**DATA MODEL DESCRIPTION FOR THE
DESCARTES AND CIDER CODES**

JAN 25 1993

**Hanford Environmental Dose
Reconstruction Project**

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PREFACE

The primary objective of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate the radiation dose that individuals could have received as a result of emissions since 1944 from the U.S. Department of Energy's (DOE) Hanford Site near Richland, Washington. An independent Technical Steering Panel (TSP) directs the project which is conducted by Battelle Pacific Northwest Laboratories (BNW).

One of the major objectives of the HEDR Project is to develop several computer codes to model the airborne releases, transport and environmental accumulation of radionuclides resulting from Hanford operations from 1944 through 1972. In July 1992, the HEDR Project Manager determined that the computer codes being developed (DESCARTES, calculation of environmental accumulation from airborne releases, and CIDER, dose calculations from environmental accumulation) were not sufficient to create accurate models.

A team of HEDR staff members developed a plan to assure that computer codes would meet HEDR Project goals. The plan consists of five tasks: 1) code requirements definition, 2) scoping studies, 3) design specifications, 4) benchmarking, and 5) data modeling. This report defines the data requirements for the DESCARTES and CIDER codes.

The work documented in this report was performed concurrently with the other tasks. Information developed in the course of the work for this document influenced the course of other scoping studies and vice versa. In the interest of prompt interaction between the HEDR staff, the TSP, and the public, this report is being issued in its current form.

GLOSSARY

age	Seven ages are defined: pre-natal, 0-1 year, 1-3 years, 3-7.5 years, 7.5-12.5 years, 12.5-17.5 years, and 17.5+ years.
animal media	Animal products for which radionuclide concentrations will be estimated. The requirements document states that the computer code must handle up to 12 animal media. Eleven have been currently defined: goat milk, grocery milk rural, grocery milk urban, creamery milk, feeding regime 1, feeding regime 2, feeding regime 3, feeding regime 4, eggs, beef, poultry
animal type	Animal species and dietary groupings for which radionuclide concentrations will be estimated. The following are current defined: cattle, chicken, dairy cow, and goat
CIDER	Calculation of Individual Doses from Environmental Radionuclides (computer code)
creamery	A milk processing and distribution center. There are currently 26 creameries defined for the area under study.
data unit size (bytes)	Byte size of both integers and reals on the HEDR Sun 690 Computer. The data unit size is 4 bytes.
days	Maximum number of days covered by the study. The number of days is 10,251, derived from 28 years (1945-1972) x 366 days/year to account for leap years + 31 days to account for the one month, December, in 1944 for which there is data.
deminimus dose level	Radionuclide concentration below which there are no measurable health effects
DESCARTES	Dynamic ESTimates of Concentrations and Accumulated Radionuclides in Terrestrial EnvironmentS (computer code)
feed type	Plant media which are part of an animal's diet . Currently, five plant media have been defined: grain, alfalfa, pasture, silage, grass hay.
feeding regime	Pre-defined dietary composition representative of cow diets. Four have currently been defined.

feeding season	Period of annual dietary intake of cows. The intake currently has 5 periods defined: winter, spring, summer, early fall, late fall.
foods	Nine human-consumed foods are defined: beef, leafy vegetables, other vegetables, fruit, grain, poultry, eggs, fresh milk, stored milk.
irrigated nodes	Those nodes which are irrigated and could support a commercial dairy or commercial vegetable production. Currently 200 nodes out of the 2091 nodes are considered to have been irrigated during the period of this study.
lifestyle	Two lifestyles are defined: urban and rural.
months	Maximum number of months covered by the study. The number of months is 337, derived from 28 years (1945-1972) x 12 months/year + 1 month to account for the one month, December, in 1944 for which there is data.
nodes	Multiple rectangular areas that have been created by a division of the geographic area under study. Currently there are 2091 nodes defined. Both DESCARTES and CIDER computer codes will perform calculations on a node basis.
organs	Human body organs for which doses are calculated. Currently 4 organs are defined: thyroid, red-bone marrow, lower large intestine, and, for calculation purposes, a factor used to estimate effective dose.
pathways	The route by which radionuclides provide dose to the human body. Currently 10 pathways are defined: external, inhalation, beef, leafy vegetable, other vegetable, fruit, grain, poultry, eggs, and milk.
plant media	Vegetation for which radionuclide concentrations will be estimated. The requirements document states that the computer code must handle up to a maximum of 15 plant media. Eleven have been currently defined: inner leafy, outer leafy, other vegetables, inner fruit, outer fruit, grain, alfalfa, pasture, grass hay, silage, sagebrush.
radionuclides	Radioactive elements. For this study there are three radionuclides that appear to contribute dose: iodine-131, ruthenium-103, ruthenium-106.
RATCHET	Regional Atmospheric Transport Code for Hanford Emissions Tracking (computer code)

realizations (R)	Random sample points on a stochastic curve that describe the data. For this study, we have assumed that 100 data points will adequately define any distribution.
resuspended soil	Airborne soil particles
seasons	Four seasons are defined: spring, summer, fall, winter.
sex	Two sexes are defined: male and female.
stochastic	Pertains to a quantity that varies randomly and which is modeled by a statistical distribution
years	Maximum number of years, 29, covered by the study (1944-1972)

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1.0 INTRODUCTION

The Hanford Environmental Dose Reconstruction (HEDR) Project is developing several computer codes to estimate doses from the release and transport of radionuclides through the atmosphere. Two of the computer codes being developed are DESCARTES and CIDER. The DESCARTES computer code will be used to estimate the concentration of radionuclides in environmental pathways from the output of the air transport code RATCHET. The CIDER computer code will use information provided by DESCARTES to estimate the dose received by an individual.

This Data Model Description report is a working document that describes the data requirements for the DESCARTES and CIDER codes. The sources of the data are identified and the flow of information within and between the codes discussed. All data necessary to produce dose estimates from airborne contaminants are identified.

This document is limited to a description of the data required by the DESCARTES and CIDER computer codes. It does not address code design issues or other topics covered by documents required by the HEDR Software Requirements Specification. This document is not intended to be a final product, and it will be updated as the parameters become fully defined.

The estimates on data size stated in this document assume a "worst case" scenario. In order to calculate the dose of radiation a person may have received in any given location, the geographic area addressed by the HEDR Project will be divided into a grid. The grid suggested by the draft requirements contains 2091 units called nodes. That is the grid size used in this document. However, a grid size of 1064 nodes is recommended to reduce the data size. The data size is directly related to the number of nodes used because both DESCARTES and CIDER perform calculations on a node basis.

Another aspect of the "worst case" scenario that has been assumed in this study is that the calculation time increment is daily/weekly. Using weekly/monthly data instead would reduce the size requirements by approximately a factor of six.

The third aspect of the scenario included here is that three radionuclides (iodine-131, ruthenium-103, and ruthenium-106) will be estimated. Because iodine-131 was the largest contributor to the historical Hanford dose (Napier, 1991) and because of database size considerations, estimating only one radionuclide, iodine-131, is recommended.

A discussion of the data flow for the DESCARTES environmental accumulation code is discussed in Section 2, and the data flow for the CIDER code is discussed in Section 3. Section 4

of this document describes the auxiliary data that are needed to manipulate the data into the appropriate forms required by the DESCARTES and CIDER codes. References are given in Section 5.

2.0 DESCARTES DATA DESCRIPTION

2.1. INPUT DATA

Three types of data are necessary to run the environmental pathways model, DESCARTES: 1) user-specified, 2) radionuclide concentrations in air and upper soil (from the RATCHET code), and 3) realization-dependent environmental parameters produced from various tasks within the HEDR Project.

2.1.1. User-Specified Data

Some variables will be user-specified. The data size requirement for these variables is expected to be small. Specifications for these data will be supplied in the DESCARTES Software Design Description and the DESCARTES User's Guide.

2.1.2. Air Concentration and Surface Deposition Data

The data produced by the RATCHET code are the air concentration and surface deposition of radiation. RATCHET produces a set of 100 realizations for daily, time-integrated air concentration and surface deposition of radiation for a 41-node by 51-node grid. There is a set of 100 files of daily information (one for each realization) for each month of the period for which contaminant concentrations are being estimated. The air concentration and surface deposition data size is derived from the following:

Parameters

Source

Daily time-integrated air concentration

Output from RATCHET

Surface deposition

Output from RATCHET

Dependencies

Radionuclides, nodes, days, realizations

Data Size

51.4 Gb (2 parameters x 3 radionuclides x 2091 nodes x 10,251 days x 100 realizations x 4 bytes)

2.1.3. Realization-Dependent Environmental Data

Some environmental data vary only by realization and are independent of radionuclide, location, time, and plant or animal type. The realization-dependent environmental data size is derived from the following:

Parameters

Source

Foliar interception (α)	PNWD-2023 HEDR ^(a)
Weathering rate (λ_{weath})	PNWD-2023 HEDR
Root zone soil density (ρ_{rz})	PNWD-2023 HEDR
Upper soil layer density (ρ_{us1})	PNWD-2023 HEDR
Mass of particulates in a m^3 of outdoor air (ML)	PNWD-2023 HEDR
Deposition velocity of resuspension (V_d)	PNWD-2023 HEDR

Dependencies

Realization

Data Size

2.4 Kb (6 parameters x 100 realizations x 4 bytes)

2.1.4. Radionuclide Data

The DESCARTES computer code contains several parameters that are radionuclide specific. The data values for iodine-131 are contained in the PNWD-2023 HEDR document. The values for any other radionuclides will have to be determined.

2.1.4.1. Constant Radionuclide Data

The only non-stochastic parameter for the radionuclide data is radiological decay. Radiological decay depends on the specific radionuclides. The constant radionuclide data size is derived from the following:

Parameter

Source

Radiological decay constant (λ_{rad})	PNWD-2023 HEDR

Dependencies

Radionuclides

Data Size

12 bytes (1 parameter x 3 radionuclides x 4 bytes)

(a) The location for each of the references to PNWD-2023 HEDR are identified by the variable symbol; i.e., ML is in the ML chapter.

2.1.4.2. Stochastic Radionuclide Data

The following parameters will be modeled stochastically. The stochastic radionuclide data size is derived from the following:

<u>Parameters</u>	<u>Source</u>
Leach rate from root zone to deep soil (λ_{Leach})	PNWD-2023 HEDR
Percolation rate from upper soil to root zone (λ_{Perc})	PNWD-2023 HEDR
Rain splash rate constant (λ_{Splash})	PNWD-2023 HEDR
Concentration ratio (CR)	PNWD-2023 HEDR
Transfer factor for beef (TF_{beef})	PNWD-2023 HEDR
Transfer factor for eggs (TF_{eggs})	PNWD-2023 HEDR
Transfer factor for milk, herd ($\text{TF}_{\text{milk\_herd}}$)	PNWD-2023 HEDR
Transfer factor for milk, individual cow ($\text{TF}_{\text{milk\_ind}}$)	PNWD-2023 HEDR
Transfer factor for poultry ($\text{TF}_{\text{poultry}}$)	PNWD-2023 HEDR

Dependencies

Radionuclide,^(a) realizations

Data Size

3.6 Kb (9 parameters x 1 radionuclide x 100 realizations x 4 bytes)

2.1.5. Plant Data

The DESCARTES computer code contains several parameters that are plant specific. The requirements document states that the computer code must handle up to 15 plant media. Only 11 plant media have currently been defined.

2.1.5.1. Constant Plant Data

The constant plant data consist of parameters that depend only on the type of plant being considered. The constant plant data size is derived from the following:

(a) For this data, only one radionuclide at a time needs to be in memory.

Parameters

Minimum biomass ($B_{\min}(p)$)	PNWD-2023 HEDR
Plant growth rate constant ($k_g(p)$)	PNWD-2023 HEDR
Plant senescence aging rate constant ($k_s(p)$)	PNWD-2023 HEDR

Dependencies

Plant media

Data Size

180 bytes (3 parameters x 15 plant media x 4 bytes)

2.1.5.2. Annual plant Data

Annual plant data refer to values of plant-specific factors that vary from year to year over a period of 29 years (1944-1972). These data will be modeled as stochastic. The annual plant data size is derived from the following:

Parameters

Source

Maximum biomass ($B_{\max}(p.yr)$)	PNWD-2023 HEDR

Dependencies

Plant media, years, realizations

Data Size

174 Kb (1 parameter x 15 plant media x 29 years x 100 realizations x 4 bytes)

2.1.5.3. Stochastic Plant Data

The stochastic plant data are derived from the following:

Parameters

Source

Dry-weight to wet-weight conversion factor ($f_d(p)$)	PNWD-2023 HEDR
Translocation factor from outer to inner vegetation ($f_{\text{trans}}(p)$)	PNWD-2023 HEDR

Dependencies

Realizations, plant media

Data Size

12 Kb (2 parameters x 100 realizations x 15 plant media x 4 bytes)

2.1.5.4. Radionuclide-Specific Plant Data

The following plant data are stochastic and vary by radionuclide. The radionuclide-specific plant data size is derived from the following:

Parameters

Source

Food-processing loss fraction ($L_{proc}(t,p)$)

PNWD-2023 HEDK

Dependencies

Radionuclides, plant media, realizations

Data Size

18 Kb (1 parameter x 3 radionuclides x 15 plant media x 100 realizations x 4 bytes)

2.1.5.5. Agricultural Practices Data

These data describe agricultural methods in the study area and will be used to determine the radionuclide concentrations on the date of consumption. The data will also be used to reset the biomass after appropriate biomass-affecting activities. For this set of data, plant type has been expanded to replace the single value of alfalfa with three values of alfalfa, representing the first, second, and third harvests. This gives us a total of 17 plant media. The agricultural practices data size is derived from the following:

Parameters

Source

Date soil tilled (Till_date)

Task 06

Date crop harvested (Harv_date)

Task 06

Dependencies

Nodes, plant media, years, realizations

Data Size

825 Mb (2 parameters x 2091 nodes x 17 plant media x 29 years x 100 realizations x 4 bytes)

2.1.5.6. Season Data

These data describe the start and end dates for each of the cow feeding seasons that affect agricultural practices. The season data size is derived from the following:

Parameters

Season start date (Season_beg)

Source

Task 06

Season end date (Season_end)

Task 06

Dependencies

Nodes, years, seasons, realizations

Data Size

242.5 Mb (2 parameters x 2091 nodes x 29 years x 5 seasons x 100 realizations x 4 bytes)

2.1.6. Animal Data

These data are necessary to determine the radionuclide concentration in animal products. The data given here describe animal consumption and the storage times for feed products.

2.1.6.1. Animal Soil-Consumption Data

The animal soil consumption data give 100 estimates of the soil consumed by a given animal type. Soil consumption varies by animal type and by time on pasture. For this estimate, the four types of animals used are cattle, chickens, cows, and goats. Data for chickens and cows are given in the parameter document, PNWD-2023 HEDR. The values for the other types of animals will have to be determined. The animal soil-consumption data size is derived from the following:

Parameters

Soil-ingestion rate (FS_{chicken} and FS_{cow})

Source

PNWD-2023 HEDR

Dependencies

Animal media, realizations

Data Size

1.6 Kb (1 parameter x 4 animal media x 100 realizations x 4 bytes)

2.1.6.2. Animal Diet Data

The animal diet data give 100 estimates of the consumption rate of five types of feed in a given animal's diet. The animal diet data size is derived from the following:

Parameters

Source

Mass of feed type consumed by an animal in a day ($R_{v,a}$)

PNL-7227 HEDR

Dependencies

Animal types, feeding regimes, feed types, seasons, realizations

Data Size

160 Kb (1 parameter x 4 animal types x 4 feeding regimes x 5 feed types x 5 seasons x 100 realizations x 4 bytes)

2.1.6.3. Feed Storage-Time Data

These data specify how long feed is stored before it is consumed by agricultural animals. These feed-specific data will be modeled stochastically. The feed storage-time data size is derived from the following:

Parameters

Source

Time between harvest and ingestion of stored feed by milk animals ($th_s(v)$)

Task 06

Dependencies

Feed types, realizations

Data Size

2 Kb (1 parameter x 5 feed types x 100 realizations x 4 bytes)

2.1.7. Creamery Milk-Production Data

There are two sets of data that are necessary to produce estimates of the radionuclide concentrations in milk at creameries: the radionuclide concentration of milk at its source and the data relating to the sources of milk for a creamery. The radionuclide concentration in milk from a given node is estimated by the four feeding regimes for cows.

2.1.7.1. Creamery Milk-Source Data

For each creamery, there is a list of those nodes that have provided milk. There are currently 26 creameries defined for this study. No more than 200 nodes provide milk for a given creamery. Total contributions from all sources must equal 100 percent. The creamery milk-source data size is derived from the following:

Parameter**Source**

Contribution of node to milk at creamery ($\text{frac}(C,N)$)

PNL-7227 HEDR

Dependencies

Irrigated nodes, creameries, realizations

Data Size

2.08 Mb (1 parameter x 200 irrigated nodes x 26 creameries x 100 realizations x 4 bytes)

2.1.7.2. Commercial Cow Feeding-Regime Data

These data provide a set of 100 estimates of the fractional contributions of up to 4 feeding regimes for that node. Total contributions from all sources must equal 100 percent. The commercial cow feeding-regime data size is derived from the following:

Parameter**Source**

Contribution of feeding regime to milk at node ($\text{frac}(N,r)$)

PNL-7227 HEDR

Dependencies

Irrigated nodes, feeding regimes, realizations

Data Size

320 Kb (1 parameter x 200 irrigated nodes x 4 feeding regimes x 100 realizations x 4 bytes)

2.1.8. Grocery Milk Production Data

Concentrations in both rural and urban grocery milk will be provided for those nodes in the commercial production/distribution area. The methods for calculating the concentrations in the two types of milk is the same, but different blends are allowed to reflect a difference in lifestyle.

2.1.8.1. Rural Grocery Milk-Source Data

The rural grocery milk-source data provide a means of establishing which creameries provided milk to that grocery and the fraction of all milk provided by each creamery. Total contributions from all sources must equal 100 percent. The rural grocery milk-source data size is derived from the following:

Parameter**Source**

Contribution of creamery to rural
grocery milk at node ($\text{frac}(N,C)$)

PNL-7227 HEDR

Dependencies

Nodes, creameries, realizations

Data Size

21.74 Mb (1 parameter x 2091 nodes x 26 creameries x 100 realizations x 4 bytes)

2.1.8.2. Urban Grocery Milk-Source Data

The urban grocery milk-source data provide a means of establishing which creameries provided milk to that grocery and the quantity of milk provided by each creamery. Total contributions from all sources must equal 100 percent. The urban grocery milk-source data size is derived from the following:

Parameter

Source

Contribution of creamery to urban grocery milk at
node ($\text{frac}(N,C)$)

PNL-7227 HEDR

Dependencies

Nodes, creameries, realizations

Data Size

21.74 Mb (1 parameter x 2091 nodes x 26 creameries x 100 realizations x 4 bytes)

2.1.9. Leafy Vegetable-Distribution Data

The leafy vegetable distribution data provide a fractional contribution from the 200 irrigated nodes where leafy vegetables could have been produced. The leafy vegetables-distribution data size is derived from the following:

Parameter

Source

Contribution of leafy vegetables from irrigated node to grocery
($\text{frac}(N_r, N_g)$)

(PNWD-2022 HEDR)

Dependencies

Nodes, irrigated nodes, realizations

Data Size

167.28 Mb (1 parameter x 2091 nodes x 200 irrigated nodes x 100 realization x 4 bytes)

2.2. OUTPUT DATA

Output from the DESCARTES computer code will be stored for interpretation and use in the CIDER dose estimation code.

2.2.1. Environmental Concentration Data

The environmental concentration data are the concentrations of radionuclides in all media. In this case, media are a combination of plant media (15 possible), animal media (12 possible), air (1 possible), upper soil (1 possible), and root-zone soil (1 possible), totaling 30 media. These data will be written to a series of computer files. This series of files will be interpreted and filtered by a pre-processor to the CIDER code. The formula to determine the byte size required by the environmental concentration data is derived as follows:

<u>Parameter</u>	<u>Source</u>
Environmental concentration (Conc)	Calculated in DESCARTES

Dependencies

Nodes, days, media, realizations

Data Size

257.22 Gb (1 parameter x 2091 nodes x 10,251 days x 30 media x 100 realizations x 4 bytes)

2.2.2. Creamery Concentration Data

The creamery concentration data contain 100 estimates of the radionuclide concentration in milk produced at each of the creameries. These data are provided so that individuals may specify a creamery as their milk source rather than home-produced or grocery milk which is tied to their node of residence. The creamery concentration data size is derived from the following:

<u>Parameter</u>	<u>Source</u>
Concentration of milk at creamery (Conc(C))	Calculated in DESCARTES

Dependencies

Creameries, days, realizations

Data Size

107 Mb (1 parameter x 26 creameries x 10,251 days x 100 realizations x 4 bytes)

2.2.3. Soil Ratio Data

The dose due to resuspended soil calculated in CIDER requires the ratio of two DESCARTES parameters, mass loading (ML) and density of the upper soil layer (ρ_{usl}). These data will be written to a computer file containing 100 realizations of the ratio. The soil ratio data size is derived from the following:

Parameter

Ratio of soil parameters $\text{ML}/\rho_{\text{usl}}$

Source

Calculated in DESCARTES

Dependencies

Nodes, realizations

Data Size

836 Kb (1 parameter x 2091 nodes x 100 realizations x 4 bytes)

2.3. DESCARTES DATA-SIZE SUMMARY

To compute the totals all numbers have been rounded off to the nearest full integer. Zero indicates those data requiring less than half a megabyte.

<u>Data Name</u>	<u>Data Size (Mb)</u>
Air and surface concentration	51400
Realization dependent	0
Constant radionuclide	0
Stochastic radionuclide	0
Constant plant	0
Annual plant	0
Stochastic plant	0
Radionuclide specific plant	0
Agricultural practices	825
Season	243
Animal soil consumption	0
Animal diet	0
Stored feed holdup time	0
Creamery milk source	2
Commercial cow feeding regime	0
Rural grocery milk source	22
Urban grocery milk source	22
Leafy vegetable distribution	167
Environmental concentration	257220
Creamery database	107
<u>Soil ratio</u>	<u>1</u>
Total	310,009

3.0 CIDER DATA DESCRIPTION

3.1. INPUT DATA

Several types of data are required to run CIDER: user information describing specific individual parameters, code run-control input, library data files necessary for computing doses, and radionuclide concentration data from DESCARTES needed for the calculations.

3.1.1. User-Definable Input Data

The user must supply a limited amount of control data to initiate a CIDER run. The user may also override the dietary and other parameters.

3.1.1.1. Code Run-Control Input Data

The code run-control input will be further defined in the CIDER Software Design Description and the CIDER User's Guide.

3.1.1.2. Individual Input Data

The individual must supply certain parameters to provide CIDER with its initial setup. The user may override various parameters describing diet, lifestyle, etc.

3.1.2. Library Data

It is necessary to have several library data files when using the CIDER computer code to calculate doses. Some of these data may be overridden by the individual.

3.1.2.1. External Dose-Factor Library Data

The external dose-factor library is a file consisting of 100 estimates of external dose conversion factors by organ and radionuclide. Currently, only factors for the effect of iodine-131 on the thyroid are available in the external dose-factor library. The external dose-factor library data size is derived as follows:

<u>Parameters</u>	<u>Source</u>
Immersion dose-rate factor (DF_{imm})	PNWD-2023 HEDR
Soil activity dose-conversion factor (DF_{rz})	PNWD-2023 HEDR
Plane deposition-dose factor (DF_{usi})	PNWD-2023 HEDR

Dependencies

Radionuclides, organs, realizations

Data Size

14.4 Kb (3 parameters x 3 radionuclides x 4 organs x 100 realizations x 4 bytes)

3.1.2.2. Internal Dose-Factor Library Data

The internal dose-factor library is a file consisting of 100 estimates of internal dose conversion factors by age, sex, organ and radionuclide. Currently, only factors for the effect of iodine-131 on the thyroid are available (see PNWD-2023 HEDR). The internal dose-factor library data size is derived as follows:

Parameters

Source

Ingestion dose-conversion factor (DF_{ing})

PNWD-2023 HEDR

Inhalation dose-conversion factor (DF_{inh})

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Dependencies

Radionuclides, ages, sexes, organs, realizations

Data Size

134.4 Kb (2 parameters x 3 radionuclides x 7 ages x 2 sexes x 4 organs x 100 realizations x 4 bytes)

3.1.2.3. Reference Diet Library Data

Representative diets for individuals of varying age, sex, and lifestyle will be provided to CIDER in the form of a library data file. This file will be used by an individual to choose one of the reference diets instead of specifying individualized consumption values. Because pre-natal infants do not eat solids, they have been eliminated from the age category. The reference diet library data size is derived from the following:

Parameter

Source

Consumption rate of food product (R_p)

Task 06

Dependencies

Foods, ages, sexes, lifestyles, seasons, realizations

Data Size

346 Kb (1 parameter x 9 foods x 6 ages x 2 sexes x 2 lifestyles x 4 seasons x 100 realizations x 4 bytes)

3.1.2.4. Reference Outdoor-Time Library Data

A library file will provide representative estimates of time spent outdoors by age, sex, lifestyle, and season. Because pre-natal infants do not go outside, they have been eliminated from the age category. The reference outdoor-time library data size is derived from the following:

Parameter

Source

Fraction of day spent outdoors (f_{time})

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Dependencies

Ages, sexes, lifestyles, seasons, realizations

Data Size

38.4 Kb (1 parameter x 6 ages x 2 sexes x 2 lifestyles x 4 seasons x 100 realizations x 4 bytes)

3.1.3. Other Input Data

Several other data are needed to describe parameters necessary for calculating dose. These miscellaneous data are described here.

3.1.3.1. Breathing-Rate Data

Some data that are necessary for computing doses are the volume of air an individual breathes in a day. Because pre-natal infants do not breathe external air, they have been eliminated from the age category. The breathing rate data size is derived as follows:

Parameter

Source

Volume (m^3) of air breathed in a day (BR)

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Dependencies

Ages, realizations

Data Size

2.4 Kb (1 parameter x 6 ages x 100 realizations x 4 bytes)

3.1.3.2. Air-Activity Data

The air-activity data are necessary to calculate inhalation dose. They account for the difference in radionuclide concentration between indoor and outdoor air. The air-activity data size is derived as follows:

Parameter

Source

Indoor-to-outdoor air activity ratio (R_{io})

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Dependencies

Realizations

Data Size

400 bytes (1 parameter x 100 realizations x 4 bytes)

3.1.3.3. Radionuclide Data

Radionuclide-specific data needed to calculate dose are provided here. The radionuclide data size is derived as follows:

Parameters

Source

External dose-reduction factor (shielding) in a building (Shl)

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Dependencies

Radionuclides, realizations

Data Size

1.2 Kb (1 parameter x 3 radionuclides x 100 realizations x 4 bytes)

3.1.3.4. Food Storage-Time Data

It is necessary to calculate the change in plant product concentrations from the time of harvest to the time of consumption. The estimates of storage time are provided here. Food consumption rates vary by month. The food storage-time data size is derived from the following:

Parameter

Source

Time between harvest and ingestion of food plant type p (th_p)

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Dependencies

Foods, months, realizations

Data Size

1.2 Mb (1 parameter x 9 foods x 337 months x 100 realizations x 4 bytes)

3.1.4. DESCARTES-Produced Data

All data concerning concentration of contaminants in the environment are calculated by the DESCARTES computer code and saved to files for input into the CIDER code.

3.1.4.1. Environmental Data

The environmental concentrations will be output from DESCARTES. There will be a pre-processor that will filter the data according to the deminimus dose level to significantly reduce storage requirements of the environmental data. Even with the filter, this file will be multiple gigabytes in size.

3.1.4.2. Creamery Data

To allow an individual to specify milk purchases from a specific creamery, the creamery milk concentrations produced in DESCARTES will be saved in a file for input into CIDER. This data will also be filtered.

3.1.4.3. Soil-Ratio Data

To calculate the resuspension doses, CIDER uses the soil-ratio data obtained from the DESCARTES computer code.

3.2. OUTPUT DATA

Data will be output by CIDER to report doses for individuals and to create dose maps using a geographic information system (GIS). The data to be produced are described here.

3.2.1. Individual-Dose Data

The individual-dose data contain the dose by organ and pathway for the individual each year of the simulation. An effective dose is also reported for the individual. These data also contain the cumulative dose over multiple years for that individual.

3.2.2. Map Data

The map data are the annual dose over all nodes for a given individual. These data will be used to produce a GIS map of doses.

3.3. CIDER DATA-SIZE SUMMARY

To compute the totals, all numbers have been rounded off to the nearest full integer. Zero indicates those data requiring less than half a megabyte. The total does not include DESCARTES generated data required to run CIDER.

<u>Data Name</u>	<u>Data Size (Mb)</u>
External dose factors	0
Internal dose factors	0
Reference diet	0
Reference outdoor time	0
Breathing rate	0
Air activity	0
Radionuclide	0
<u>Fresh food storage time</u>	<u>1</u>
Total	1

4.0 AUXILIARY

4.1. LOCATION TRANSLATION DATA

The DESCARTES and CIDER codes will operate on a node basis. Some of the location-dependent data needed by the codes are provided by county or census division. The data must be translated into the node level. A master file will be developed independent of the DESCARTES and CIDER codes to translate any files that are not on a node basis. This file will contain the node identification, the node coordinates (x-y location of the node centroid), the dimensions of the node, the census division containing the node, and the county containing the node. The location translation data size is derived from the following:

<u>Parameters</u>	<u>Source</u>
Node identification	(To be Determined)
Node coordinates (2 values)	(To be Determined)
Node dimensions (2 values)	(To be Determined)
Census division identification	(To be Determined)
County identification	(To be Determined)

Dependencies

Nodes

Data Size

58.5 Kb (7 parameters x 2091 nodes x 4 bytes)

4.2. DATABASE FILTER DATA

The data will be filtered before and after the environmental accumulation calculations to eliminate nodes where no contaminants were found. Nodes can exit and re-enter the calculations. For the data-size estimates, however, it is assumed that each node enters and exits once.

Before data are put into the DESCARTES code, nodes will be eliminated based on the air concentration data. Before data are put into the CIDER code, nodes will be eliminated based on a screening estimate of dose. This will significantly reduce the amount of computation required by the CIDER code.

4.2.1. Air-Concentration Filter Data

An active air node list will be produced by the pre-processor which interprets the air data for use by DESCARTES. This will ensure that only nodes with an air concentration above the deminimus level will be included in any given month. The database filter data size is derived from the following:

Parameters

Node identification

Time on

Time off

Source

Pre-processor

Pre-processor

Pre-processor

Dependencies

Nodes, months

Data Size

8.5 Mb (3 parameters x 2091 nodes x 337 months x 4 bytes)

4.2.2. Dose-Level Filter Data

An active dose node list will be produced by the processor which interprets the DESCARTES database for use by CIDER. This will ensure that only nodes with representative doses above a deminimus level will be included in any month. The dose-level filter data size is derived from the following:

Parameters

Node identification

Time on

Time off

Source

Pre-processor

Pre-processor

Pre-processor

Dependencies

Nodes, months

Data Size

8.5 Mb (3 parameters x 2091 nodes x 337 months x 4 bytes)

4.3. AUXILIARY DATA SUMMARY

To compute the totals all numbers have been rounded off to the nearest full integer. Zero indicates those data requiring less than half a megabyte.

<u>Data Name</u>	<u>Data Size (Mb)</u>
Location translation	0
Air-concentration filter	9
<u>Dose-lever filter</u>	<u>9</u>
Total	18

5.0 REFERENCES

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