impacts has been changed in version 3.2. Previous versions evaluated impacts for waterborne cases in each 70-year time period for exposure duration defined for each pathway. For airborne and measured soil cases the evaluation was performed only for the first 70 year time period. The new version allows the user to define the scheme for evaluating the impacts. The user defines the maximum time over which the analysis is to be performed and a time increment. Starting at the time impacts are to begin (user defined risk start time), impacts are evaluated at each time increment in succession until the maximum time has been reached (or exceeded). The exposure duration for each evaluation is the same for a given exposure scenario and is defined by the user. The exposure duration may be less than or greater than the time increment. The MEPAS 3.2 allows the user to specify direct calculation of radiation dose that is expressed as rem (committed effective dose equivalent) as well as health impacts and environmental concentrations (provided in the previous version of MEPAS).

The previous version of MEPAS calculated average concentrations in water and air over a 70-year time period. The MEPAS 3.2 uses time varying water and air concentrations averaged over a user-defined time increment. The time increment may be defined to be from 1 year to 100,000 years. However, the best time increment to use depends on how rapidly the calculated water or air concentration varies. For cases where the concentration varies rapidly, a shorter time period should be used.

The MEPAS 3.2 accounts for leaching by evaluating a leach rate constant from user-defined surface soil properties and absorption coefficients (K_d) values. The leach rate constant is defined by the following equation.

$$\lambda_{wi} = \frac{i}{h\theta\left(1 + \frac{\rho_b}{\theta}K_{di}\right)} \qquad (1)$$

where

i = total infiltration rate (cm/yr.)

h = thickness of the surface-soil layer (cm)

θ = moisture content of the surface-soil layer (fraction)

ρ_b = bulk density of the surface-soil layer (g/cm3)

K_{di} = distribution coefficient for isotope i (mL/g).

The MEPAS User Interface has been modified to ask the user to supply these parameter values whenever pathways are selected that involve accumulation in soils. For example, the groundwater transport pathways involving irrigation of food crops requires these parameters to estimate accumulation in agricultural soils, but not to evaluate drinking water exposures. The user may supply absorption coefficients for each member of a decay chain independently.

The "measured soil" pathway was included in the initial versions of MEPAS to allow evaluation of cases involving known concentration in soil to which individuals were exposed. For these cases, the concentration was defined at some initial point in time and decay was followed over the first 70-year period. In version 3.2, the initial concentration is defined in the same manner. However, losses by leaching is now evaluated with the analysis being performed over a much longer time period (defined by the user).

The final change in the exposure pathway analyses performed by MEPAS involves accumulation and loss from surface soils involved in the exposure assessment. When material is deposited to soil from irrigation deposition (groundwater or surface water sources) or from atmospheric deposition, accumulation of material in the soil with ingrowth of progeny radionuclides can be expected to occur. Losses from the soil will also occur from leaching and radioactive decay. The change in soil concentration for cases involving measured soil concentrations (e.g. concentrations defined at an initial time) also requires following the soil concentration over time with consideration of leaching and radioactive decay and progeny ingrowth. The MEPAS 3.2 implements these changes involving accumulation, leaching, and radioactive chain decay in surface soils. The accumulation in soils is evaluated using the chain decay algorithm described by Strenge (1997).

The previous version of MEPAS allowed deposition and accumulation in soil (without leaching loss, but with decay and progeny ingrowth) over a 70 year time period. At the end of the seventy years, the soil was assumed to be clean and deposition and accumulation began again for the next 70 years. This process was applied to groundwater and surface water irrigation pathways. For atmospheric assessments, the analysis was always stopped after one 70-year period. The new version of MEPAS allows deposition, leaching, and decay to occur continuously to a user defined maximum time (100,000 years or less) for air and waterborne depositions to soil.

2.2 Water Transport Module

Several modifications have been implemented for the waterborne transport modules (Whelan and McDonald, 1996 and Whelan et al., 1996) for MEPAS 3.2. These modifications include

(1) providing instantaneous concentrations as a function of time to the exposure component as opposed to 70-year average concentrations,
(2) the implementation of a near-field capability for the saturated zone,
(3) a more efficient integration scheme coupled with better integration limit algorithms,
(4) provisions to assure mass conservation in cases where the source term release module generates fluxes of decay products to the waterborne transport pathways, and
(5) the addition of a wetlands component.

Each of these items is discussed in the following paragraphs.

In previous versions of MEPAS, the waterborne component provided average receptor concentrations over 70-year intervals to the exposure component. Thus, the 70-year averaging interval was hard-coded into the system. In version 3.2, instantaneous concentrations as a function of time are provided to the exposure component. Average concentrations are then produced directly by the exposure component over any user-defined time interval.

In previous versions of MEPAS, the saturated zone pathway produced best results under far-field conditions (i.e., a receptor located far enough away from the source such that water inflowing from the vadose zone has little impact on computed concentrations). Often times, if the receptor were located too close to the source, computed aqueous concentrations would exceed the initial aqueous concentration present at the source itself. This problem occurred because the source configurations implemented for the saturated zone (point, line, or area sources at the water table) all had a thickness (or z-dimension) of zero. In reality, however, constituents occurring in the aquifer beneath a waste site are already mixed in some volume of water, mainly the water flowing in from the vadose zone. By not accounting for this initial mixing, the saturated zone component overestimated receptor concentrations in the near-field. When this occurred, the computed receptor concentrations were simply set equal to the source concentration.

To address this problem, a 3-dimensional volume source (i.e., a rectangular box) was added to the saturated zone component. This allows constituents to be mixed within a volume of water in the aquifer beneath the waste site, and thus reduce near-field concentrations to reasonable levels. The size of the volume source is determined such that constituent concentrations in the volume source are equal to their concentration in the inflowing vadose zone water. The thickness of the volume source is determined based on the amount of water flowing in from the vadose zone. The length and width of the volume source is the same as that for the vadose zone source. Currently, this near-field capability is implemented only for area source releases to the vadose zone. This is because for non-area sources and releases directly to the saturated zone, the volume of inflowing vadose zone water cannot be determined.

Initially, the addition of the volume source caused computer run times for the waterborne component to become so long, that use of the volume source was impractical. These long run times resulted primarily from two factors: 1) the need to converge on an infinite series which oscillates for many terms before stabilizing (needed for the volume source solution), and 2) the short-duration nature of the function being integrated under near-field conditions in conjunction with less than ideal integration limits. Thus, convergence of the infinite series needed to be accelerated and a more efficient and faster integration scheme was needed. Convergence of the infinite series was accelerated using a repeated moving average technique, and the adaptive Simpson's quadrature integration technique used in previous versions of MEPAS was replaced in version 3.2 with a relatively simple trapezoid technique. Newton's method was employed to numerically define better integration limits. These improvements made the volume source technique practical and reduced computer run times for the waterborne component anywhere from a factor of 2 to 10 compared to previous versions.

Modifications to the waterborne component were necessary in order to form a linkage to the source term release module that conserved mass. The source term release module generates constituent fluxes to the various transport pathways for parent constituents and their progeny. The waterborne transport code computes parent concentrations at the receptor using the formulations for that component (e.g., a form of the advective dispersive equation) and then uses the Bateman equation to compute progeny concentrations. If this approach were used strictly on the parent constituents, progeny released from the source would not be accounted for and mass would not be conserved.

To solve this problem, each individual constituent of a decay chain released from the source (using the source term release module) is treated by the waterborne component as a parent having its own decay chain. Each 'parent' is then modeled and receptor concentrations are computed. The Bateman equation is used to compute the decay chain for each 'parent'. Finally, the original decay chain is reaggregated by summing together concentrations for like constituents to produce a final output.

For example, consider the 3-member decay chain of Thorium-228 as the parent decaying to Radium-224 and then to Lead-212. The source term release module would compute fluxes for all three of these constituents for a given waterborne transport pathway. In MEPAS 3.2, the waterborne component will simulate all three of these constituents as parents having their own decay chains. The first parent would be Thorium-228 with its two decay products, Radium-224 and Lead-212. The second parent would be Radium-224 with its decay product Lead-212. And the third parent would be Lead-212 having no decay products. The waterborne component will compute receptor concentrations for each parent, and then use the Bateman equation to populate the decay chains. Then, these three decay chains are reaggregated into a single chain by summing together the concentrations for like constituents. The final output for use by the exposure component is a set of time varying concentrations for a single parent (Thorium-228) and its decay products (Radium-224 and Lead-212).

The MEPAS 3.2 wetland component assumes a wetland can be described as a completely-stirred tank reactor. Wetland processes considered by this component are equilibrium phase partitioning between the water column and bottom sediments, equilibrium phase partitioning between the water column and plant biomass, decay/degradation, both aqueous-phase controlled and sediment-phase controlled volatilization, and outflow to groundwater or surface water. Based on constituent emission rates entering the wetland and the amount of constituent already present in the wetland, the wetland component computes aqueous concentrations in the wetland or constituent fluxes to groundwater or surface water. Constituents can enter the wetland pathway from the overland, saturated zone, or direct release pathways, and exit the wetland through volatilization, decay/degradation, outflow to groundwater, or outflow to surface water.

The MEPAS 3.2 version does not have the capability to handle progeny-specific transport parameters (i.e., K_d, solubility) for in-growth decay cases. This capability will be provided in a future version of MEPAS.

2.3 Atmospheric Transport Module

The atmospheric transport module (Droppo and Buck, 1995) has not been changed in version 3.2. However, the transfer of air concentration and deposition rates to the exposure module has been modified. The input to the exposure component is now expressed as release rates from the source as a function of time. This release rate data is coupled with the normalized dispersion parameters (X/Q and D/Q) to estimate the deposition rates for average air concentrations to soil for each time period of interest in the exposure analysis.

2.4 Example Cases Used to Test MEPAS

The testing of the MEPAS 3.2 modules and the example cases were developed based on the objectives stated in Chapter 1. Several example cases were developed to test and demonstrate the new attributes of the MEPAS 3.2. The test cases are similar to hypothetical sites that NRC staff have used in the past. This section provides a brief description of each example case. MEPAS worksheet files listing the input parameters for each example case can be found in the appendices. The example cases demonstrate the new capabilities developed in MEPAS 3.2 software and are not meant to depict a real site. Past cases developed for the NRC were used as a starting point for these cases. There may be some inconsistencies in parameter values between the different example cases but this is not critical to their function. MEPAS 3.2 currently has a 20 constituent limit for a given run and because 238U, 235U and 234U generate many progeny, several cases were developed that separate these constituents.

2.4.1 Waterborne Example Cases

Two different scenarios were developed using four example cases for the waterborne analysis. CASE1A and CASE1B .PRM files contain all the input data required for the example groundwater analysis for 238U and 235U, respectively. CASE2A and CASE2B .PRM files contain all the input data required for the example overland to surface water analysis for 238U and 235U, respectively. The .PRM input file example cases are included with the MEPAS 3.2 code.

The conceptual model describes the groundwater transport features and receptor locations for each pile. Two analyses were performed, one for each pile. A receptor well is assumed to be located approximately 500 ft directly downgradient from the source. The source is assumed to be leaching (no other release types considered) into a partially saturated zone and then to a saturated zone and finally to the receptor well. The infiltration rate is known for this site (22 cm/year). The use of the water for domestic and agricultural purposes (leafy and other vegetables, meat [beef], and milk) is assumed for the receptor well. Figure 2-1(B) is a plot of the impact results from the groundwater test case. For comparison, Figure 2-1(A) shows the results for the same test case, but using 70-year average concentrations to calculate dose as is done in MEPAS Version 3.1. For this particular problem, the only significant differences are at early times when the radionuclides are just reaching the receptor and concentrations are changing rapidly. Differences could be larger for problems with sharp peaks in the radionuclide concentration vs. time plots.

The surface water conceptual model has four sources of contamination: Pile 1, southern half of Pile 2, northeastern part of Pile 2, and northwestern part of the Pile 2. All sources ultimately drain into the Minor Run, which drains to Little Creek. The sources were aggregated into a homogenous pile and assumed to be eroding from the piles as a result of precipitation that produces overland runoff to the Minor Run. The overland erosion rate is computed internally and no other release type was considered. This overland runoff enters a wetlands region that is connected to the river system. A receptor on the Minor Run is assumed to eat fish and shellfish from the run and to use the water for animals (no food or feed crops). No drinking water use is likely to occur from the small stream.

2.4.2 Airborne Example Cases

Two different scenarios were developed using two example cases for the airborne type analysis. CASE3A .PRM file contains all the input data required for the example wind suspension analysis of 234U contamination, while CASE3B.PRM contains all the input data required for the example volatilization analysis of benzene and toluene contamination from the ash piles.

The conceptual model is defined as an Ash Pile contaminated with 234U and a second Ash Pile contaminated with organic compounds (benzene and toluene) from a recent spill. The site characteristics were used to compute the wind erosion rate (mass loading factor). The surface characteristics are defined as a dry non-vegetated site with several structures in the vicinity. The receptors are offsite residential homes associated with a large city downwind of the site. The exposure routes are assumed to be soil pathway (ingestion, inhalation, resuspension, and external) and air pathway (inhalation and external).

2.4.3 Direct Exposure Example Cases

CASE4A.PRM and CASE4B.PRM example cases provide information on the direct exposure scenario. The source is assumed to be 238U and 235U, respectively, for the two cases. It is assumed that 4 people live onsite and use the land for a small garden (leafy and other vegetables, meat (beef), milk, and direct). The major exposure pathway is through the direct route (incidental soil ingestion and inhalation).

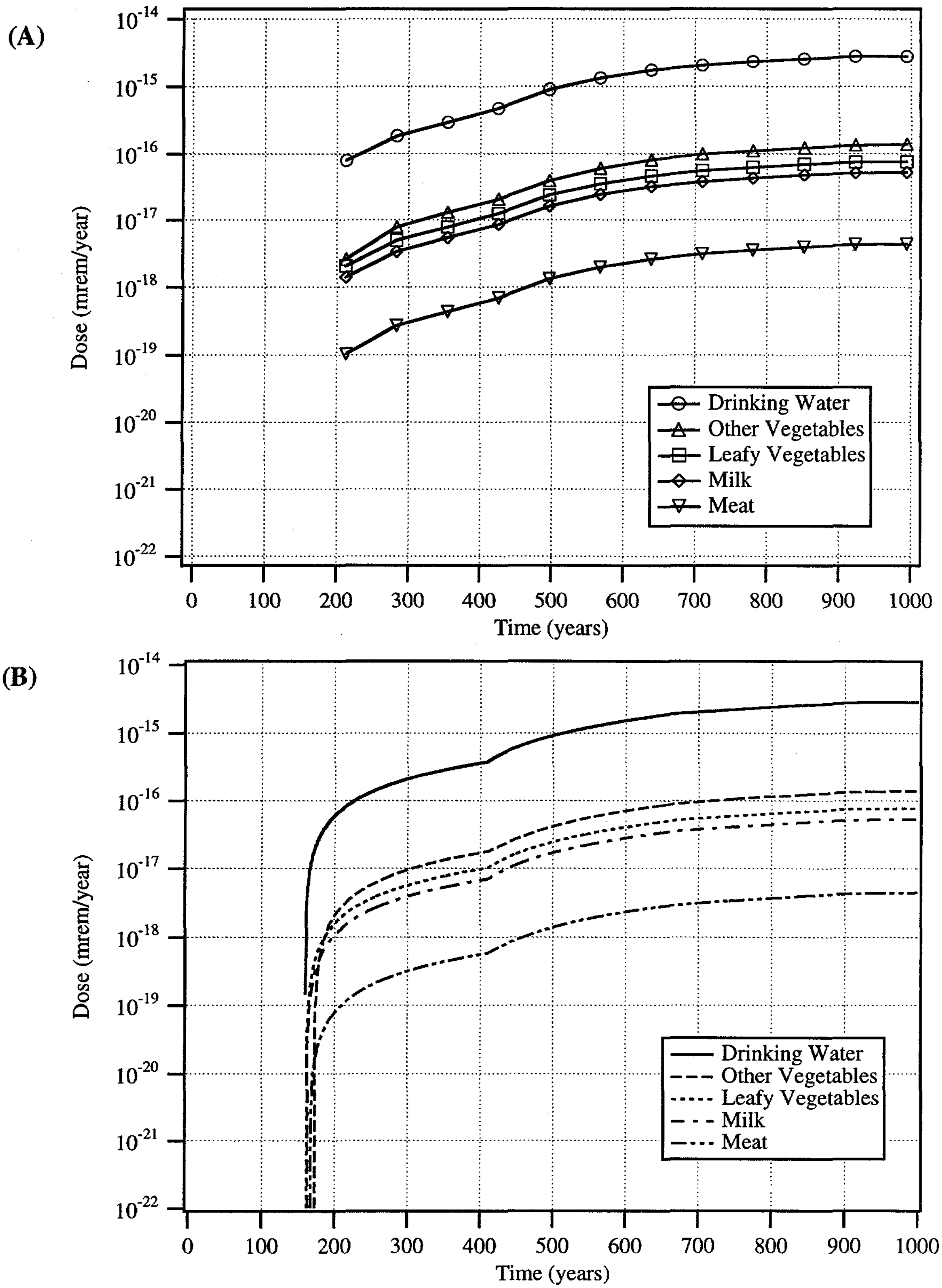

Figure 2-1. Groundwater test case results: dose for U-238 by groundwater exposure route. (A) - based on 70 year average concentrations (as in MEPAS Version 3.1); (B) - based on annual concentrations (MEPAS Version 3.2).

3 Source-Term Release Module

The source term release module was not required to fulfill the objectives states in Chapter 1, but it is included in MEPAS Version 3.2 and is therefore discussed here. The following information will allow user's of MEPAS 3.2 to understand the Source Term Release Module and how it can be used.

The MEPAS source-term release component (Streile et al. 1995) includes models for estimating contaminant loss from three different types of source zones (contaminated aquifer, contaminated pond/surface impoundment, and contaminated vadose zone) due to decay/degradation, leaching, wind suspension, water erosion, overland flow, and/or volatilization. When multiple loss routes are assumed to occur simultaneously, the models account for their interaction and calculate an appropriate pollutant mass budget to each loss route over time.

The ultimate objective of the source-term release component of MEPAS is to calculate a set of mass-partitioned contaminant fluxes as a function of time from the source for different loss routes. Mass-partitioned is defined as apportioning contaminate mass loss from the source via different loss routes. If the user wishes to explicitly enter the contaminant flux/emission rates for one or more loss routes (based on known or assumed data, or the predictions of some other model), the source-term release component will use the supplied values as a function of time. If the user cannot or does not wish to supply explicit contaminant flux/emissions rates for any or all loss routes, the source-term release component contains models that will calculate the flux/emission as a function of time (also according to mass partitioning considerations). If the user wants to analyze a scenario that assumes contaminant release to only a subset of the possible loss routes for a given type of source zone, loss to undesired routes can be turned off. Figure 3-1 is a diagram of how this module partitions mass through the different release mechanisms.

In all types of contaminant source zones, it is assumed that the contaminants may be present in multiple phases (i.e., in aqueous solution, sorbed to solid particles, in vapor-filled pore space, or in a separate non-aqueous-phase liquid [NAPL] that is immiscible with water and air). The source-term release component contains models to determine which contaminants in the release scenario will partition into which phases, and to what degree. An important feature of the source-term release component is its ability to calculate aqueous and vapor concentrations of contaminants in equilibrium with a NAPL phase composed of a changing mixture of contaminants. Different partitioning theory is used when the contaminant is present as a dilute, primary, or intermediate constituent of the NAPL phase.

All types of contaminant source zones are conceptualized as completely stirred tank reactors (i.e., the properties of the zone are assumed to be spatially uniform throughout). However, for one possible vadose zone condition, this conceptualization leads to unrealistically high estimates of volatilization loss. In this instance, a calculation based on a simple spatial gradient model is used as a bounding calculation for volatilization flux. The contaminant concentrations in the source zone, and in some cases the location of the boundary of the zone can change over time due to the action of the loss routes.

The source-term release module can be used to simulate baseline scenarios as well as remediation scenarios, where certain types of remediation technologies have been implemented at the site. Remediation technologies that can be simulated for any type of source zone include all methodologies that can be represented merely by changing the magnitude of certain model parameters from their baseline values.

For a contaminated aquifer source zone, the contaminant can be present in either the aqueous or sorbed phases, and possibly also an immobile NAPL phase (depending on contaminant type and inventory). The possible contaminant loss routes for the saturated zone are first-order decay/degradation and advective and dispersive leaching from the saturated zone along with the groundwater flow streamline.

For a contaminated pond/surface impoundment source zone, the contaminant can be present in either the aqueous or sorbed (to suspended sediment) phases, and possibly also a NAPL phase that exists as small globules suspended throughout the zone (depending on contaminant type and inventory). The possible contaminant loss routes are first-order decay/degradation within the zone, advective and dispersive leaching from the zone along with the infiltrating water, overland flow from the pond through runoff water, and volatilization from the impoundment surface.

For contaminated vadose zone sources, the contaminant can be present in either the aqueous, sorbed, or vapor phases, and possibly also an immobile NAPL phase (depending on contaminant type and inventory). The possible contaminant loss routes are first-order decay/degradation within the vadose zone, advective and dispersive leaching from the vadose zone due to percolating water, wind suspension of contaminated soil particles from the surface, water erosion of contaminated soil particles from the surface, and volatilization from the soil. In addition, there are two types of remediation technologies (in situ vitrification [ISV] and in situ solidification [ISS]) that require special theory and are defined in Streile et al. (1996).

The mass partitioning and phase distribution theory consists of expressing contaminant loss fluxes through first-order, ordinary differential equations, which are solved in the source-term component by numerical methods (fourth-order Runge Kutta). There are also analytical solutions that are applicable to certain special cases of contaminant release. These analytical solutions can be used to verify the output of the source-term release component in those special cases.

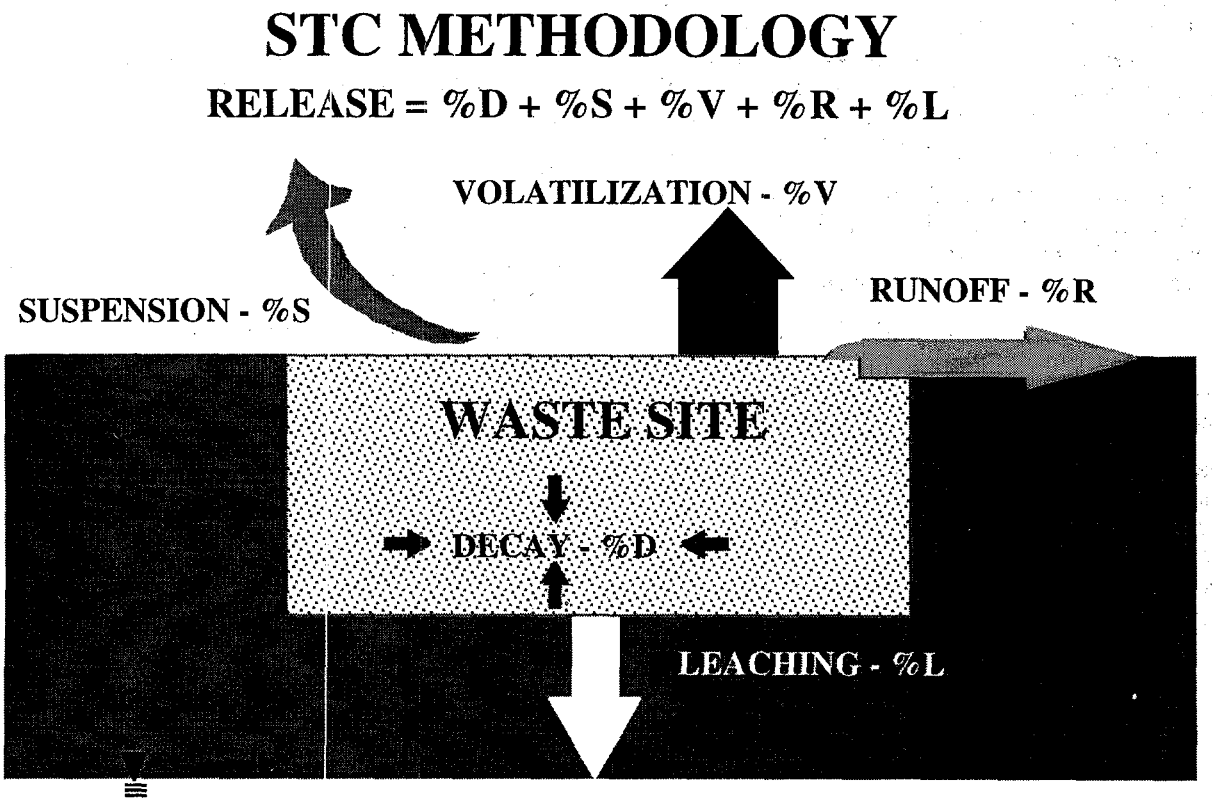

Figure 3-1. Conceptual diagram of the source term release module

Because a numerical solution scheme is used to solve the differential equations of contaminant mass loss as a function of time, certain environmental input parameters can be entered as time varying quantities rather than being constrained to constants.

The major outputs from the source-term release component models are sets of contaminant flux as a function of time (at time intervals equal to the numerical time step) for each contaminant for each selected loss route. These outputs are linked as input to other components as part of the integrated MEPAS exposure and impact evaluation software.

4 References

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Whelan, G., and J. P. McDonald, "The Multimedia Environmental Pollutant Assessment System (MEPAS): Riverine Pathway Formulations," *PNNL-11176,* Pacific Northwest National Laboratory, Richland, WA, 1996.

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Appendix A: Worksheet for Example CASE1A

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: JP McDonald

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
Slag Piles Ref: 0

Release site name -- FS-RELEASS:
Pile 1 Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
Pile 1 - Modified Ref: 0

Original source FS-SOURCE:
Operating Facility Ref: 0

Original source contamination mechanism FS-ORIMEC:
Discharge

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Infil.

Worksheet for Example CASE1A

Constituent Selected: Page 1 of 1

```
Constituent CASID          Constituent Name
                              FS-CNAME
U238        URANIUM-238          Ref: 0
```

Source and Exposure Summary: Page 1 of 1

```
Location name -- FS-LOCNAM:                  Type:Groundwater
Groundwater Well       Ref: 0
Exposure routes -- FS-LOCRT:
Drnk-Ing  LVeg-Ing  OVeg-Ing  Meat-Ing  Milk-Ing



Receptor location designation -- FS-ONSITE:
            Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN                   Ref: 0

Receptor latitude -- FS-RLAT:
                       Ref: 0
Receptor longitude -- FS-RLONG:
                       Ref: 0
```

Overall Control Parameters: Page 1 of 1

```
Starting date of the release unit -- WS-DATE: 04/29/1997   Ref: 0

Starting date for risk -- WS-TRISK:           04/29/1997  Ref: 0
```

```
Mass Partition - Control Parameters: Page 1 of 1

Mass partition the total inventories -- MB-MASSBAL: [Y/N] Y    Ref: 0

   Y = Compute using mass partitioning routines.
   N = Compute without mass partitioning routines.


Leaching                ST-INF_OP:    [3] 1  Ref: 0
   0 = Turn off pathway
   1 = Input known infiltration rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Overland runoff         ST-OVL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Suspension              ST-SUS_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Volatilization          ST-VOL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(s)
   3 = Compute pathway


Source/Sink             ST-SRC_OP:    [0] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(es)


Time interval for first 100 years ST-DELTA_T: [1.0]
                                            1.0    years  Ref: 0

Length of run ST-MAXTIME: [7000.0]        10000    years  Ref: 0

Minium waste fraction  ST-MINWST:  [0.0]  0.0    Ref: 0
```

Waterborne Control Parameters: Page 1 of 1

```
Source-term type -- CW-STYPE: 1      Ref: 0
      1 = Leaching to the partially saturated zone.
      2 = Leaching to the saturated zone.
      3 = a) Discharge to surface water from overland runoff.
             The surface soil contamination must be known.
          b) Direct discharge to a surface water body.


Select the discrete medium types as encountered,
moving from source to receptor -- CW-MEDIA: 13          Ref: 0

   1 = Partially saturated zone. This is the unsaturated or vadose
       zone where some air is present in the pore space.
   3 = Saturated zone to a well. This is the aquifer.
   4 = Saturated zone to a surface water body. This is the discharge zone
       for the aquifer where groundwater flows into a surface water body.
   5 = River. This refers to a river, not to other surface water body
       types such as holding ponds or wetlands.
   7 = Wetland. This refers to a wetland, bog, swamp, etc.
```

Exposure Control Parameters: Page 1 of 1

```
Toxicity data for chemical effects -- CE-TOXC: 0    Ref: 0

   0 = Include toxicity values from all sources
   1 = Include toxicity values from only IRIS*
   2 = Include toxicity values from IRIS and HEAST*

   Note: The MEPAS database contains only one set of toxicity
         values for each constituent.  This option disallows
         use of toxicity values based on their pedigree.

   * Warning -- Zero risk values will occur for contaminants for
                which toxicity values are excluded by this option.


Risk methodology for ionizing radiation -- CE-TOXR: 0    Ref: 0

   0 = Use ICRP dose factors for all radionuclides
   1 = Use EPA HEAST slope factors if available,
       otherwise use ICRP dose factors


REPORTING
   Maximum time for reporting -- CE-TMAX: [1,000]    1000    Ref: 0

   Number of time points for evaluation of results
                                 -- CE-NTIMES:    1000  Ref: 0
```

Mass Partition - Waste Zone: Page 1 of 1

Input the texture that most closely matches the soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Waste zone soil textural classification -- ST-ZCLASS: Sand

% Sand of soil -- ST-ZSAND: [92] 92 % Ref: 0

% Silt of soil -- ST-ZSILT: [5] 5 % Ref: 0

% Clay of soil -- ST-ZCLAY: [3] 3 % Ref: 0

% Organic matter content of soil -- ST-ZOMC: 1 % Ref: 0

% Iron and aluminum in the soil -- ST-ZIRON: 3 % Ref: 0

pH of top soil -- ST-ZPH: 6.4 Ref: 0

Annual mean temperature -- ST-AVTEMP: 11.1 C Ref: 0

Depth to top of waste zone ST-CLEAN: 0 cm Ref: 0

Thickness of waste zone ST-THICK: 506 cm Ref: 0

Length of waste zone -- ST-LENGTH: 18000 cm Ref: 0

Width of waste zone -- ST-WIDTH: 18500 cm Ref: 0

Dry bulk density -- ST-ZBULKD: 2.65 g/cm^3 Ref: 0

Moisture content -- ST-MOISTC: 0.032 fr Ref: 0

Total porosity -- ST-TOTPOR: 0.397 fr Ref: 0

Volumetric air content -- ST-AIRSPC: 0.365 fr Ref: 0

Mass Partition - Contaminant Inventory: Page 1 of 1

Constituent FS-CNAME	ST-INVEN Inventory		
URANIUM-238	1.48	Ci	Ref: 0

Mass Partition - Volatilization ratio: Page 1 of 1

Constituent FS-CNAME		ST-VOLRAT		
URANIUM-238	[1.0]	1.0	fr	Ref: 0

Mass Partition - Erosion/Flow Rates: Page 1 of 1

Number of infiltration rates -- ST-DARCY_NUM: 1

Mass Partition - Aqueous solubility: Page 1 of 1

Constituent FS-CNAME		ST-SOL		
URANIUM-238	[0.00]	1e20	mg/l	Ref: 0
THORIUM-234	[0.00]	1e20	mg/l	Ref: 0
URANIUM-234	[0.00]	1e20	mg/l	Ref: 0
THORIUM-230	[0.00]	1e20	mg/l	Ref: 0
RADIUM-226	[0.00]	1e20	mg/l	Ref: 0
RADON-222	[0.00]	1e20	mg/l	Ref: 0
LEAD-210	[0.00]	1e20	mg/l	Ref: 0
BISMUTH-210	[0.00]	1e20	mg/l	Ref: 0
POLONIUM-210	[0.00]	1e20	mg/l	Ref: 0

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME	ST-KD_NUM
URANIUM-238	1
THORIUM-234	1
URANIUM-234	1
THORIUM-230	1
RADIUM-226	1
RADON-222	1
LEAD-210	1
BISMUTH-210	1
POLONIUM-210	1

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-238

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	238.12	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-234

[computed]	ST-KD		Ending Time ST-KD_TIM	
[100.]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-234

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	238.12	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-230

[computed]	ST-KD		Ending Time ST-KD_TIM	
[100.]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADIUM-226

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[24.3]	1.80	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADON-222

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[0.00]	0.1	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: LEAD-210

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[234.]	10.45	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: BISMUTH-210

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[0.00]	9.80	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: POLONIUM-210

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[5.90]	5.95	ml/g	10000	years

Source-Term Data: Page 1 of 1

FS-CNAME	WS_TLIFE	WS-CDATE
URANIUM-238	9999	04/29/97

Partially Saturated Zone (PSZ): Page 1 of 1

Layer 1 of 2 Media Types CW-MEDIA: 13

Input the soil texture that most closely matches the PSZ: 9 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Soil classification in the PSZ -- WP-CLASS: Silty Clay Loam

% Sand in the PSZ -- WP-SAND: [10] 10 % Ref: 0

% Silt in the PSZ -- WP-SILT: [57] 57 % Ref: 0

% Clay in the PSZ -- WP-CLAY: [33] 33 % Ref: 0

% Organic matter content in the PSZ -- WP-OMC: 0 % Ref: 0

% Iron and aluminum in the PSZ -- WP-IRON: 0 % Ref: 0

pH of the pore water in the PSZ -- WP-PH: 7 Ref: 0

Thickness of PSZ -- WP-THICK: 7 ft Ref: 0

Bulk density of PSZ -- WP-BULKD: 1.7 g/cm^3 Ref: 0

Total porosity of PSZ -- WP-TOTPOR: 46 % Ref: 0

Field capacity of PSZ -- WP-FIELDC: 40 % Ref: 0

Longitudinal dispersivity of PSZ -- WP-LDISP: 0.07 ft Ref: 0

Saturated hydraulic conductivity -- WP-CONDUC: 1.95E-05 cm/s Ref: 0

Worksheet for Example CASE1A

Saturated Zone (SZ): Page 1 of 1

Media Types CW-MEDIA: 13

Input the soil texture that most closely matches the SZ: 3 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Soil class in the saturated zone -- WZ-CLASS: Sandy Loam

% Sand in the saturated zone -- WZ-SAND: [65] 65 % Ref: 0

% Silt in the saturated zone -- WZ-SILT: [25] 25 % Ref: 0

% Clay in the saturated zone -- WZ-CLAY: [10] 10 % Ref: 0

% Organic matter content in the saturated zone -- WZ-OMC:
0 % Ref: 0

% Iron and aluminum in the saturated zone -- WZ-IRON: 0 % Ref: 0

pH of the pore water in the saturated zone -- WZ-PH: 7 Ref: 0

Total porosity of saturated zone -- WZ-TOTPOR: 46 % Ref: 0

Effective porosity of saturated zone -- WZ-EFFPOR: 20 % Ref: 0

Darcy velocity of saturated zone -- WZ-PVELOC:
1.68E-02 ft/da Ref: 0

Thickness of saturated zone -- WZ-THICK: 40 ft Ref: 0

Bulk density of saturated zone -- WZ-BULKD: 1.43 g/cm^3 Ref: 0

	Travel	------------ Dispersivity (ft) --------		
Usage Location	Distance	Longitudinal	Transverse	Vertical
FS-LOCNAM	WZ-DIST(ft)	WZ-LDISP	WZ-TDISP	WZ-VDISP

Groundwater Well 473 ft 47.3 ft 15.6 ft 0.118 ft Ref: 0

Pct. of contaminant flux to saturated zone -- WZ-FRACT: 100 % Ref: 0

Usage Location FS-LOCNAM	Perpendicular Distance To Plume Center Line WZ-YDIST			Vertical Distance Below Groundwater Table WZ-AQDEPTH		
Groundwater Well	0	ft	Ref: 0	0	ft	Ref: 0

Adsorption Coefficients (kd) - SZ: Page 1 of 1

Constituent FS-CNAME		WA-SUBKD Subsurface KD		
URANIUM-238	[0.00]	0.0	ml/g	Ref: 0

Adsorption Coefficients (kd) - SZ: Page 1 of 1

Constituent FS-CNAME		WA-SUBKD Subsurface KD		
URANIUM-238	[0.00]	0.0	ml/g	Ref: 0

Adsorption Coefficients (kd) - PSZ: Page 1 of 1

Constituent FS-CNAME		WA-SUBKD Subsurface KD		
URANIUM-238	[500.]	34.43	ml/g	Ref: 0

Adsorption Coefficients (kd) - SZ: Page 1 of 1

Constituent FS-CNAME		WA-SUBKD Subsurface KD		
URANIUM-238	[0.00]	0.0	ml/g	Ref: 0

Worksheet for Example CASE1A

Agricultural Soil Leaching: Page 1 of 1

Soil texture that most closely matches surface soil: 9 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Top soil textural classification -- EL-CLASS: Silty Clay Loam

% Sand of surface soil -- EL-SAND: [10] 10 % Ref: 0

% Silt of surface soil -- EL-SILT: [57] 57 % Ref: 0

% Clay of surface soil -- EL-CLAY: [33] 33 % Ref: 0

% Organic matter content of surface soil -- EL-OMC: 1 % Ref: 0

% Iron and aluminum in the surface soil -- EL-IRON: 3 % Ref: 0

pH of surface soil -- EL-PH: 6.4 Ref: 0

Infiltration rate (incl. irrigation) -- EL-LEACHV: 22 cm/yr Ref: 0

Thickness of surface soil -- EL-THICK: 15 cm Ref: 0

Moisture content of surface soil -- EL-MOISTC: 3.2 % Ref: 0

Bulk density of surface soil -- EL-BULKD: 1.35 g/cm^3 Ref: 0

Agricultural Soil Leaching - Absorption Coeff.: Page 1 of 1

Constituent FS-CNAME		EL-SOILKD		
URANIUM-238	[500.]	34.43	ml/g	Ref: 0
THORIUM-234	[2.70E+03]	61.78	ml/g	Ref: 0
URANIUM-234	[500.]	34.43	ml/g	Ref: 0
THORIUM-230	[2.70E+03]	61.78	ml/g	Ref: 0
RADIUM-226	[124.]	31.90	ml/g	Ref: 0
RADON-222	[0.00]	0.1	ml/g	Ref: 0
LEAD-210	[1.83E+03]	204.39	ml/g	Ref: 0
BISMUTH-210	[0.00]	7.34	ml/g	Ref: 0
POLONIUM-210	[14.9]	49.44	ml/g	Ref: 0

Appendix B: Worksheet for Example CASE1B

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: JP McDonald

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
Slag Piles Ref: 0

Release site name -- FS-RELEASS:
Pile 1 Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
Pile 1 - Modified Ref: 0

Original source FS-SOURCE:
Above Ground Liquid Storage Ref: 0

Original source contamination mechanism FS-ORIMEC:
Discharge

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Infil.

Constituent Selected: Page 1 of 1

Constituent CASID	Constituent Name FS-CNAME	
U235	URANIUM-235	Ref: 0

Source and Exposure Summary: Page 1 of 1

Location name -- FS-LOCNAM: Type:Groundwater
Groundwater Well Ref: 0
Exposure routes -- FS-LOCRT:
Drnk-Ing LVeg-Ing OVeg-Ing Meat-Ing Milk-Ing

Receptor location designation -- FS-ONSITE:
Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN Ref: 0

Receptor latitude -- FS-RLAT:
Ref: 0
Receptor longitude -- FS-RLONG:
Ref: 0

Overall Control Parameters: Page 1 of 1

Starting date of the release unit -- WS-DATE: 04/29/1997 Ref: 0

Starting date for risk -- WS-TRISK: 04/29/1997 Ref: 0

Mass Partition - Control Parameters: Page 1 of 1

```
Mass partition the total inventories -- MB-MASSBAL: [Y/N] Y    Ref: 0

   Y = Compute using mass partitioning routines.
   N = Compute without mass partitioning routines.


Leaching                ST-INF_OP:    [3] 1  Ref: 0
   0 = Turn off pathway
   1 = Input known infiltration rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Overland runoff         ST-OVL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Suspension              ST-SUS_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Volatilization          ST-VOL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(s)
   3 = Compute pathway


Source/Sink             ST-SRC_OP:    [0] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(es)


Time interval for first 100 years ST-DELTA_T: [1.0]
                                            1.0   years  Ref: 0

Length of run ST-MAXTIME: [7000.0]       10000    years  Ref: 0

Minium waste fraction  ST-MINWST:  [0.0]  0.0    Ref: 0
```

Waterborne Control Parameters: Page 1 of 1

```
Source-term type -- CW-STYPE: 1      Ref: 0
      1 = Leaching to the partially saturated zone.
      2 = Leaching to the saturated zone.
      3 = a) Discharge to surface water from overland runoff.
             The surface soil contamination must be known.
          b) Direct discharge to a surface water body.


Select the discrete medium types as encountered,
moving from source to receptor -- CW-MEDIA: 13         Ref: 0

   1 = Partially saturated zone. This is the unsaturated or vadose
       zone where some air is present in the pore space.
   3 = Saturated zone to a well. This is the aquifer.
   4 = Saturated zone to a surface water body. This is the discharge zone
       for the aquifer where groundwater flows into a surface water body.
   5 = River. This refers to a river, not to other surface water body
       types such as holding ponds or wetlands.
   7 = Wetland. This refers to a wetland, bog, swamp, etc.
```

Exposure Control Parameters: Page 1 of 1

```
Toxicity data for chemical effects -- CE-TOXC: 0    Ref: 0

   0 = Include toxicity values from all sources
   1 = Include toxicity values from only IRIS*
   2 = Include toxicity values from IRIS and HEAST*

   Note: The MEPAS database contains only one set of toxicity
         values for each constituent.  This option disallows
         use of toxicity values based on their pedigree.

   * Warning -- Zero risk values will occur for contaminants for
                which toxicity values are excluded by this option.


Risk methodology for ionizing radiation -- CE-TOXR: 0    Ref: 0

   0 = Use ICRP dose factors for all radionuclides
   1 = Use EPA HEAST slope factors if available,
       otherwise use ICRP dose factors


REPORTING
   Maximum time for reporting -- CE-TMAX: [1,000]    3000    Ref: 0

   Number of time points for evaluation of results
                                     -- CE-NTIMES:        Ref: 0
```

Mass Partition - Waste Zone: Page 1 of 1

Input the texture that most closely matches the soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Waste zone soil textural classification -- ST-ZCLASS: Sand

% Sand of soil -- ST-ZSAND: [92] 89 % Ref: 0

% Silt of soil -- ST-ZSILT: [5] 4 % Ref: 0

% Clay of soil -- ST-ZCLAY: [3] 3 % Ref: 0

% Organic matter content of soil -- ST-ZOMC: 1 % Ref: 0

% Iron and aluminum in the soil -- ST-ZIRON: 3 % Ref: 0

pH of top soil -- ST-ZPH: 6.4 Ref: 0

Annual mean temperature -- ST-AVTEMP: 11.1 C Ref: 0

Depth to top of waste zone ST-CLEAN: 0 cm Ref: 0

Thickness of waste zone ST-THICK: 506 cm Ref: 0

Length of waste zone -- ST-LENGTH: 18000 cm Ref: 0

Width of waste zone -- ST-WIDTH: 18500 cm Ref: 0

Dry bulk density -- ST-ZBULKD: 2.65 g/cm^3 Ref: 0

Moisture content -- ST-MOISTC: 0.032 fr Ref: 0

Total porosity -- ST-TOTPOR: 0.397 fr Ref: 0

Volumetric air content -- ST-AIRSPC: 0.365 fr Ref: 0

Mass Partition - Contaminant Inventory: Page 1 of 1

Constituent FS-CNAME	ST-INVEN Inventory		
URANIUM-235	0.36	Ci	Ref: 0

Mass Partition - Volatilization ratio: Page 1 of 1

Constituent FS-CNAME		ST-VOLRAT		
URANIUM-235	[1.0]	1.0	fr	Ref: 0

Mass Partition - Erosion/Flow Rates: Page 1 of 1

Number of infiltration rates -- ST-DARCY_NUM: 1

Mass Partition - Aqueous solubility: Page 1 of 1

Constituent FS-CNAME		ST-SOL		
URANIUM-235	[0.00]	1e20	mg/l	Ref: 0
THORIUM-231	[0.00]	1e20	mg/l	Ref: 0
PROTACTINIUM-231	[0.00]	1e20	mg/l	Ref: 0
ACTINIUM-227	[0.00]	1e20	mg/l	Ref: 0
THORIUM-227	[0.00]	1e20	mg/l	Ref: 0
RADIUM-223	[0.00]	1e20	mg/l	Ref: 0

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME	ST-KD_NUM
URANIUM-235	1
THORIUM-231	1
PROTACTINIUM-231	1
ACTINIUM-227	1
THORIUM-227	1
RADIUM-223	1

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-235

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	238.12	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-231

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: PROTACTINIUM-231

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	45.53	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: ACTINIUM-227

[computed]	ST-KD		Ending Time ST-KD_TIM	
[228.]	41.91	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-227

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	667.55	ml/g	10000	years

Worksheet for Example CASE1B

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADIUM-223

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[24.3]	1.80	ml/g	10000	years

Source-Term Data: Page 1 of 1

FS-CNAME	WS_TLIFE	WS-CDATE
URANIUM-235	9999	04/29/97

Partially Saturated Zone (PSZ): Page 1 of 1

Layer 1 of 2 Media Types CW-MEDIA: 13

Input the soil texture that most closely matches the PSZ: 9 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Soil classification in the PSZ -- WP-CLASS: Silty Clay Loam

% Sand in the PSZ -- WP-SAND: [10] 10 % Ref: 0

% Silt in the PSZ -- WP-SILT: [57] 57 % Ref: 0

% Clay in the PSZ -- WP-CLAY: [33] 33 % Ref: 0

% Organic matter content in the PSZ -- WP-OMC: 0 % Ref: 0

% Iron and aluminum in the PSZ -- WP-IRON: 0 % Ref: 0

pH of the pore water in the PSZ -- WP-PH: 7 Ref: 0

Thickness of PSZ -- WP-THICK: 7 ft Ref: 0

Bulk density of PSZ -- WP-BULKD: 1.7 g/cm^3 Ref: 0

Total porosity of PSZ -- WP-TOTPOR: 46 % Ref: 0

Field capacity of PSZ -- WP-FIELDC: 40 % Ref: 0

Longitudinal dispersivity of PSZ -- WP-LDISP: 0.07 ft Ref: 0

Saturated hydraulic conductivity -- WP-CONDUC: 1.95E-05 cm/s Ref: 0

Worksheet for Example CASE1B

Saturated Zone (SZ): Page 1 of 1

Media Types CW-MEDIA: 13

Input the soil texture that most closely matches the SZ: 3 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Soil class in the saturated zone -- WZ-CLASS: Sandy Loam

% Sand in the saturated zone -- WZ-SAND: [65] 65 % Ref: 0

% Silt in the saturated zone -- WZ-SILT: [25] 25 % Ref: 0

% Clay in the saturated zone -- WZ-CLAY: [10] 10 % Ref: 0

% Organic matter content in the saturated zone -- WZ-OMC:
0 % Ref: 0

% Iron and aluminum in the saturated zone -- WZ-IRON: 0 % Ref: 0

pH of the pore water in the saturated zone -- WZ-PH: 7 Ref: 0

Total porosity of saturated zone -- WZ-TOTPOR: 46 % Ref: 0

Effective porosity of saturated zone -- WZ-EFFPOR: 20 % Ref: 0

Darcy velocity of saturated zone -- WZ-PVELOC:
1.68E-02 ft/da Ref: 0

Thickness of saturated zone -- WZ-THICK: 40 ft Ref: 0

Bulk density of saturated zone -- WZ-BULKD: 1.43 g/cm^3 Ref: 0

	Travel	------------	Dispersivity (ft)	--------
Usage Location	Distance	Longitudinal	Transverse	Vertical
FS-LOCNAM	WZ-DIST(ft)	WZ-LDISP	WZ-TDISP	WZ-VDISP

```
Groundwater Well 473     ft  47.3     ft     15.6     ft      0.118    ft  Ref: 0


Pct. of contaminant flux to saturated zone -- WZ-FRACT: 100       %  Ref: 0


Usage Location          Perpendicular Distance    Vertical Distance Below
                         To Plume Center Line      Groundwater Table
FS-LOCNAM                    WZ-YDIST                    WZ-AQDEPTH


Groundwater Well         0         ft  Ref: 0      0          ft  Ref: 0
```

Adsorption Coefficients (kd) - PSZ: Page 1 of 1

```
   Constituent                         WA-SUBKD
   FS-CNAME                          Subsurface KD
   URANIUM-235     [      500.]  34.43       ml/g  Ref: 0
```

Adsorption Coefficients (kd) - SZ: Page 1 of 1

```
   Constituent                         WA-SUBKD
   FS-CNAME                          Subsurface KD
   URANIUM-235     [      0.00]  0.0         ml/g  Ref: 0
```

Worksheet for Example CASE1B

Agricultural Soil Leaching: Page 1 of 1

Soil texture that most closely matches surface soil: 9 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Top soil textural classification -- EL-CLASS: Silty Clay Loam

% Sand of surface soil -- EL-SAND: [10] 10 % Ref: 0

% Silt of surface soil -- EL-SILT: [57] 57 % Ref: 0

% Clay of surface soil -- EL-CLAY: [33] 33 % Ref: 0

% Organic matter content of surface soil -- EL-OMC: 1 % Ref: 0

% Iron and aluminum in the surface soil -- EL-IRON: 3 % Ref: 0

pH of surface soil -- EL-PH: 6.4 Ref: 0

Infiltration rate (incl. irrigation) -- EL-LEACHV: 22 cm/yr Ref: 0

Thickness of surface soil -- EL-THICK: 15 cm Ref: 0

Moisture content of surface soil -- EL-MOISTC: 3.2 % Ref: 0

Bulk density of surface soil -- EL-BULKD: 1.35 g/cm^3 Ref: 0

Agricultural Soil Leaching - Absorption Coeff.: Page 1 of 1

Constituent FS-CNAME		EL-SOILKD		
URANIUM-235	[500.]	34.43	ml/g	Ref: 0
THORIUM-231	[0.00]	61.78	ml/g	Ref: 0
PROTACTINIUM-231	[500.]	4.50	ml/g	Ref: 0
ACTINIUM-227	[4.60E+03]	56.16	ml/g	Ref: 0
THORIUM-227	[0.00]	61.78	ml/g	Ref: 0
RADIUM-223	[124.]	31.90	ml/g	Ref: 0

Appendix C: Worksheet for Example CASE2A

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme   Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: MEPAS Team

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
Slag Piles   Ref: 0

Release site name -- FS-RELEASS:
Pile 1   Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
Southern Half   Ref: 0

Original source FS-SOURCE:
Operating Facility   Ref: 0

Original source contamination mechanism FS-ORIMEC:
Discharge

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Overland

Worksheet for Example CASE2A

Constituent Selected: Page 1 of 1

```
Constituent CASID          Constituent Name
                               FS-CNAME
U238                       URANIUM-238             Ref: 0
```

Source and Exposure Summary: Page 1 of 1

```
Location name -- FS-LOCNAM:                  Type:Surface Water
Minor Run upstream receptor  Ref: 0
Exposure routes -- FS-LOCRT:
Meat-Ing  Milk-Ing  Ffish-Ing Sfish-Ing



Receptor location designation -- FS-ONSITE:
            Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN                    Ref: 0

Receptor latitude -- FS-RLAT:
                        Ref: 0
Receptor longitude -- FS-RLONG:
                        Ref: 0
```

Overall Control Parameters: Page 1 of 1

```
Starting date of the release unit -- WS-DATE: 04/29/1997   Ref: 0

Starting date for risk -- WS-TRISK:           04/29/1997  Ref: 0
```

Mass Partition - Control Parameters: Page 1 of 1

```
Mass partition the total inventories -- MB-MASSBAL: [Y/N] Y    Ref: 0

   Y = Compute using mass partitioning routines.
   N = Compute without mass partitioning routines.


Leaching                ST-INF_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known infiltration rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Overland runoff         ST-OVL_OP:    [3] 3  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Suspension              ST-SUS_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Volatilization          ST-VOL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(s)
   3 = Compute pathway


Source/Sink             ST-SRC_OP:    [0] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(es)


Time interval for first 100 years ST-DELTA_T: [1.0]
                                          1.0   years  Ref: 0

Length of run ST-MAXTIME: [7000.0]      10000   years  Ref: 0

Minium waste fraction  ST-MINWST:  [0.0]  0.0   Ref: 0
```

Waterborne Control Parameters: Page 1 of 1

Source-term type -- CW-STYPE: 3   Ref: 0

1 = Leaching to the partially saturated zone.
2 = Leaching to the saturated zone.
3 = a) Discharge to surface water from overland runoff. The surface soil contamination must be known.
b) Direct discharge to a surface water body.

Select the discrete medium types as encountered, moving from source to receptor -- CW-MEDIA: 75   Ref: 0

1 = Partially saturated zone. This is the unsaturated or vadose zone where some air is present in the pore space.
3 = Saturated zone to a well. This is the aquifer.
4 = Saturated zone to a surface water body. This is the discharge zone for the aquifer where groundwater flows into a surface water body.
5 = River. This refers to a river, not to other surface water body types such as holding ponds or wetlands.
7 = Wetland. This refers to a wetland, bog, swamp, etc.

Exposure Control Parameters: Page 1 of 1

Toxicity data for chemical effects -- CE-TOXC: 0   Ref: 0

0 = Include toxicity values from all sources
1 = Include toxicity values from only IRIS*
2 = Include toxicity values from IRIS and HEAST*

Note: The MEPAS database contains only one set of toxicity values for each constituent. This option disallows use of toxicity values based on their pedigree.

* Warning -- Zero risk values will occur for contaminants for which toxicity values are excluded by this option.

Risk methodology for ionizing radiation -- CE-TOXR: 0   Ref: 0

0 = Use ICRP dose factors for all radionuclides
1 = Use EPA HEAST slope factors if available, otherwise use ICRP dose factors

REPORTING

Maximum time for reporting -- CE-TMAX: [1,000]   10000   Ref: 0

Number of time points for evaluation of results -- CE-NTIMES: Ref: 0

Mass Partition - Waste Zone: Page 1 of 1

Input the texture that most closely matches the soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Waste zone soil textural classification -- ST-ZCLASS: Sand

% Sand of soil -- ST-ZSAND: [92] 89 % Ref: 0

% Silt of soil -- ST-ZSILT: [5] 4 % Ref: 0

% Clay of soil -- ST-ZCLAY: [3] 3 % Ref: 0

% Organic matter content of soil -- ST-ZOMC: 1 % Ref: 0

% Iron and aluminum in the soil -- ST-ZIRON: 3 % Ref: 0

pH of top soil -- ST-ZPH: 6.4 Ref: 0

Release site elevation -- ST-ELEV: 264 m Ref: 0

Annual mean temperature -- ST-AVTEMP: 11.1 C Ref: 0

Depth to top of waste zone ST-CLEAN: 0.0 cm Ref: 0

Thickness of waste zone ST-THICK: 506 cm Ref: 0

Length of waste zone -- ST-LENGTH: 18000 cm Ref: 0

Width of waste zone -- ST-WIDTH: 9250 cm Ref: 0

Dry bulk density -- ST-ZBULKD: 2.65 g/cm^3 Ref: 0

Moisture content -- ST-MOISTC: 0.032 fr Ref: 0

Total porosity -- ST-TOTPOR: 0.397 fr Ref: 0

Volumetric air content -- ST-AIRSPC: 0.365 fr Ref: 0

Worksheet for Example CASE2A

Mass Partition - Contaminant Inventory: Page 1 of 1

Constituent FS-CNAME	ST-INVEN Inventory		
URANIUM-238	0.80	Ci	Ref: 0

Mass Partition - Volatilization ratio: Page 1 of 1

Constituent FS-CNAME		ST-VOLRAT		
URANIUM-238	[1.0]	1.0	fr	Ref: 0

Mass Partition - Release Site Water Erosion: Page 1 of 1

Dry bulk density of surface soil -- ST-SBULKD: 2.65 g/cm^3 Ref: 0

Depth of 2-yr, 6-hr precipitation event-- ST-PRECIP: 5.08 cm Ref: 0

Length of site down erodible slope -- ST-SLENGTH: 18000 cm Ref: 0

Release unit overland slope -- ST-SLOPE: 4 % Ref: 0

Soil-erodibility factor -- ST-KFACTR: 0.03 Ref: 0

Index on the storm type -- ST-STORMI: 2 Ref: 0

1 = Storm type I - Maritime climate associated with southern and central California.

2 = Storm type II - Associated with
- a) eastern portions of California.
- b) all of ID, MT, NV, UT, WY, AZ, NM.
- c) the remaining portions of the United States not covered by storm types I and IA.

3 = Storm type IA - Associated with coastal areas of northern CA, OR, WA, and the western slopes of the Sierra Nevada.

Vegetative-cover factor -- ST-CFACTR: 0.50 Ref: 0

Bare-soil surface (0 to 20% vegetation)	
Hard surfaces (e.g. dirt road)	1.20
Soft sandy surfaces (e.g. beach-like)	0.85
Other surfaces	0.50
Vegetated surface (20 to 100% vegetation)	
Heavily forested	0.04
Well vegetated (60 to 100% vegetation)	0.14
Moderately vegetated (20 to 60% vegetation)	0.29

Land management practice factor -- ST-PFACTR: 1.0 Ref: 0

Surface condition with no cover (<20% vegetation)
1.3 = Compact, smooth, scraped, or raked with heavy equipment.
.9 = Rough irregular surface, equipment tracks in all directions.
.8 = Loose with rough surface > 0.3m depth.
.9 = Loose with smooth surface > 0.3m depth.

Structures
.5 = Small sediment basins or erosion control surfaces

Other
1.0 = All other conditions or Unknown conditions

Mass Partition - Hydrology & Climatology: Page 1 of 1

Elevation of weather station -- ST-LCDELEV: 264 m Ref: 0

Latitude of weather station -- ST-LAT: 39.9 deg Ref: 0

Annual mean temperature -- ST-AVTEMP: 11.1 C Ref: 0

Height of wind measurement -- ST-WINDHT: 9.75 m Ref: 0

SCS curve number -- ST-SCSCN: 68 Ref: 0

Water holding capacity of waste zone - ST-AVAILW: 0.75 cm Ref: 0

Mean annual wind speed -- ST-AVWINDV: 5 m/s Ref: 0

Number of precipitation days per year -- ST-NUMPRCP: 50 #/yr Ref: 0

Month	#	ST-TEMP	ST-MPRECIP	ST-WINDV	ST-CLOUD	ST-MNUMPRE	
Jan	1	-2.29 C	7.14 cm	3.81 m/s	0.794 fr	13.44 days	Ref: 0
Feb	2	-0.68 C	5.79 cm	3.64 m/s	0.742 fr	11.35 days	Ref: 0
Mar	3	4.66 C	7.92 cm	3.76 m/s	0.734 fr	13.73 days	Ref: 0
Apr	4	10.79 C	8.59 cm	3.56 m/s	0.687 fr	13.15 days	Ref: 0
May	5	16.43 C	9.68 cm	3.04 m/s	0.651 fr	12.33 days	Ref: 0
Jun	6	21.33 C	9.98 cm	2.68 m/s	0.620 fr	10.73 days	Ref: 0
Jul	7	23.52 C	11.66 cm	2.46 m/s	0.626 fr	10.85 days	Ref: 0
Aug	8	22.52 C	8.28 cm	2.31 m/s	0.634 fr	9.43 days	Ref: 0
Sep	9	18.71 C	6.88 cm	2.52 m/s	0.630 fr	8.49 days	Ref: 0
Oct	10	12.31 C	5.23 cm	2.76 m/s	0.660 fr	8.98 days	Ref: 0
Nov	11	5.98 C	7.77 cm	3.57 m/s	0.794 fr	11.62 days	Ref: 0
Dec	12	0.19 C	6.93 cm	3.55 m/s	0.825 fr	12.96 days	Ref: 0

Worksheet for Example CASE2A

Month	#	ST-RHMAX		ST-RHMIN		
Jan	1	88.35	%	60.14	%	Ref: 0
Feb	2	87.78	%	55.85	%	Ref: 0
Mar	3	86.87	%	48.58	%	Ref: 0
Apr	4	87.57	%	44.23	%	Ref: 0
May	5	90.16	%	45.73	%	Ref: 0
Jun	6	91.30	%	46.35	%	Ref: 0
Jul	7	92.58	%	47.98	%	Ref: 0
Aug	8	93.23	%	46.94	%	Ref: 0
Sep	9	92.40	%	46.11	%	Ref: 0
Oct	10	90.95	%	46.58	%	Ref: 0
Nov	11	88.87	%	52.90	%	Ref: 0
Dec	12	89.02	%	60.26	%	Ref: 0

Mass Partition - Aqueous solubility: Page 1 of 1

Constituent FS-CNAME		ST-SOL		
URANIUM-238	[0.00]	1E+20	mg/l	Ref: 0
THORIUM-234	[0.00]	1E+20	mg/l	Ref: 0
URANIUM-234	[0.00]	1E+20	mg/l	Ref: 0
THORIUM-230	[0.00]	1E+20	mg/l	Ref: 0
RADIUM-226	[0.00]	1E+20	mg/l	Ref: 0
RADON-222	[0.00]	1E+20	mg/l	Ref: 0
LEAD-210	[0.00]	1E+20	mg/l	Ref: 0
BISMUTH-210	[0.00]	1E+20	mg/l	Ref: 0
POLONIUM-210	[0.00]	1E+20	mg/l	Ref: 0

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME	ST-KD_NUM
URANIUM-238	1
THORIUM-234	1
URANIUM-234	1
THORIUM-230	1
RADIUM-226	1
RADON-222	1
LEAD-210	1
BISMUTH-210	1
POLONIUM-210	1

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-238

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	238.12	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-234

[computed]	ST-KD		Ending Time ST-KD_TIM	
[100.]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-234

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	238.12	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-230

[computed]	ST-KD		Ending Time ST-KD_TIM	
[100.]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADIUM-226

[computed]	ST-KD		Ending Time ST-KD_TIM	
[24.3]	1.80	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADON-222

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	0.1	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: LEAD-210

[computed]	ST-KD		Ending Time ST-KD_TIM	
[234.]	10.45	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: BISMUTH-210

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[0.00]	9.80	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: POLONIUM-210

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[5.90]	5.95	ml/g	10000	years

Source-Term Data: Page 1 of 1

FS-CNAME	WS_TLIFE	WS-CDATE
URANIUM-238	9999	04/29/97

Surface Water: Page 1 of 1

River flow velocity -- WW-VELOC: 0.2 ft/s Ref: 0

Usage Location	River Depth ft	River Width ft	Distance ft	Discharge ft^3/s	
FS-LOCNAM	WW-DEPTH	WW-WIDTH	WW-DIST	WW-DISCHG	
Minor Run upstrel ptor	10		600	2	Ref: 0

Wetlands: Page 1 of 1

Length of wetland -- WELENGTH: 100 ft Ref: 0

Width of wetland -- WEWIDTH 300 ft Ref: 0

Water-column volume -- WE-WATVOL: 1.356 acre*ft Ref: 0

Surface water discharge from wetlands -- WE-SWDIS: 2 ft^3/s Ref: 0

Groundwater discharge from wetlands -- WE-GWDIS: 0 ft^3/da Ref: 0

Sediment mass in wetlands -- WE-SEDMAS: 5.73E+05 kg Ref: 0

Biomass in wetlands -- WE-BIOMAS: 5600 kg Ref: 0

Sediment dry bulk density -- WEBULKD: 1.35 g/cm^3 Ref: 0

Volatilization -- WEVTYPE: 1 Ref: 0
1 = Sediment controlled
2 = Water phase controlled

Depth of contaminated sediment -- WEDEPTHS: 0.5 ft Ref: 0

Benthic organisms present? -- WEBENTHC: (Y/N) N Ref: 0

Constituent FS-CNAME	Initial Water Column Conc. WE-CONC		Equilibrium Coefficient WE-KD		Bioconcentration Factor WE-BIOFAC		
URANIUM-238	0	Ci/l	1700	ml/g	0	ml/g	Ref: 0

Worksheet for Example CASE2A

Agricultural Soil Leaching: Page 1 of 1

Soil texture that most closely matches surface soil: 9 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Top soil textural classification -- EL-CLASS: Silty Clay Loam

% Sand of surface soil -- EL-SAND: [10] 10 % Ref: 0

% Silt of surface soil -- EL-SILT: [57] 57 % Ref: 0

% Clay of surface soil -- EL-CLAY: [33] 33 % Ref: 0

% Organic matter content of surface soil -- EL-OMC: 1 % Ref: 0

% Iron and aluminum in the surface soil -- EL-IRON: 3 % Ref: 0

pH of surface soil -- EL-PH: 6.4 Ref: 0

Infiltration rate (incl. irrigation) -- EL-LEACHV: 22 cm/yr Ref: 0

Thickness of surface soil -- EL-THICK: 15 cm Ref: 0

Moisture content of surface soil -- EL-MOISTC: 3.2 % Ref: 0

Bulk density of surface soil -- EL-BULKD: 1.35 g/cm^3 Ref: 0

Agricultural Soil Leaching - Absorption Coeff.: Page 1 of 1

Constituent FS-CNAME		EL-SOILKD		
URANIUM-238	[500.]	3443	ml/g	Ref: 0
THORIUM-234	[2.70E+03]	6178	ml/g	Ref: 0
URANIUM-234	[500.]	3443	ml/g	Ref: 0
THORIUM-230	[2.70E+03]	6178	ml/g	Ref: 0
RADIUM-226	[124.]	3190	ml/g	Ref: 0
RADON-222	[0.00]	0.1	ml/g	Ref: 0
LEAD-210	[1.83E+03]	20439	ml/g	Ref: 0
BISMUTH-210	[0.00]	734	ml/g	Ref: 0
POLONIUM-210	[14.9]	4944	ml/g	Ref: 0

Appendix D: Worksheet for Example CASE2B

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: MEPAS Team

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
Slag Piles Ref: 0

Release site name -- FS-RELEASS:
Pile 1 Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
Southern Half Ref: 0

Original source FS-SOURCE:
Operating Facility Ref: 0

Original source contamination mechanism FS-ORIMEC:
Discharge

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Overland

Worksheet for Example CASE2B

Constituent Selected: Page 1 of 1

Constituent CASID	Constituent Name FS-CNAME	
U235	URANIUM-235	Ref: 0

Source and Exposure Summary: Page 1 of 1

Location name -- FS-LOCNAM: Type:Surface Water
Minor Run upstream receptor Ref: 0
Exposure routes -- FS-LOCRT:
Meat-Ing Milk-Ing Ffish-Ing Sfish-Ing

Receptor location designation -- FS-ONSITE:
Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN Ref: 0

Receptor latitude -- FS-RLAT:
Ref: 0
Receptor longitude -- FS-RLONG:
Ref: 0

Overall Control Parameters: Page 1 of 1

Starting date of the release unit -- WS-DATE: 04/29/1997 Ref: 0

Starting date for risk -- WS-TRISK: 04/29/1997 Ref: 0

Mass Partition - Control Parameters: Page 1 of 1

```
Mass partition the total inventories -- MB-MASSBAL: [Y/N] Y    Ref: 0

   Y = Compute using mass partitioning routines.
   N = Compute without mass partitioning routines.


Leaching                ST-INF_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known infiltration rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Overland runoff         ST-OVL_OP:    [3] 3  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Suspension              ST-SUS_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Volatilization          ST-VOL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(s)
   3 = Compute pathway


Source/Sink             ST-SRC_OP:    [0] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(es)


Time interval for first 100 years ST-DELTA_T: [1.0]
                                             1.0   years  Ref: 0

Length of run ST-MAXTIME: [7000.0]        10000    years  Ref: 0

Minium waste fraction  ST-MINWST:  [0.0]  0.0    Ref: 0
```

Worksheet for Example CASE2B

Waterborne Control Parameters: Page 1 of 1

```
Source-term type -- CW-STYPE: 3       Ref: 0
      1 = Leaching to the partially saturated zone.
      2 = Leaching to the saturated zone.
      3 = a) Discharge to surface water from overland runoff.
             The surface soil contamination must be known.
          b) Direct discharge to a surface water body.


Select the discrete medium types as encountered,
moving from source to receptor -- CW-MEDIA: 75          Ref: 0

   1 = Partially saturated zone. This is the unsaturated or vadose
       zone where some air is present in the pore space.
   3 = Saturated zone to a well. This is the aquifer.
   4 = Saturated zone to a surface water body. This is the discharge zone
       for the aquifer where groundwater flows into a surface water body.
   5 = River. This refers to a river, not to other surface water body
       types such as holding ponds or wetlands.
   7 = Wetland. This refers to a wetland, bog, swamp, etc.
```

Exposure Control Parameters: Page 1 of 1

```
Toxicity data for chemical effects -- CE-TOXC: 0    Ref: 0

   0 = Include toxicity values from all sources
   1 = Include toxicity values from only IRIS*
   2 = Include toxicity values from IRIS and HEAST*

   Note: The MEPAS database contains only one set of toxicity
         values for each constituent.  This option disallows
         use of toxicity values based on their pedigree.

   * Warning -- Zero risk values will occur for contaminants for
                which toxicity values are excluded by this option.


Risk methodology for ionizing radiation -- CE-TOXR: 0    Ref: 0

   0 = Use ICRP dose factors for all radionuclides
   1 = Use EPA HEAST slope factors if available,
       otherwise use ICRP dose factors


REPORTING
   Maximum time for reporting -- CE-TMAX: [1,000]    10000   Ref: 0

   Number of time points for evaluation of results
                                     -- CE-NTIMES:          Ref: 0
```

Mass Partition - Waste Zone: Page 1 of 1

Input the texture that most closely matches the soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Waste zone soil textural classification -- ST-ZCLASS: Sand

% Sand of soil -- ST-ZSAND: [92] 92 % Ref: 0

% Silt of soil -- ST-ZSILT: [5] 5 % Ref: 0

% Clay of soil -- ST-ZCLAY: [3] 3 % Ref: 0

% Organic matter content of soil -- ST-ZOMC: 1 % Ref: 0

% Iron and aluminum in the soil -- ST-ZIRON: 3 % Ref: 0

pH of top soil -- ST-ZPH: 6.4 Ref: 0

Release site elevation -- ST-ELEV: 264 m Ref: 0

Annual mean temperature -- ST-AVTEMP: 11.1 C Ref: 0

Depth to top of waste zone ST-CLEAN: 0.0 cm Ref: 0

Thickness of waste zone ST-THICK: 506 cm Ref: 0

Length of waste zone -- ST-LENGTH: 18000 cm Ref: 0

Width of waste zone -- ST-WIDTH: 9250 cm Ref: 0

Dry bulk density -- ST-ZBULKD: 2.65 g/cm^3 Ref: 0

Moisture content -- ST-MOISTC: 0.032 fr Ref: 0

Total porosity -- ST-TOTPOR: 0.397 fr Ref: 0

Volumetric air content -- ST-AIRSPC: 0.365 fr Ref: 0

Worksheet for Example CASE2B

Mass Partition - Contaminant Inventory: Page 1 of 1

Constituent FS-CNAME	ST-INVEN Inventory	
URANIUM-235	0.18	Ci Ref: 0

Mass Partition -- Volatilization ratio: Page 1 of 1

Constituent FS-CNAME		ST-VOLRAT
URANIUM-235	[1.0]	1.0 fr Ref: 0

Mass Partition - Release Site Water Erosion: Page 1 of 1

Dry bulk density of surface soil -- ST-SBULKD: 2.65 g/cm^3 Ref: 0

Depth of 2-yr, 6-hr precipitation event-- ST-PRECIP: 5.08 cm Ref: 0

Length of site down erodible slope -- ST-SLENGTH: 18000 cm Ref: 0

Release unit overland slope -- ST-SLOPE: 4 % Ref: 0

Soil-erodibility factor -- ST-KFACTR: 0.03 Ref: 0

Index on the storm type -- ST-STORMI: 2 Ref: 0

1 = Storm type I - Maritime climate associated with southern and central California.

2 = Storm type II - Associated with
   a) eastern portions of California.
   b) all of ID, MT, NV, UT, WY, AZ, NM.
   c) the remaining portions of the United States not covered by storm types I and IA.

3 = Storm type IA - Associated with coastal areas of northern CA, OR, WA, and the western slopes of the Sierra Nevada.

Vegetative-cover factor -- ST-CFACTR: 0.50 Ref: 0

Bare-soil surface (0 to 20% vegetation)	
Hard surfaces (e.g. dirt road)	1.20
Soft sandy surfaces (e.g. beach-like)	0.85
Other surfaces	0.50
Vegetated surface (20 to 100% vegetation)	
Heavily forested	0.04
Well vegetated (60 to 100% vegetation)	0.14
Moderately vegetated (20 to 60% vegetation)	0.29

Land management practice factor -- ST-PFACTR: 1.0 Ref: 0

Surface condition with no cover (<20% vegetation)
1.3 = Compact, smooth, scraped, or raked with heavy equipment.
.9 = Rough irregular surface, equipment tracks in all directions.
.8 = Loose with rough surface > 0.3m depth.
.9 = Loose with smooth surface > 0.3m depth.

Structures
.5 = Small sediment basins or erosion control surfaces

Other
1.0 = All other conditions or Unknown conditions

Worksheet for Example CASE2B

Mass Partition - Hydrology & Climatology: Page 1 of 1

Elevation of weather station -- ST-LCDELEV:	264 m	Ref: 0
Latitude of weather station -- ST-LAT:	39.9 deg	Ref: 0
Annual mean temperature -- ST-AVTEMP:	11.1 C	Ref: 0
Height of wind measurement -- ST-WINDHT:	9.75 m	Ref: 0
SCS curve number -- ST-SCSCN:	30	Ref: 0
Water holding capacity of waste zone - ST-AVAILW:	0.5 cm	Ref: 0
Mean annual wind speed -- ST-AVWINDV:	5 m/s	Ref: 0
Number of precipitation days per year -- ST-NUMPRCP:	50 #/yr	Ref: 0

Month	#	ST-TEMP		ST-MPRECIP		ST-WINDV		ST-CLOUD		ST-MNUMPRE		
Jan	1	-2.29	C	7.14	cm	3.81	m/s	0.794	fr	13.44	days	Ref: 0
Feb	2	-0.68	C	5.79	cm	3.64	m/s	0.742	fr	11.35	days	Ref: 0
Mar	3	4.66	C	7.92	cm	3.76	m/s	0.734	fr	13.73	days	Ref: 0
Apr	4	10.79	C	8.59	cm	3.56	m/s	0.687	fr	13.15	days	Ref: 0
May	5	16.43	C	9.68	cm	3.04	m/s	0.651	fr	12.33	days	Ref: 0
Jun	6	21.33	C	9.98	cm	2.68	m/s	0.620	fr	10.73	days	Ref: 0
Jul	7	23.52	C	11.66	cm	2.46	m/s	0.626	fr	10.85	days	Ref: 0
Aug	8	22.52	C	8.28	cm	2.31	m/s	0.634	fr	9.43	days	Ref: 0
Sep	9	18.71	C	6.88	cm	2.52	m/s	0.630	fr	8.49	days	Ref: 0
Oct	10	12.31	C	5.23	cm	2.76	m/s	0.660	fr	8.98	days	Ref: 0
Nov	11	5.98	C	7.77	cm	3.57	m/s	0.794	fr	11.62	days	Ref: 0
Dec	12	0.19	C	6.93	cm	3.55	m/s	0.825	fr	12.96	days	Ref: 0

Month	#	ST-RHMAX		ST-RHMIN		
Jan	1	88.35	%	60.14	%	Ref: 0
Feb	2	87.78	%	55.85	%	Ref: 0
Mar	3	86.87	%	48.58	%	Ref: 0
Apr	4	87.57	%	44.23	%	Ref: 0
May	5	90.16	%	45.73	%	Ref: 0
Jun	6	91.30	%	46.35	%	Ref: 0
Jul	7	92.58	%	47.98	%	Ref: 0
Aug	8	93.23	%	46.94	%	Ref: 0
Sep	9	92.40	%	46.11	%	Ref: 0
Oct	10	90.95	%	46.58	%	Ref: 0
Nov	11	88.87	%	52.90	%	Ref: 0
Dec	12	89.02	%	60.26	%	Ref: 0

Mass Partition - Aqueous solubility: Page 1 of 1

Constituent FS-CNAME		ST-SOL		
URANIUM-235	[0.00]	1E+20	mg/l	Ref: 0
THORIUM-231	[0.00]	1E+20	mg/l	Ref: 0
PROTACTINIUM-231	[0.00]	1E+20	mg/l	Ref: 0
ACTINIUM-227	[0.00]	1E+20	mg/l	Ref: 0
THORIUM-227	[0.00]	1E+20	mg/l	Ref: 0
RADIUM-223	[0.00]	1E+20	mg/l	Ref: 0

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME	ST-KD_NUM
URANIUM-235	1
THORIUM-231	1
PROTACTINIUM-231	1
ACTINIUM-227	1
THORIUM-227	1
RADIUM-223	1

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-235

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	238.12	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-231

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: PROTACTINIUM-231

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	45.53	ml/g	10000	years

Worksheet for Example CASE2B

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: ACTINIUM-227

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[228.]	41.91	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-227

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[0.00]	667.55	ml/g	10000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADIUM-223

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[24.3]	1.80	ml/g	10000	years

Source-Term Data: Page 1 of 1

FS-CNAME	WS_TLIFE	WS-CDATE
URANIUM-235	9999	04/29/97

Surface Water: Page 1 of 1

River flow velocity -- WW-VELOC: 0.2 ft/s Ref: 0

Usage Location	River Depth	River Width	Distance	Discharge	
	ft	ft	ft	ft^3/s	
FS-LOCNAM	WW-DEPTH	WW-WIDTH	WW-DIST	WW-DISCHG	
Minor Run upstre1	ptor	10	600	2	Ref: 0

Wetlands: Page 1 of 1

Length of wetland -- WELENGTH: 100 ft Ref: 0

Width of wetland -- WEWIDTH 300 ft Ref: 0

Water-column volume -- WE-WATVOL: 1.356 acre*ft Ref: 0

Surface water discharge from wetlands -- WE-SWDIS: 2 ft^3/s Ref: 0

Groundwater discharge from wetlands -- WE-GWDIS: 0 ft^3/da Ref: 0

Sediment mass in wetlands -- WE-SEDMAS: 5.73E+05 kg Ref: 0

Biomass in wetlands -- WE-BIOMAS: 5600 kg Ref: 0

Sediment dry bulk density -- WEBULKD: 1.35 g/cm^3 Ref: 0

Volatilization -- WEVTYPE: 1 Ref: 0
1 = Sediment controlled
2 = Water phase controlled

Depth of contaminated sediment -- WEDEPTHS: 0.5 ft Ref: 0

Benthic organisms present? -- WEBENTHC: (Y/N) N Ref: 0

Constituent FS-CNAME	Initial Water Column Conc. WE-CONC		Equilibrium Coefficient WE-KD		Bioconcentration Factor WE-BIOFAC		
URANIUM-235	0.0	Ci/l	1700	ml/g	0.0	ml/g	Ref: 0

Worksheet for Example CASE2B

Agricultural Soil Leaching: Page 1 of 1

Soil texture that most closely matches surface soil: 9 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Top soil textural classification -- EL-CLASS: Silty Clay Loam

% Sand of surface soil -- EL-SAND: [10] 10 % Ref: 0

% Silt of surface soil -- EL-SILT: [57] 57 % Ref: 0

% Clay of surface soil -- EL-CLAY: [33] 33 % Ref: 0

% Organic matter content of surface soil -- EL-OMC: 1 % Ref: 0

% Iron and aluminum in the surface soil -- EL-IRON: 3 % Ref: 0

pH of surface soil -- EL-PH: 6.4 Ref: 0

Infiltration rate (incl. irrigation) -- EL-LEACHV: 22 cm/yr Ref: 0

Thickness of surface soil -- EL-THICK: 15 cm Ref: 0

Moisture content of surface soil -- EL-MOISTC: 3.2 % Ref: 0

Bulk density of surface soil -- EL-BULKD: 1.35 g/cm^3 Ref: 0

Agricultural Soil Leaching - Absorption Coeff.: Page 1 of 1

Constituent FS-CNAME		EL-SOILKD		
URANIUM-235	[500.]	3443	ml/g	Ref: 0
THORIUM-231	[0.00]	6178	ml/g	Ref: 0
PROTACTINIUM-231	[500.]	450	ml/g	Ref: 0
ACTINIUM-227	[4.60E+03]	5616	ml/g	Ref: 0
THORIUM-227	[0.00]	6178	ml/g	Ref: 0
RADIUM-223	[124.]	3190	ml/g	Ref: 0

Appendix E: Worksheet for Example CASE3A

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: JW Buck

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
Ash pile Ref: 0

Release site name -- FS-RELEASS:
Ash pile Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
ASHPILE Ref: 0

Original source FS-SOURCE:
Engineered Structures Ref: 0

Original source contamination mechanism FS-ORIMEC:
Other

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Suspen.

Worksheet for Example CASE3A

Constituent Selected: Page 1 of 1

```
Constituent CASID         Constituent Name
                              FS-CNAME
U234                      URANIUM-234           Ref: 0
```

Source and Exposure Summary: Page 1 of 1

```
Location name -- FS-LOCNAM:                 Type:Air Regional
Residental House      Ref: 0
Exposure routes -- FS-LOCRT:
Soil-Ing  Soil-Der  Air-Inh   Soil-Inh  Soil-Ext  Air-Ext



Receptor location designation -- FS-ONSITE:
            Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN                  Ref: 0

Receptor latitude -- FS-RLAT:
                      Ref: 0
Receptor longitude -- FS-RLONG:
                      Ref: 0
```

Overall Control Parameters: Page 1 of 1

```
     Starting date of the release unit -- WS-DATE: 04/30/1997   Ref: 0

     Starting date for risk -- WS-TRISK:           04/30/1997  Ref: 0
```

Mass Partition - Control Parameters: Page 1 of 1

```
Mass partition the total inventories -- MB-MASSBAL: [Y/N] Y    Ref: 0

   Y = Compute using mass partitioning routines.
   N = Compute without mass partitioning routines.


Leaching               ST-INF_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known infiltration rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Overland runoff        ST-OVL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway
```

```
Suspension              ST-SUS_OP:    [3] 3  Ref: 0

   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Volatilization          ST-VOL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(s)
   3 = Compute pathway


Source/Sink             ST-SRC_OP:    [0] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(es)


Time interval for first 100 years ST-DELTA_T: [1.0]
                                                1.0   years  Ref: 0

Length of run ST-MAXTIME: [7000.0]        1000     years  Ref: 0

Minium waste fraction  ST-MINWST:  [0.0]  0.     Ref: 0
```

Exposure Control Parameters: Page 1 of 1

```
Toxicity data for chemical effects -- CE-TOXC: 0    Ref: 0

   0 = Include toxicity values from all sources
   1 = Include toxicity values from only IRIS*
   2 = Include toxicity values from IRIS and HEAST*

   Note: The MEPAS database contains only one set of toxicity
         values for each constituent.  This option disallows
         use of toxicity values based on their pedigree.

   * Warning -- Zero risk values will occur for contaminants for
                which toxicity values are excluded by this option.


Risk methodology for ionizing radiation -- CE-TOXR: 0    Ref: 0

   0 = Use ICRP dose factors for all radionuclides
   1 = Use EPA HEAST slope factors if available,
       otherwise use ICRP dose factors

REPORTING
   Maximum time for reporting -- CE-TMAX: [1,000]    1000    Ref: 0

   Number of time points for evaluation of results
                                 -- CE-NTIMES:        Ref: 0
```

Worksheet for Example CASE3A

Mass Partition - Waste Zone: Page 1 of 1

Input the texture that most closely matches the soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Waste zone soil textural classification -- ST-ZCLASS: Sand

% Sand of soil -- ST-ZSAND: [92] 89 % Ref: 0

% Silt of soil -- ST-ZSILT: [5] 4 % Ref: 0

% Clay of soil -- ST-ZCLAY: [3] 3 % Ref: 0

% Organic matter content of soil -- ST-ZOMC: 1 % Ref: 0

% Iron and aluminum in the soil -- ST-ZIRON: 4 % Ref: 0

pH of top soil -- ST-ZPH: 7 Ref: 0

Annual mean temperature -- ST-AVTEMP: 10 C Ref: 0

Depth to top of waste zone ST-CLEAN: 0 cm Ref: 0

Thickness of waste zone ST-THICK: 1000 cm Ref: 0

Length of waste zone -- ST-LENGTH: 1000 cm Ref: 0

Width of waste zone -- ST-WIDTH: 1000 cm Ref: 0

Dry bulk density -- ST-ZBULKD: 1.63 g/cm^3 Ref: 0

Moisture content -- ST-MOISTC: .1 fr Ref: 0

Total porosity -- ST-TOTPOR: .39 fr Ref: 0

Volumetric air content -- ST-AIRSPC: .1 fr Ref: 0

Mass Partition - Contaminant Inventory: Page 1 of 1

Constituent FS-CNAME	ST-INVEN Inventory	
URANIUM-234	1	Ci Ref: 0

Mass Partition - Volatilization ratio: Page 1 of 1

Constituent FS-CNAME		ST-VOLRAT	
URANIUM-234	[1.0]	1.	fr Ref: 0

Mass Partition - Release Site Wind Erosion: Page 1 of 1

Dry bulk density -- ST-SBULKD:	1.63	g/cm^3	Ref: 0
Percent sand in surface soil -- ST-SAND:	25	%	Ref: 0
Surface cover correction factor --ST-CORRSC:	1		Ref: 0
Local surface roughness -- ST-LOCSUR:	0.2	m	Ref: 0
Fraction vegetation cover -- ST-VEGFR:	0	fr	Ref: 0
Fraction of surface covered with crust -- ST-CRUST:	0	fr	Ref: 0
Number of disturbances per month -- ST-NUMDIS:	0	#/mon	Ref: 0
Height of wind measurement -- ST-WINDHT:	10	m	Ref: 0
Mean annual wind speed -- ST-AVWINDV:	7	m/s	Ref: 0
Fastest wind speed -- ST-MAXWIND:	50	m/s	Ref: 0
Precipitation-evaporation index -- ST-PEI:	44		Ref: 0
Is there roadway travel at the site --ST-ROADS:	n		Ref: 0

Mass Partition - Aqueous solubility: Page 1 of 1

Constituent FS-CNAME		ST-SOL		
URANIUM-234	[0.00]	0	mg/l	Ref: 0
THORIUM-230	[0.00]	0	mg/l	Ref: 0
RADIUM-226	[0.00]	0	mg/l	Ref: 0
RADON-222	[0.00]	0	mg/l	Ref: 0
LEAD-210	[0.00]	0	mg/l	Ref: 0
BISMUTH-210	[0.00]	0	mg/l	Ref: 0
POLONIUM-210	[0.00]	0	mg/l	Ref: 0

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME	ST-KD_NUM
URANIUM-234	1
THORIUM-230	1
RADIUM-226	1
RADON-222	1
LEAD-210	1
BISMUTH-210	1
POLONIUM-210	1

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: URANIUM-234

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	0	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: THORIUM-230

[computed]	ST-KD		Ending Time ST-KD_TIM	
[100.]	0	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADIUM-226

[computed]	ST-KD		Ending Time ST-KD_TIM	
[24.3]	0	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: RADON-222

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.00]	0	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: LEAD-210

[computed]	ST-KD		Ending Time ST-KD_TIM	
[234.]	0	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: BISMUTH-210

			Ending Time	
[computed]	ST-KD		ST-KD_TIM	
[0.00]	0	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: POLONIUM-210

Ending Time
[computed] ST-KD ST-KD_TIM [5.90] 0
ml/g 1000 years

Climatology: Page 1 of 1

Morning mixing height -- AC-MIXAM: 300 m Ref: 0

Afternoon mixing height -- AC-MIXPM: 2600 m Ref: 0

Precipitation-evaporation index -- AC-PEI: 88 Ref: 0

Reference weather station -- AC-LCDREF:
Name: rfp-air Ref: 0 State: CO

# of thunderstorms per year -- AC-NUMTS: 41 Ref: 0

Fastest wind speed -- AC-FASTV: 44 mi/hr Ref: 0

Mean annual wind speed -- AC-WINDV: 9 mi/hr Ref: 0

Height of wind measurement -- AC-WINDHT: 10 m Ref: 0

Annual mean air temperature -- AC-TEMP: 50 F Ref: 0

Annual precipitation -- AC-RAIN: 21 in. Ref: 0

# of precipitation days per year -- AC-PRENUM: 40 Ref: 0

Atmospheric Joint Frequency Data: Page 1 of 1

Joint frequency data station -- AJ-STATNM:
Name: RFP Ref: 0 State: CO

Joint frequency data anemometer height -- AJ-ANEMHT: 10 m

Joint frequency data roughness length -- AJ-RLEN: 10 cm

Joint frequency data wind speed group midpoints -- AJ-WINDS(6):

Wind Speed Group	Midpoints (m/s)
1	.77
2	2.6
3	4.4
4	7
5	9.8
6	10.8

Input name to read joint frequency summary data input.

File name: site .JFD

Enter nothing if you wish to enter new data.

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 1 (A)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	8.10E-05	0.00036	00.00	0.00	0.00	0.00
NNE	0.00101	0.00148	0.00	0.00	0.00	0.00
NE	0.00104	0.00240	0.00	0.00	0.00	0.00
ENE	0.00137	0.00233	0.00	0.00	0.00	0.00
E	0.00152	0.00294	0.00	0.00	0.00	0.00
ESE	0.00147	0.00295	0.00	0.00	0.00	0.00
SE	0.00097	00.00180	0.00	0.00	0.00	0.00
SSE	0.00064	00.00051	00.00	0.00	0.00	0.00
S	0.00037	00.00032	00.00	0.00	0.00	0.00
SSW	7.00E-05	0.00013	00.00	0.00	0.00	0.00
SW	0.00018	06.00E-05	0.00	0.00	0.00	0.00
WSW	6.00E-05	8.00E-05	0.00	0.00	0.00	0.00
W	0.00014	08.00E-05	0.00	0.00	0.00	0.00
WNW	0.00016	06.00E-05	0.00	0.00	0.00	0.00
NW	0.00015	00.00011	00.00	0.00	0.00	0.00
NNW	0.00037	00.00017	00.00	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 2 (B)

Wind	--------------------Wind Speed Group--------------					
Dir.	1	2	3	4	5	6
N	0.000160	0.000440	2.00E-05	0.00	0.00	0.00
NNE	0.000280	0.00127	0.00	0.00	0.00	0.00
NE	0.000270	0.00201	2.00E-05	0.00	0.00	0.00
ENE	0.000210	0.00176	4.00E-05	0.00	0.00	0.00
E	0.000390	0.00218	4.00E-05	0.00	0.00	0.00
ESE	0.000240	0.00261	2.00E-05	0.00	0.00	0.00
SE	0.000310	0.00187	2.00E-05	0.00	0.00	0.00
SSE	0.000200	0.000450	4.00E-05	0.00	0.00	0.00
S	0.000190	0.000190	4.00E-05	0.00	0.00	0.00
SSW	0.00	9.00E-05	2.00E-05	0.00	0.00	0.00
SW	0.000120	0.000110	2.00E-05	0.00	0.00	0.00
WSW	0.000120	4.00E-05	2.00E-05	0.00	0.00	0.00
W	8.00E-05	4.00E-05	4.00E-05	0.00	0.00	0.00
WNW	2.00E-05	4.00E-05	0.00	0.00	0.00	0.00
NW	6.00E-05	8.00E-05	2.00E-05	0.00	0.00	0.00
NNW	0.000180	0.000300	2.00E-05	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 3 (C)

Wind	--------------------Wind Speed Group--------------					
Dir.	1	2	3	4	5	6
N	0.000300	0.00170	0.000270	2.00E-05	0.00	0.00
NNE	0.000470	0.00280	0.000780	0.00	0.00	0.00
NE	0.000450	0.00305	0.000970	0.00	0.00	0.00
ENE	0.000460	0.00248	0.000570	0.00	0.00	0.00
E	0.000360	0.00322	0.000510	0.00	0.00	0.00
ESE	0.000480	0.00439	0.00136	0.00	0.00	0.00
SE	0.000200	0.00420	0.000930	0.00	0.00	0.00
SSE	0.000300	0.00170	0.000280	2.00E-05	0.00	0.00
S	0.000120	0.000380	8.00E-05	0.00	0.00	0.00
SSW	8.00E-05	0.000320	0.000110	0.00	0.00	0.00
SW	4.00E-05	0.000380	0.000130	0.00	0.00	0.00
WSW	6.00E-05	0.000190	6.00E-05	0.00	0.00	0.00
W	0.000120	6.00E-05	0.000110	0.00	0.00	0.00
WNW	0.000180	0.000280	0.000130	2.00E-05	0.00	0.00
NW	0.000230	0.000300	0.000230	4.00E-05	0.00	0.00
NNW	0.000230	0.000530	0.000210	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 4 (D)

Wind	Wind Speed Group					
Dir.	1	2	3	4	5	6
N	0.00188	0.00958	0.0174	0.0184	0.00367	0.00131
NNE	0.00234	0.00826	0.0143	0.0114	0.00140	0.000620
NE	0.00193	0.00680	0.00981	0.00470	0.000380	4.00E-05
ENE	0.00197	0.00515	0.00642	0.00244	2.00E-05	0.00
E	0.00139	0.00521	0.00598	0.00176	6.00E-05	0.00
ESE	0.00104	0.00595	0.00900	0.00259	6.00E-05	0.00
SE	0.00150	0.00801	0.00141	0.00606	0.000270	4.00E-05
SSE	0.00153	0.00913	0.0142	0.0100	0.000870	0.000270
S	0.00167	0.00739	0.00924	0.0108	0.00108	0.000250
SSW	0.00217	0.00568	0.000706	0.00894	0.00114	0.000420
SW	0.00161	0.00462	0.00530	0.0101	0.00136	0.000270
WSW	0.00164	0.00456	0.00699	0.0182	0.00354	0.00117
W	0.00195	0.00498	0.00651	0.0188	0.00894	0.00816
WNW	0.00195	0.00559	0.00786	0.0325	0.0192	0.0204
NW	0.00238	0.00680	0.00897	0.0224	0.00898	0.00472
NNW	0.00202	0.00801	0.0133	0.0169	0.00316	0.000640

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 5 (E)

Wind	Wind Speed Group					
Dir.	1	2	3	4	5	6
N	0.000147	0.00619	0.00951	0.00	0.00	0.00
NNE	0.000920	0.00350	0.00470	0.00	0.00	0.00
NE	0.000580	0.00286	0.00265	0.00	0.00	0.00
ENE	0.000510	0.00157	0.00146	0.00	0.00	0.00
E	0.000530	0.00197	0.00161	0.00	0.00	0.00
ESE	0.000510	0.00163	0.00138	0.00	0.00	0.00
SE	0.000560	0.00227	0.00239	0.00	0.00	0.00
SSE	0.000910	0.00400	0.00479	0.00	0.00	0.00
S	0.00110	0.00454	0.00953	0.00	0.00	0.00
SSW	0.000900	0.00464	0.0122	0.00	0.00	0.00
SW	0.00123	0.00655	0.0188	0.00	0.00	0.00
WSW	0.00176	0.00761	0.0248	0.00	0.00	0.00
W	0.00131	0.00905	0.0181	0.00	0.00	0.00
WNW	0.00218	0.00856	0.0184	0.00	0.00	0.00
NW	0.00162	0.00841	0.0192	0.00	0.00	0.00
NNW	0.00178	0.00739	0.0173	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 6 (F)

Wind	Wind Speed Group					
Dir.	1	2	3	4	5	6
N	0.000500	0.00223	0.00	0.00	0.00	0.00
NNE	0.000300	0.00106	0.00	0.00	0.00	0.00
NE	0.000180	0.000680	0.00	0.00	0.00	0.00
ENE	0.000140	0.000500	0.00	0.00	0.00	0.00
E	0.000210	0.000470	0.00	0.00	0.00	0.00
ESE	0.000130	0.000320	0.00	0.00	0.00	0.00
SE	0.000190	0.000760	0.00	0.00	0.00	0.00
SSE	0.000340	0.00165	0.00	0.00	0.00	0.00
S	0.000420	0.00371	0.00	0.00	0.00	0.00
SSW	0.000960	0.00608	0.00	0.00	0.00	0.00
SW	0.000880	0.00759	0.00	0.00	0.00	0.00
WSW	0.00128	0.00812	0.00	0.00	0.00	0.00
W	0.00153	0.0106	0.00	0.00	0.00	0.00
WNW	0.00153	0.00956	0.00	0.00	0.00	0.00
NW	0.000880	0.00697	0.00	0.00	0.00	0.00
NNW	0.000510	0.00407	0.00	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 7 (G)

Wind	Wind Speed Group					
Dir.	1	2	3	4	5	6
N	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Calms for each stability class -- AJ-CALMS:

Stability Class 1 (A)	0	#/%/fr
Stability Class 2 (B)	0	#/%/fr
Stability Class 3 (C)	0	#/%/fr
Stability Class 4 (D)	0	#/%/fr
Stability Class 5 (E)	0	#/%/fr
Stability Class 6 (F)	0	#/%/fr
Stability Class 7 (G)	0	#/%/fr

Regional Surface and Topographical Data: Page 1 of 1

Input name to read regional surface roughness lengths -- AR-FNAME

File name: .TOP

Press end if you wish to enter new data.

Regional Surface and Topographical Data: Page 1 of 1

Regional surface roughness lengths (Zo's) -- AR-REGSUR:

Distance km	---Direction Sectors From The Release (45 degrees)-------------- N	NE	E	SE	S	SW	W	NW	
0 - 1:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm
1 - 3:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm
3 -10:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm
10-70:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm

Regional topographical type index -- AR-TOPTYP: 0 Ref: 0
0 = Flat terrain
1 = Non-flat terrain

Area Gaseous Emissions: Page 1 of 1
Surface area -- AG-AREA: 1000 m^2 Ref: 0

Bulk density of soil-- AG-BULKD: 1.63 g/cm^3 Ref: 0

Constituent Name FS-CNAME	Mean Soil Concentration AG-SOLCON
#16#	#17#

Appendix F: Worksheet for Example CASE3B

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: JW Buck

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
Ash pile Ref: 0

Release site name -- FS-RELEASS:
Ash pile Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
ASHPILE with Organic Ref: 0

Original source FS-SOURCE:
Engineered Structures Ref: 0

Original source contamination mechanism FS-ORIMEC:
Other

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Volatil.

Worksheet for Example CASE3B

Constituent Selected: Page 1 of 1

```
Constituent CASID          Constituent Name
                              FS-CNAME
71432                      BENZENE              Ref: 0
108883                     TOLUENE              Ref: 0
```

Source and Exposure Summary: Page 1 of 1

```
Location name -- FS-LOCNAM:                     Type:Air Regional
Receptor-1                Ref: 0
Exposure routes -- FS-LOCRT:
Air-Inh


Receptor location designation -- FS-ONSITE:
            Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN                      Ref: 0

Receptor latitude -- FS-RLAT:
                          Ref: 0
Receptor longitude -- FS-RLONG:
                          Ref: 0
```

Overall Control Parameters: Page 1 of 1

```
Starting date of the release unit -- WS-DATE: 04/30/1997   Ref: 0

Starting date for risk -- WS-TRISK:           04/30/1997  Ref: 0
```

Mass Partition - Control Parameters: Page 1 of 1

```
Mass partition the total inventories -- MB-MASSBAL: [Y/N] Y   Ref: 0

   Y = Compute using mass partitioning routines.
   N = Compute without mass partitioning routines.


Leaching                 ST-INF_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known infiltration rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Overland runoff          ST-OVL_OP:    [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
```

```
   3 = Compute pathway


Suspension              ST-SUS_OP:     [3] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known erosion rate(s)
   2 = Input known flux(es)
   3 = Compute pathway


Volatilization          ST-VOL_OP:     [3] 3  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(s)
   3 = Compute pathway


Source/Sink             ST-SRC_OP:     [0] 0  Ref: 0
   0 = Turn off pathway
   1 = Input known flux(es)


Time interval for first 100 years ST-DELTA_T: [1.0]
                                              1.0   years  Ref: 0

Length of run ST-MAXTIME: [7000.0]        1000     years  Ref: 0

Minium waste fraction  ST-MINWST:  [0.0]  0.     Ref: 0
```

Worksheet for Example CASE3B

Mass Partition - Waste Zone: Page 1 of 1

Input the texture that most closely matches the soil: 10 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Waste zone soil textural classification -- ST-ZCLASS: Sandy Clay

% Sand of soil -- ST-ZSAND: [52] 52 % Ref: 0

% Silt of soil -- ST-ZSILT: [7] 7 % Ref: 0

% Clay of soil -- ST-ZCLAY: [41] 41 % Ref: 0

% Organic matter content of soil -- ST-ZOMC: 0 % Ref: 0

% Iron and aluminum in the soil -- ST-ZIRON: 0 % Ref: 0

pH of top soil -- ST-ZPH: 7 Ref: 0

Annual mean temperature -- ST-AVTEMP: 10 C Ref: 0

Depth to top of waste zone ST-CLEAN: 0 cm Ref: 0

Thickness of waste zone ST-THICK: 1000 cm Ref: 0

Length of waste zone -- ST-LENGTH: 1000 cm Ref: 0

Width of waste zone -- ST-WIDTH: 1000 cm Ref: 0

Dry bulk density -- ST-ZBULKD: 1.63 g/cm^3 Ref: 0

Moisture content -- ST-MOISTC: .1 fr Ref: 0

Total porosity -- ST-TOTPOR: .39 fr Ref: 0

Volumetric air content -- ST-AIRSPC: .1 fr Ref: 0

Mass Partition - Contaminant Inventory: Page 1 of 1

Constituent FS-CNAME	ST-INVEN Inventory		
BENZENE	1E+6	g	Ref: 0
TOLUENE	1E+6	g	Ref: 0

Mass Partition - Volatilization ratio: Page 1 of 1

Constituent FS-CNAME		ST-VOLRAT		
BENZENE	[1.0]	1.	fr	Ref: 0
TOLUENE	[1.0]	1.	fr	Ref: 0

Mass Partition - Aqueous solubility: Page 1 of 1

Constituent FS-CNAME		ST-SOL		
BENZENE	[1.75E+03]	1.75e+3	mg/l	Ref: 0
TOLUENE	[535.]	535	mg/l	Ref: 0

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME	ST-KD_NUM
BENZENE	1
TOLUENE	1

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: BENZENE

[computed]	ST-KD		Ending Time ST-KD_TIM	
[0.706]	.706	ml/g	1000	years

Mass Partition - Adsorption Coefficients (Kd): Page 1 of 1

FS-CNAME: TOLUENE

[computed]	ST-KD		Ending Time ST-KD_TIM	
[2.55]	2.55	ml/g	1000	years

Worksheet for Example CASE3B

Climatology: Page 1 of 1

Morning mixing height -- AC-MIXAM: 300 m Ref: 0

Afternoon mixing height -- AC-MIXPM: 2600 m Ref: 0

Precipitation-evaporation index -- AC-PEI: 88 Ref: 0

Reference weather station -- AC-LCDREF:
Name: rfp-air Ref: 0 State: CO

# of thunderstorms per year -- AC-NUMTS: 41 Ref: 0

Fastest wind speed -- AC-FASTV: 44 mi/hr Ref: 0

Mean annual wind speed -- AC-WINDV: 9 mi/hr Ref: 0

Annual mean air temperature -- AC-TEMP: 50 F Ref: 0

Annual precipitation -- AC-RAIN: 21 in. Ref: 0

# of precipitation days per year -- AC-PRENUM: 40 Ref: 0

Atmospheric Joint Frequency Data: Page 1 of 1

Joint frequency data station -- AJ-STATNM:
Name: RFP Ref: 0 State: CO

Joint frequency data anemometer height -- AJ-ANEMHT: 10 m

Joint frequency data roughness length -- AJ-RLEN: 10 cm

Joint frequency data wind speed group midpoints -- AJ-WINDS(6):

Wind Speed Group	Midpoints (m/s)
1	.77
2	2.6
3	4.4
4	7
5	9.8
6	10.8

Input name to read joint frequency summary data input.

File name: site .JFD

Enter nothing if you wish to enter new data.

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 1 (A)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	8.10E-05	0.000360	0.00	0.00	0.00	0.00
NNE	0.00101	0.00148	0.00	0.00	0.00	0.00
NE	0.00104	0.00240	0.00	0.00	0.00	0.00
ENE	0.00137	0.00233	0.00	0.00	0.00	0.00
E	0.00152	0.00294	0.00	0.00	0.00	0.00
ESE	0.00147	0.00295	0.00	0.00	0.00	0.00
SE	0.000970	0.00180	0.00	0.00	0.00	0.00
SSE	0.000640	0.000510	0.00	0.00	0.00	0.00
S	0.000370	0.000320	0.00	0.00	0.00	0.00
SSW	7.00E-05	0.000130	0.00	0.00	0.00	0.00
SW	0.000180	6.00E-05	0.00	0.00	0.00	0.00
WSW	6.00E-05	8.00E-05	0.00	0.00	0.00	0.00
W	0.000140	8.00E-05	0.00	0.00	0.00	0.00
WNW	0.000160	6.00E-05	0.00	0.00	0.00	0.00
NW	0.000150	0.000110	0.00	0.00	0.00	0.00
NNW	0.000370	0.000170	0.00	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 2 (B)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	0.000160	0.000440	2.00E-05	0.00	0.00	0.00
NNE	0.000280	0.00127	0.00	0.00	0.00	0.00
NE	0.000270	0.00201	2.00E-05	0.00	0.00	0.00
ENE	0.000210	0.00176	4.00E-05	0.00	0.00	0.00
E	0.000390	0.00218	4.00E-05	0.00	0.00	0.00
ESE	0.000240	0.00261	2.00E-05	0.00	0.00	0.00
SE	0.000310	0.00187	2.00E-05	0.00	0.00	0.00
SSE	0.000200	0.000450	4.00E-05	0.00	0.00	0.00
S	0.000190	0.000190	4.00E-05	0.00	0.00	0.00
SSW	0.00	9.00E-05	2.00E-05	0.00	0.00	0.00
SW	0.000120	0.000110	2.00E-05	0.00	0.00	0.00
WSW	0.000120	4.00E-05	2.00E-05	0.00	0.00	0.00
W	8.00E-05	4.00E-05	4.00E-05	0.00	0.00	0.00
WNW	2.00E-05	4.00E-05	0.00	0.00	0.00	0.00
NW	6.00E-05	8.00E-05	2.00E-05	0.00	0.00	0.00
NNW	0.000180	0.000300	2.00E-05	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 3 (C)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	0.000300	0.00170	0.000270	2.00E-05	0.00	0.00
NNE	0.000470	0.00280	0.000780	0.00	0.00	0.00
NE	0.000450	0.00305	0.000970	0.00	0.00	0.00
ENE	0.000460	0.00248	0.000570	0.00	0.00	0.00
E	0.000360	0.00322	0.000510	0.00	0.00	0.00
ESE	0.000480	0.00439	0.00136	0.00	0.00	0.00
SE	0.000200	0.00420	0.000930	0.00	0.00	0.00
SSE	0.000300	0.00170	0.000280	2.00E-05	0.00	0.00
S	0.000120	0.000380	8.00E-05	0.00	0.00	0.00
SSW	8.00E-05	0.000320	0.000110	0.00	0.00	0.00
SW	4.00E-05	0.000380	0.000130	0.00	0.00	0.00
WSW	6.00E-05	0.000190	6.00E-05	0.00	0.00	0.00
W	0.000120	6.00E-05	0.000110	0.00	0.00	0.00
WNW	0.000180	0.000280	0.000130	2.00E-05	0.00	0.00
NW	0.000230	0.000300	0.000230	4.00E-05	0.00	0.00
NNW	0.000230	0.000530	0.000210	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 4 (D)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	0.00188	0.00958	0.0174	0.0184	0.00367	0.00131
NNE	0.00234	0.00826	0.0143	0.0114	0.00140	0.000620
NE	0.00193	0.00680	0.00981	0.00470	0.000380	4.00E-05
ENE	0.00197	0.00515	0.00642	0.00244	2.00E-05	0.00
E	0.00139	0.00521	0.00598	0.00176	6.00E-05	0.00
ESE	0.00104	0.00595	0.00900	0.00259	6.00E-05	0.00
SE	0.00150	0.00801	0.00141	0.00606	0.000270	4.00E-05
SSE	0.00153	0.00913	0.0142	0.0100	0.000870	0.000270
S	0.00167	0.00739	0.00924	0.0108	0.00108	0.000250
SSW	0.00217	0.00568	0.000706	0.00894	0.00114	0.000420
SW	0.00161	0.00462	0.00530	0.0101	0.00136	0.000270
WSW	0.00164	0.00456	0.00699	0.0182	0.00354	0.00117
W	0.00195	0.00498	0.00651	0.0188	0.00894	0.00816
WNW	0.00195	0.00559	0.00786	0.0325	0.0192	0.0204
NW	0.00238	0.00680	0.00897	0.0224	0.00898	0.00472
NNW	0.00202	0.00801	0.0133	0.0169	0.00316	0.000640

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 5 (E)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	0.000147	0.00619	0.00951	0.00	0.00	0.00
NNE	0.000920	0.00350	0.00470	0.00	0.00	0.00
NE	0.000680	0.00286	0.00265	0.00	0.00	0.00
ENE	0.000510	0.00157	0.00146	0.00	0.00	0.00
E	0.000530	0.00197	0.00161	0.00	0.00	0.00
ESE	0.000510	0.00163	0.00138	0.00	0.00	0.00
SE	0.000560	0.00227	0.00239	0.00	0.00	0.00
SSE	0.000910	0.00400	0.00479	0.00	0.00	0.00
S	0.00110	0.00454	0.00953	0.00	0.00	0.00
SSW	0.000900	0.00464	0.0122	0.00	0.00	0.00
SW	0.00123	0.00655	0.0188	0.00	0.00	0.00
WSW	0.00176	0.00761	0.0248	0.00	0.00	0.00
W	0.00181	0.00905	0.0181	0.00	0.00	0.00
WNW	0.00218	0.00856	0.0184	0.00	0.00	0.00
NW	0.00162	0.00841	0.0192	0.00	0.00	0.00
NNW	0.00178	0.00739	0.0173	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 6 (F)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	0.000500	0.00223	0.00	0.00	0.00	0.00
NNE	0.000300	0.00106	0.00	0.00	0.00	0.00
NE	0.000180	0.000680	0.00	0.00	0.00	0.00
ENE	0.000140	0.000500	0.00	0.00	0.00	0.00
E	0.000210	0.000470	0.00	0.00	0.00	0.00
ESE	0.000130	0.000320	0.00	0.00	0.00	0.00
SE	0.000190	0.000760	0.00	0.00	0.00	0.00
SSE	0.000340	0.00165	0.00	0.00	0.00	0.00
S	0.000420	0.00371	0.00	0.00	0.00	0.00
SSW	0.000960	0.00608	0.00	0.00	0.00	0.00
SW	0.000880	0.00759	0.00	0.00	0.00	0.00
WSW	0.00128	0.00812	0.00	0.00	0.00	0.00
W	0.00153	0.0106	0.00	0.00	0.00	0.00
WNW	0.00153	0.00956	0.00	0.00	0.00	0.00
NW	0.000880	0.00697	0.00	0.00	0.00	0.00
NNW	0.000510	0.00407	0.00	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Wind joint frequency summary data -- AJ-FDATA
Stability Class 7 (G)

Wind Dir.	Wind Speed Group 1	2	3	4	5	6
N	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00

Atmospheric Joint Frequency Data: Page 1 of 1

Calms for each stability class -- AJ-CALMS:

Stability Class 1 (A)	0	#/%/fr
Stability Class 2 (B)	0	#/%/fr
Stability Class 3 (C)	0	#/%/fr
Stability Class 4 (D)	0	#/%/fr
Stability Class 5 (E)	0	#/%/fr
Stability Class 6 (F)	0	#/%/fr
Stability Class 7 (G)	0	#/%/fr

Regional Surface and Topographical Data: Page 1 of 1

Input name to read regional surface roughness lengths -- AR-FNAME

File name: .TOP

Press end if you wish to enter new data.

Regional Surface and Topographical Data: Page 1 of 1

Regional surface roughness lengths (Zo's) -- AR-REGSUR:

Distance km	---Direction Sectors From The Release (45 degrees)--- N	NE	E	SE	S	SW	W	NW	
0 - 1:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm
1 - 3:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm
3 -10:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm
10-70:	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	cm

Regional topographical type index -- AR-TOPTYP: 0 Ref: 0
0 = Flat terrain
1 = Non-flat terrain

Area Gaseous Emissions: Page 1 of 1

Surface area -- AG-AREA: 1000 m^2 Ref: 0

Depth of soil cover-- AG-DSOIL: .1 m Ref: 0

Bulk density of soil-- AG-BULKD: 1.63 g/cm^3 Ref: 0

Field capacity of soil-- AG-FIELDC: 10 % Ref: 0

Organic material in sediment or soil-- AG-OMC: 0 % Ref: 0

Sand in sediment or soil-- AG-SAND: 52 % Ref: 0

Silt in sediment or soil-- AG-SILT: 7 % Ref: 0

Clay in sediment or soil-- AG-CLAY: 41 % Ref: 0

Constituent Name FS-CNAME	Mean Soil Concentration AG-SOLCON		
BENZENE	1000	ug/cm^3	Ref: 0
TOLUENE	1000	ug/cm^3	Ref: 0

Appendix G: Worksheet for Example CASE4A

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: DL Sternge

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
None Ref: 0

Release site name -- FS-RELEASS:
Area 1 Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
None Ref: 0

Release site name -- FS-RELEASS:
Area 1 Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Worksheet for Example CASE4A

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
Source 1 Ref: 0

Original source FS-SOURCE:
Surface Soil Ref: 0

Original source contamination mechanism FS-ORIMEC:
Other

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Direct

Constituent Selected: Page 1 of 1

Constituent CASID	Constituent Name FS-CNAME	
U235	URANIUM-235	Ref: 0

Source and Exposure Summary: Page 1 of 1

Location name -- FS-LOCNAM: Type:Direct Soil Exposure
Area 1 resident Ref: 0
Exposure routes -- FS-LOCRT:
LVeg-Ing OVeg-Ing Meat-Ing Milk-Ing Soil-Ing Soil-Inh Soil-Ext

Receptor location designation -- FS-ONSITE:
Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN Ref: 0

Receptor latitude -- FS-RLAT:
Ref: 0
Receptor longitude -- FS-RLONG:
Ref: 0

Overall Control Parameters: Page 1 of 1

Starting date of the release unit -- WS-DATE: 04/29/1997 Ref: 0

Starting date for risk -- WS-TRISK: 04/29/1997 Ref: 0

Agricultural Soil Leaching: Page 1 of 1

Soil texture that most closely matches surface soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Top soil textural classification -- EL-CLASS: Sand

% Sand of surface soil -- EL-SAND: [92] 92 % Ref: 0

% Silt of surface soil -- EL-SILT: [5] 5 % Ref: 0

% Clay of surface soil -- EL-CLAY: [3] 3 % Ref: 0

% Organic matter content of surface soil -- EL-OMC: 1 % Ref: 0

% Iron and aluminum in the surface soil -- EL-IRON: 3 % Ref: 0

pH of surface soil -- EL-PH: 6.4 Ref: 0

Infiltration rate (incl. irrigation) -- EL-LEACHV: 22 cm/yr Ref: 0

Thickness of surface soil -- EL-THICK: 506 cm Ref: 0

Moisture content of surface soil -- EL-MOISTC: 3.2 % Ref: 0

Bulk density of surface soil -- EL-BULKD: 2.65 g/cm^3 Ref: 0

Agricultural Soil Leaching - Absorption Coeff.: Page 1 of 1

Constituent FS-CNAME		EL-SOILKD		
URANIUM-235	[0.00]	23800	ml/g	Ref: 0
THORIUM-231	[0.00]	66700	ml/g	Ref: 0
PROTACTINIUM-231	[0.00]	4550	ml/g	Ref: 0
ACTINIUM-227	[228.]	4190	ml/g	Ref: 0
THORIUM-227	[0.00]	66700	ml/g	Ref: 0
RADIUM-223	[24.3]	180	ml/g	Ref: 0

Appendix H: Worksheet for Example CASE4B

Facility Summary: Page 1 of 1

Facility name -- FS-FACLTY: Acme Ref: 0

Location/nearest city -- FS-LOCAT: Smallville

State code -- FS-STATE: OH

Investigator -- FS-INVSTR: DL Sternge

Data coordinator -- FS-LEADER:

Reviewer -- FS-RVIEWR:

Facility latitude -- FS-FLAT:

Facility longitude -- FS-FLONG:

Release Site Summary: Page 1 of 1

Subdivision name -- FS-RANKUN:
None Ref: 0

Release site name -- FS-RELEASS:
Area 1 Ref: 0

Release site latitude -- FS-RLAT:

Release site longitude -- FS-RLONG:

Source and Exposure Summary: Page 1 of 1

Source name FS-ORISOU:
Source 1 Ref: 0

Original source FS-SOURCE:
Surface Soil Ref: 0

Original source contamination mechanism FS-ORIMEC:
Other

Contaminated media & releases FS-CMEDIA:
Unsat Soil (Vadose Zone)

Releases
Direct

Worksheet for Example CASE4B

Constituent Selected: Page 1 of 1

```
Constituent CASID        Constituent Name
                             FS-CNAME
U235                     URANIUM-235          Ref: 0
```

Source and Exposure Summary: Page 1 of 1

```
Location name -- FS-LOCNAM:                  Type:Direct Soil Exposure
Area 1 resident       Ref: 0
Exposure routes -- FS-LOCRT:
LVeg-Ing  OVeg-Ing  Meat-Ing  Milk-Ing  Soil-Ing  Soil-Inh  Soil-Ext



Receptor location designation -- FS-ONSITE:
            Ref: 0
Receptor landuse designation -- FS-LANDUSE:
YNNN                  Ref: 0

Receptor latitude -- FS-RLAT:
                      Ref: 0
Receptor longitude -- FS-RLONG:
                      Ref: 0
```

Overall Control Parameters: Page 1 of 1

```
     Starting date of the release unit -- WS-DATE: 04/29/1997   Ref: 0

     Starting date for risk -- WS-TRISK:           04/29/1997  Ref: 0
```

Exposure Control Parameters: Page 1 of 1

Toxicity data for chemical effects -- CE-TOXC: 0   Ref: 0

0 = Include toxicity values from all sources
1 = Include toxicity values from only IRIS*
2 = Include toxicity values from IRIS and HEAST*

Note: The MEPAS database contains only one set of toxicity values for each constituent. This option disallows use of toxicity values based on their pedigree.

* Warning -- Zero risk values will occur for contaminants for which toxicity values are excluded by this option.

Risk methodology for ionizing radiation -- CE-TOXR: 0   Ref: 0

0 = Use ICRP dose factors for all radionuclides
1 = Use EPA HEAST slope factors if available, otherwise use ICRP dose factors

REPORTING

Maximum time for reporting -- CE-TMAX: [1,000]   1000   Ref: 0

Number of time points for evaluation of results -- CE-NTIMES: Ref: 0

Worksheet for Example CASE4B

Agricultural Soil Leaching: Page 1 of 1

Soil texture that most closely matches surface soil: 1 Ref: 0

	Soil Texture	%Sand	%Silt	%Clay
1)	Sand	92	5	3
2)	Loamy Sand	83	11	6
3)	Sandy Loam	65	25	10
4)	Loam	42	38	20
5)	Silty Loam	20	65	15
6)	Silt	7	88	5
7)	Sandy Clay Loam	60	14	26
8)	Clay Loam	32	35	33
9)	Silty Clay Loam	10	57	33
10)	Sandy Clay	52	7	41
11)	Silty Clay	7	46	47
12)	Clay	20	20	60

Top soil textural classification -- EL-CLASS: Sand

% Sand of surface soil -- EL-SAND: [92] 92 % Ref: 0

% Silt of surface soil -- EL-SILT: [5] 5 % Ref: 0

% Clay of surface soil -- EL-CLAY: [3] 3 % Ref: 0

% Organic matter content of surface soil -- EL-OMC: 1 % Ref: 0

% Iron and aluminum in the surface soil -- EL-IRON: 3 % Ref: 0

pH of surface soil -- EL-PH: 6.4 Ref: 0

Infiltration rate (incl. irrigation) -- EL-LEACHV: 22 cm/yr Ref: 0

Thickness of surface soil -- EL-THICK: 506 cm Ref: 0

Moisture content of surface soil -- EL-MOISTC: 3.2 % Ref: 0

Bulk density of surface soil -- EL-BULKD: 2.65 g/cm^3 Ref: 0

Agricultural Soil Leaching - Absorption Coeff.: Page 1 of 1

Constituent FS-CNAME		EL-SOILKD		
URANIUM-235	[0.00]	23800	ml/g	Ref: 0
THORIUM-231	[0.00]	66700	ml/g	Ref: 0
PROTACTINIUM-231	[0.00]	4550	ml/g	Ref: 0
ACTINIUM-227	[228.]	4190	ml/g	Ref: 0
THORIUM-227	[0.00]	66700	ml/g	Ref: 0
RADIUM-223	[24.3]	180	ml/g	Ref: 0

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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10. SUPPLEMENTARY NOTES

T. J. Nicholson, NRC Project Manager

11. ABSTRACT *(200 words or less)*

The Multimedia Environmental Pollutant Assessment System (MEPAS) is a software tool developed by Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE) to allow DOE to conduct human health risk analyses nation-wide. This report describes modifications to the MEPAS to meet the requirements of the U.S. Nuclear Regulatory Commission (NRC) staff in their analyses of Site Decommissioning Management Plan sites. In general, these modifications provide the MEPAS, Version 3.2, with the capability of calculating and reporting annual dose/risk information. Modifications were made to the exposure pathway and health impact modules and the water and atmospheric transport modules. Several example cases used to test the MEPAS, Version 3.2, are also presented. The MEPAS, Version 3.2, also contains a new source-term release component that includes models for estimating contaminant loss from three different types of source zones (contaminated aquifer, contaminated pond/surface impoundment, and contaminated vadose zone) due to decay/degradation, leaching, wind suspension, water erosion, overland flow, and/or volatilization. When multiple loss routes are assumed to occur simultaneously, the models account for their interaction and calculate an appropriate pollutant mass budget to each loss route over time.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

chemical contaminants
decommissioning analysis
dose assessment
environmental software
integrated assessment
MEPAS
radionuclide contaminants
risk assessment
source-term module
transport and exposure pathways

13. AVAILABILITY STATEMENT

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